The Influence of Designers' Culture on the Design and Design Process for Familiar and Unfamiliar User Cultures

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Declaration

I hereby declare that I wrote the presented thesis without any help besides that explicitly mentioned.

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Date, Signature

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List of Abbreviations

CCF: Culture-Concept Fit

CI: Cluster Instrument or Instrument Cluster

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1 Introduction

1.1 Motivation

The concept of globalisation has come to dominate the world since the 1990s. Globalisation has brought new opportunities to developing countries such as India, whose tremendous market potential makes them extremely attractive investment prospects for companies across the world. The rise of the emerging markets has fundamentally altered the global marketplace. In fact, it has created a truly global marketplace – a vast, wired network of manufacturers, programmers and designers who can be anywhere (Chavan, Gorney, Prabhu, & Arora, 2009).

Companies have employed various strategies to tap into the potential of these emerging international markets. Some of the strategies include 'globalisation' itself, where the same product is offered all over the world. However, this strategy has not always met with success, such as when Kellogg's tried to tap into India's tremendous market potential in the 1990s. As Indian cultural critic Homi Bhaba (2005) reports:

> Kellogg's set up a branch in India and started producing cornflakes . . . . [W]hat they didn't realise was that Indians, rather like the Chinese, think that to start the day with something cold – like cold milk on your cereal – is a shock to the system. And if you pour warm milk on Kellogg's cornflakes, they instantly turn into wet paper.

Kellogg's made the error of transplanting developed market experience onto an emerging market, assuming that people in Bangalore, India started their day in the same way as people in Battle Creek, Michigan (Chavan et al., 2009).

Another approach to catering for different and emerging markets is 'localisation'. Here, a base version of a product is adapted to suit the needs of the target market, as described by Chavan et al. (2009) in the case of the Whirlpool Corporation. As a part of its global strategy, the Whirlpool Corporation designed a single, stripped-down washing machine platform for emerging markets. Dubbed the "World Washer", it was launched in Brazil, Mexico, China, and India, with slight feature and styling modifications for each market to reflect local tastes. Exterior accents were added for China, for example, and "Delicate" was relabelled "Sari Cycle" on the Indian model. The washing machine ended up doing very well everywhere except India. Sales in South India were notably abysmal. With tens of millions of dollars at risk, Whirlpool dispatched a team to the subcontinent to find out what had gone wrong. They finally realised that people were putting traditional South Indian clothing into the machine. Clothing such as lungis, dupattas, mundus, angavestrams, and – of course – saris. Little more than sheets of very fine cotton or silk, six to nine yards long, garments were getting caught, entangled, and shredded in the millimetre-wide gap between the machine's agitator and drum. That single millimetre forced Whirlpool to completely restructure its business model and abandon its joint venture, in addition to designing a new washing machine for India (Bhan, 1990 from Chavan et al., 2009).

These examples emphasise the importance of considering the target users' context and culture in design. Companies are beginning to appreciate these factors, as shown by Nokia's success in emerging markets such as India. Here, instead of the globalisation or localisation approaches, the company employed designs specific to the market or target user (Wharton University of Pennsylvania, 2007).

However, despite "understanding" the user, products may still not achieve their expected success. This can happen due to differences in perception of product form between users and designers (Hsu, Chuang, & Chang, 2000), and the fact that cultural differences strongly influence the understanding of product emotion (Lu, Čok, & Zhu, 2014). For example, in a study on telephone designs by Hsu et al. (2000), designers tended to value telephone samples with an elegant style while users preferred modern and sleek designs. Wiedmann, Hennigs, & Siebels (2007) propose a model from a cultural and marketing perspective to measure consumers' luxury value perception, based on the notion that different sets of consumers will have different perceptions of the luxury value for the same brands, and this differentiated perception of luxury value may be dependent on the cultural context and the people concerned. To illustrate the point further with an example from a design perspective, *premium* for a designer from one culture could mean a clean matte finished surface, smart highlights and accents, whereas premium for the target user in another culture could mean a glossy surface and chrome highlights. Therefore, even though the user research correctly extracted premium as a design requirement, the designer's interpretation leads to a mismatch between the design and user expectation. Such situations typically occur when the user research and design are carried out by different teams and/or when designers from one culture design for target users belonging to a different, unfamiliar culture (Diehl & Christiaans, 2006).

Furthermore, given that design (product) is the medium of communication between the designer and the user (Hsiao & Chen, 2006) and that cultural differences strongly influence the understanding of product emotion (Lu et al., 2014), it is important for the designers to understand and communicate their designs in a form understandable to the target user.

Previous research into culture and design or designing for different cultures has tended to focus on understanding user needs (e.g., Polcher & Honold, 2000; Diehl & Christiaans, 2006; Moalsi, Popovic, & Hickling-Hudson, 2010; etc.), i.e., the influence of the users' culture on design. Research on the designer's own preferences and culture (e.g., Razzaghi, 2007; Hidaka, 2003; Heaton, 2002) has tended to focus exclusively on the influence of designers' culture on design. Holistic approaches to examining the combined influence of both the designers' and users' cultures on a design and the design process are rare. This thesis aims to bridge this gap. Examining designers' and users' design cultures in tandem should help make designers more sensitive to cultural differences and thus create better designs for different cultures, leading to greater user satisfaction and product success.

1.2 Objective and scope

The main goal of this thesis is to examine the influence of designers' and users' cultures on design (i.e., both the act of designing and the final design). This goal is achieved via detailed design studies using Indian and German cultures as the examples for both the designers and users, with product/industrial design students in the role of the designers. Ulrich, Eppinger, & Goyal (2009, pp 34) define *new product platforms, derivatives of existing product platforms*, *incremental improvements to existing products* and *fundamentally new products* as the four types of product development projects. Using this classification, this thesis makes a conscious decision to focus on the incremental improvements to existing products category, due to the relative ease with which different phases of the design process can be acted upon while keeping both designers and users in mind. The vehicle cluster instrument falls into this category, and hence is the product whose design and design process is examined in this thesis.

Based on the results of the design studies and expert evaluation of the concepts designed, a possible method for design across different unfamiliar cultures keeping in mind both the designers' and users' perceptions is suggested. Feedback on the suggested design process was obtained through another round of design studies with students and the expert evaluation of the concepts generated using the suggested process.

1.3 Structure

This chapter has illustrated the motivation for the research topic. Chapter 2 discusses the current state of the art in culture and design research. Section 2.2 establishes a common understanding by defining key terms such as *design*, *product/industrial design*, *design process* and *culture*. Section 2.3 explores the relationship between culture and design, the designer, and the user from a theoretical perspective. This exploration pins down the exact area of research for this thesis – the influence of culture on a design and the design process from both designers' and users' perspectives. Section 2.4 looks into previous research in this field where the design for different cultures is explored from both the design and design process points of view. To add to the completeness of the review, Section 2.5 briefly lays out other research on culture and design. Finally, Section 2.6 illustrates the deficit analysis performed on current research to identify any gaps. This identification of gaps in research clarifies the main research task and its attendant sub-questions.

Chapter 3 describes the design studies carried out to understand the influence of culture on a design and the design process. Section 3.1 lays out the objectives of the design studies while Section 3.2 describes their methodology. Section 3.3 describes the various quantitative and qualitative measures according to which the results of the design studies were examined and compared. Finally, Section 3.4 describes the results of the design studies for the research questions according to these measures.

Chapter 4 describes the suggested design process to design for different cultures based on the results of Chapter 3. Section 4.1 puts the results of the design studies into perspective, while Section 4.2 describes the suggested design process.

Chapter 5 describes the design studies carried out to obtain feedback and validate the design process suggested in this thesis. Sections 5.1., 5.2., and 5.3 describe the objectives, methodology, and results of the validation studies respectively.

Chapter 6 discusses the results of the thesis with regard to the research questions of the influence of designers' and users' culture on the design process and design in Sections 6.1 and 6.2 respectively. Section 6.3 goes on to discuss the design process suggested in this thesis along with the feedback from the validation studies.

Chapter 7 discusses the methodological implications of the thesis in Section 7.1 and the development of tools to understand differences in perceptions in section 7.2. Section 7.3 discusses the implications of the thesis in terms of sensitising students to cross-cultural design and thereby the design process suggested in this thesis. Finally, Section 7.4 discusses directions for future research.

Finally, Chapter 8 summarises and formally concludes the thesis.

2 State of the Art

2.1 Introduction

As seen from the examples in Chapter 1, culture, design, and their interaction make for an exciting research topic in this globalised world. Users are increasingly looking for differentiation in the products they own, as shown by Delaney et al. (2002) and Aula et al. (2003). Industrial/product design, the design process, and culture as understood in this thesis are defined in Section 2.2. Section 2.3 discusses the relationship between culture and design, culture and designer, and culture and user. In Section 2.4, the different strategies for incorporating culture into design and the design process while designing for different cultures are addressed. For completeness, a brief overview of other research in the area of culture and design is laid out in Section 2.5. Finally, Section 2.6 describes the deficit analysis of the literature, which produced the key research questions for this thesis.

2.2 Concepts and definitions

It is important to establish a common understanding of the various terms and their definitions used in the context of this thesis. Here, key terms such as *design* and *industrial/product design*, *design process*, and *culture* are defined and briefly explained.

2.2.1 Design and industrial/product design

The Merriam-Webster online dictionary[1] provides two possible meanings for the word 'design'. As a verb, 'to design' means "to plan and make decisions about (something that is being built or created): to create the plans, drawings, etc., that show how (something) will be made." Thus designing is a process or a series of activities. As a noun, 'a design' means "the way something has been made: the way the parts of something (such as a building, machine, book, etc.) are formed and arranged for a particular use, effect, etc." Thus a design is also an object or entity. Miller (2005) defines design as "the thought process comprising the creation of an entity."

The people who create this entity are known as *designers*. Kazmierczak (2003) defines design from a designer's perspective as a process of interpreting and transmitting designers' visions and ideas to the exterior environment. Similarly, the International Council of Societies of Industrial Design [ICSID] (ICSID, 2002 from Razzaghi, 2007) defines design as "a creative activity of designers whose aims are to establish multi-faceted qualities of objects and accordingly, central to the innovative humanisation of technologies crucial to cultural and economic exchange."

[1] http://www.merriam-webster.com/dictionary/design Last accessed: 25.07.2014

Design and designers are popularly classified (e.g., communication, industrial/product, etc.) based on the kind of entity created. Examples of communication design include illustrations, typography, visual identity design, etc. Examples of industrial/product design include the design of physical products such as coffee machines, furniture, bicycles, etc. Using this classification, this thesis focuses on industrial/product designers and their design and design activities. The IDSA (Industrial Design Society of America) defines industrial design as "the professional service of creating and developing concepts and specifications that optimise the function, value and appearance of products and systems for the mutual benefit of both user and manufacturer."[2]

In some countries industrial design is sometimes referred to as product design, with both terms being used interchangeably. In the context of this thesis, unless otherwise specified, the terms 'design', 'designer' and 'design process' refer to 'industrial design', 'industrial designer' and 'industrial design process' respectively.

2.2.2 Design process

Using the definition of design given by Miller (2005), the design process can be defined as the sequence of activities a designer performs to create his entity. Purcell & Gero (1998) describe the design process as constantly concerned with generating and exploring ideas and interpretations; reinterpretation can occur during both the generation and exploration phases and hence can be viewed as a process of *synthesis*. Following Dawson (2002), Gagliardi (2001), Magrab (1997), Roozenburg (2002), and Urban & Hauser (1993), Razzaghi (2007) argues that products are never created on the spur of moment, but in a process which is hybrid, stepwise, sequential or phase-oriented while affording the required flexibility to meet the aims of the design process.

Many researchers have reviewed models of the design process (e.g., Evbuomwan, Sivaloganathan, & Jebb, 1996; Hubka & Eder, 1992; Karandikar & Shupe, 1995; Tate & Nordlund, 1995; etc.), and these models have been generalised into different categories. Tate & Nordlund (1996) grouped the design process models into those based on activities and those based on phases of design object evolution.

Activity-based models consist of repeated iterations of analysis, synthesis, and evaluation. Tate & Nordlund (1996) define these three activities as follows: Analysis involves understanding the design problem and generating requirements and specifications. Synthesis involves generating ideas and solutions by exploring the design space. Evaluation involves appraisal of design solutions against requirements, specifications, and "set corporate criteria". Examples of activity-based models mentioned in Tate & Nordlund (1996) include Archer (1984), Cross (2000), and Jones (1984).

[2] http://www.idsa.org/what-is-industrial-design Last accessed: 20.07.2014

As described by Tate & Nordlund (1996), the various phase-based, sequential models of the design process tend to emphasise the progression of the design in terms of the amount known about the details of its implementation – its physical embodiment. As in the activity-based models, the phases may be augmented with more specific activities or steps (e.g., Pahl & Beitz, 1984). The design process in general consists of four main phases or stages, according to Honold (2000):

1. Product initiation
2. Concept design
3. Embodiment design
4. Detail design

These four stages are in line with design process and model described by Pahl & Beitz (1984), as shown in Figure 1.

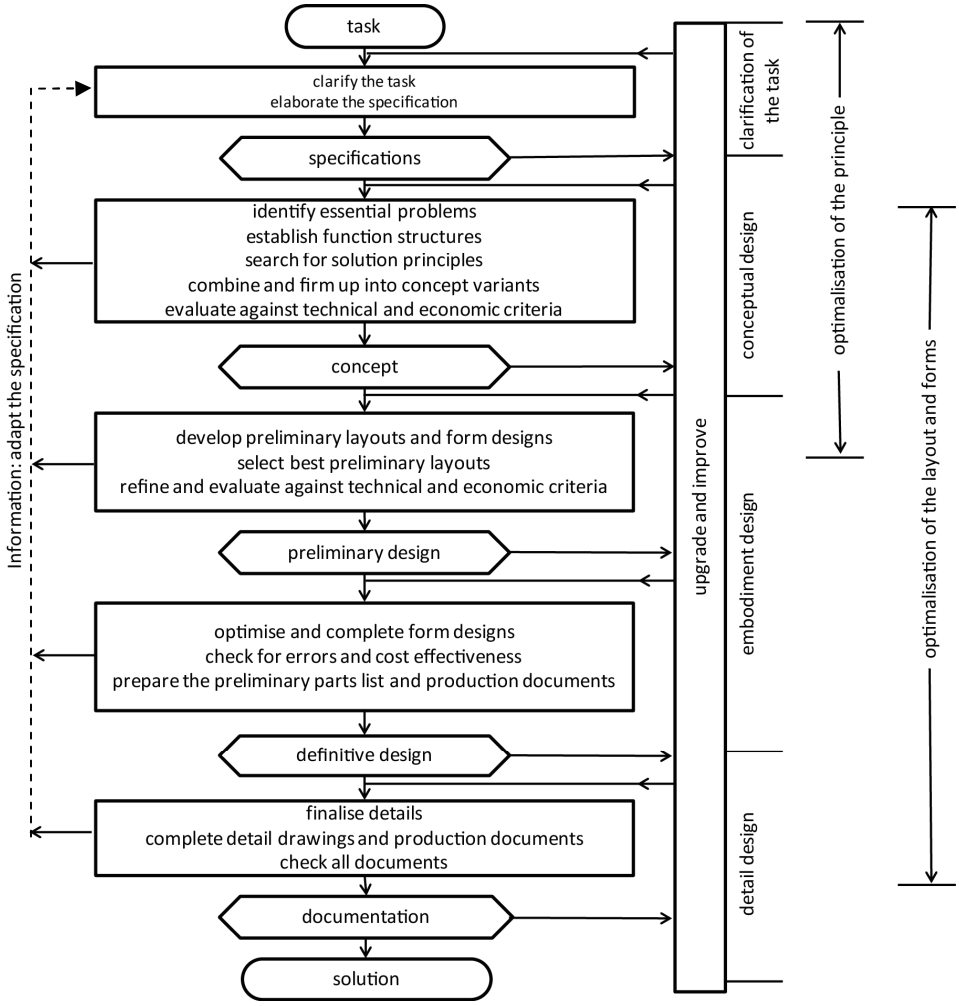


Figure 1: Pahl and Beitz design model (1984)[3]

[3] Adapted from Image source: http://www.wikid.eu/images/thumb/b/bd/DDG-1-13.png/400px-DDG-1-13.png Last accessed: 01.09.2014

According to Honold (2000), during the product initiation stage, a preliminary idea of the product is defined and investigated, including manufacturing, marketing, and customer requirements. This first phase is often referred to as the *design brief*, which aids designers in meeting the product requirements. The concept generation phase is where designers seek solutions to the defined problems via drawing or sketching. This is where the core idea of the product is formed. In the embodiment design stage of the design process, the layout drawings and prototypes of a number of selected concepts are produced and more information on material selection, product size, and manufacturing procedure influencing the design process is generated (Razzaghi, 2007). Finally, during the final detail design phase full documentation describing the physical product is produced (Simon et al. 1998). The different phases of the phase-based model must be qualified with two disclaimers: a clear distinction cannot always be drawn between these phases and it is not possible to avoid backtracking (Pahl & Beitz, 1996 from Tate & Nordlund, 1996).

From the above, this thesis focuses on the conceptualisation or concept generation phase of the design process. Buergel & Zeller (1997) note that up to 90% of a product's properties and price range are fixed at the moment a concept is decided. This early stage of the design process provides an opportunity for designers to be more creative and innovative in their thinking. In addition, at the beginning of the process management activity has little influence on the outcome (Maurer, 2014) (Figure 2), giving maximum freedom to the designers. As mentioned earlier, it is at this concept design stage that the core idea of a product is formed. During this early stage designers seek solutions to the defined problems, hence this thesis focuses on designers and their activities in the conceptualisation phase.

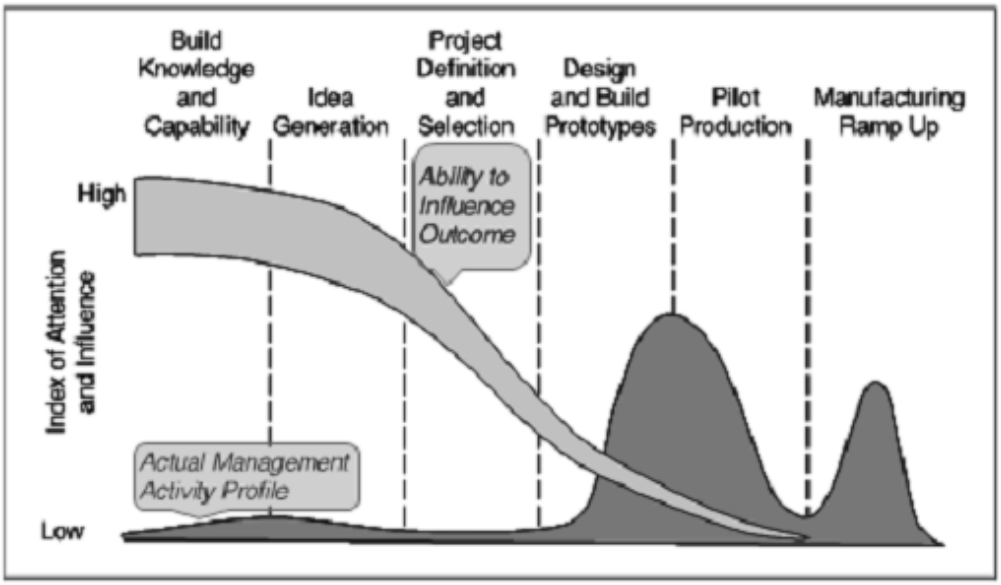


Figure 2: Management activity and opportunities to influence the outcome (Source: Wheelwright, 1995 from Maurer, 2014)

User-centred Design: Gagliardi (2001), Urban & Hauser (1993), Razzaghi (2007), and many others believe that a reliable product design process is one which learns from the customers. This implies that products must meet customer requirements rather than forcing customers to

adapt to the product. Kotler (2003) argues that customer values should be seen as a directing force for business decisions, whereas the previous value-delivery system was oriented around the physical aspects of products. The examples given in Chapter 1 further emphasise the importance of user needs to design. When users and their needs are the designers' focus during the design process, it is generally known as user-centred design (UCD) or human-centred design. The UCD methodology allows product/interface developers to place users at the heart of the design process (Gregor & Newell, 2001). User involvement in the design process results in products that are more likely to provide what the users need and want. The UCD approach is widely considered the key to product usefulness and usability and an effective approach to overcoming the limitations of traditional system-centred design (Mao, Vredenburg, Smith, & Carey, 2005).

Abras, Maloney-Krichmar, & Preece (2004) report that the term 'user-centred design' originated in Donald Norman's research laboratory at the University of California San Diego (UCSD) in the 1980s and became widely used after the publication of a co-authored book entitled *User-Centred System Design: New Perspectives on Human-Computer Interaction* (Norman & Draper, 1986). Norman built further on the UCD concept in his seminal book *The Psychology of Everyday Things* (Norman, 1988) where he recognises the needs and the interests of the user and focuses on the usability of a design.

Going further, the DIN EN ISO 9241-210 provides requirements and recommendations for human-centred design principles and activities throughout the lifecycles of computer-based interactive systems. It is intended to be used by those managing the design process, and is concerned with ways in which both hardware and software components of interactive systems can enhance human-system interaction. This approach has found increasing popularity and acceptance in the industrial/product design community, among others. The ISO 9241-210 illustrated in Figure 3 involves an iterative cycle of specifying the context in which the product will be used and the user and organisational requirements, and then producing design solutions which can be evaluated against these requirements. Table 1 further illustrates some of the methods used in each of the steps of the human-centred design process.

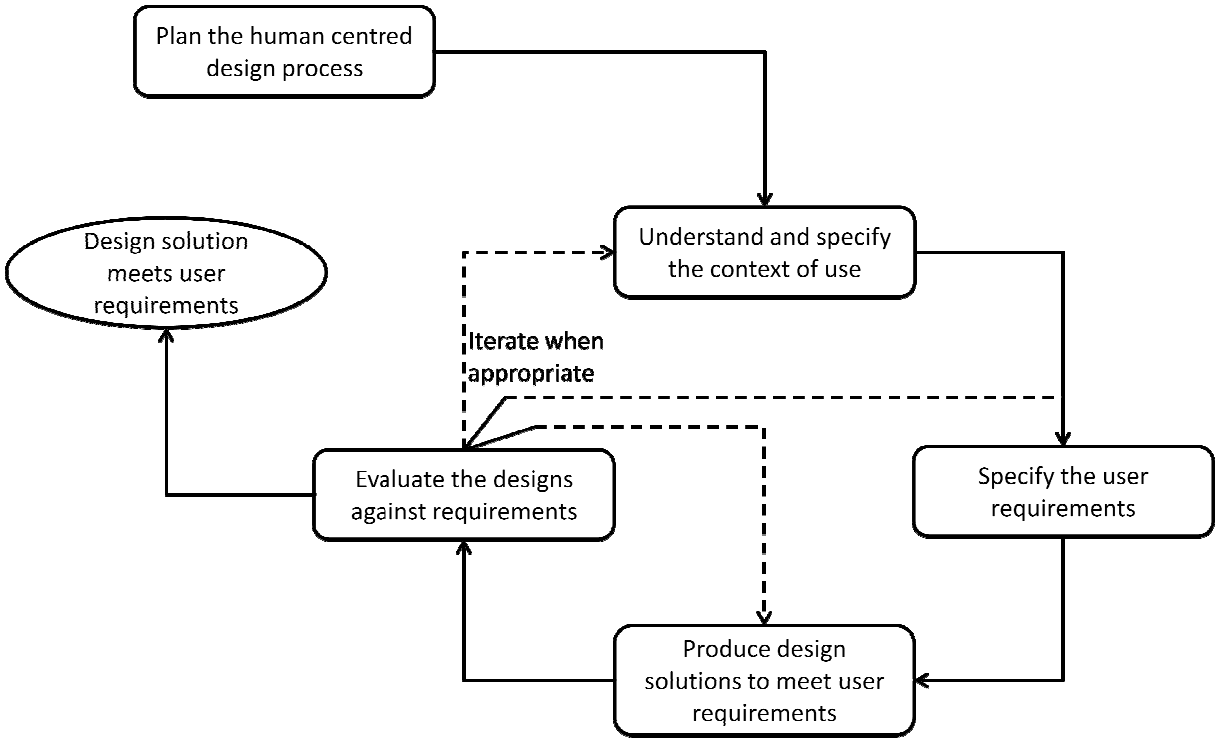


Figure 3: The DIN EN ISO 9241-210 describing the human-centred design process

Table 1: Methods for human-centred design adopted from Maguire (2001)

Planning	Context of use	Requirements	Design	Evaluation
Usability planning and scoping Usability cost-benefit analysis	Identification of stakeholders Context of use analysis Survey of existing users Field study/user observation Diary keeping Task analysis	Stakeholder analysis User cost-benefit analysis User requirements interview Focus groups Usage scenarios Personas Existing system/competitor analysis Task/function mapping Function allocation User, usability and organisational requirements	Brainstorming Parallel design Design guidelines and standards Storyboarding Affinity diagram Card sorting Paper prototyping Software prototyping Wizard of Oz prototyping Organisational prototyping	Participatory evaluation Assisted evaluation Heuristic or expert evaluation Controlled user testing Satisfaction questionnaires Assessing cognitive workload Critical incidents Post-experience interviews

The major advantage of the user-centred design approach is that a deeper understanding of the psychological, organisational, social, and ergonomic factors that affect the use of computer technology (or a product) emerges from the involvement of the users at every stage of the

design and evaluation of the product. This approach therefore helps designers manage users' expectations about a new product (Abras et al., 2004).

The downside of this approach is that members of the team have to learn to communicate effectively and to respect each other's contributions and expertise. This can be time consuming and hence adds costs to the process. In addition, management may question whether this added value is worth the cost, particularly if delivery dates are threatened (Dix et al., 1997; Preece et al., 1994; Preece, Rogers, & Sharp, 2002).

2.2.3 Culture

Like most common language words drafted into scientific study, there is no commonly accepted definition of the word "culture" (Taras, Rowney, & Steel, 2009). There are a whole host of definitions for culture across academic disciplines, with popular definitions including those by Kroeber & Kluckhohn (1952) - from Lyte et al. (1995), Hofstede (2001), Sapir & Irvine (1994), and Press & Cooper (2003), amongst others. An analysis of the different definitions of culture by Taras et al. (2009) found that, while the existing definitions vary greatly, there were several common elements present in virtually all of them. First, it was generally agreed that culture is a complex multi-level construct. Second, culture is shared among individuals belonging to a group or society. Third, culture is formed over a relatively long period. Finally, culture is relatively stable. Researchers from different fields focused on different elements of culture (Taras et al, 2009).

Bearing this is mind, culture is defined and understood in this thesis as:

> The underlying values, behaviours and codes of practice of a group of people which guides people as how to behave and react in the response to a given situation. These responses can be seen as almost a shared pattern among members of a society.
>
> Razzaghi, 2007

Therefore, culture in effect dictates the "dos and don'ts" of different societies (Gupta, 1993).

Trompenaars & Hampden-Turner (1998) use an onion diagram to show culture has different layers (a multi-level construct), manifesting itself at different levels:

1. National culture. This is the highest level at which culture can be manifested, e.g., German versus Indian for example

2. Corporate culture. This refers to the particular attitudes within a specific organisation, e.g., culture at Google.

3. Professional culture. This manifests among people within certain functions who share attitudes or orientations towards certain professional and ethical situations, e.g., designers' culture.

Based on this model, this thesis focuses on national and professional cultures. As seen from studies such as Offermann & Hellmann (1997), Trubisky et al. (1997), Eylon & Au (1999),

Razzaghi (2007), Hofstede (2001), etc., culture has been popularly equated with nationality or citizenship. This thesis also considers national culture, with Indian and German designers understood as belonging to their respective national cultures. Similarly, the design activities carried out in this thesis are targeted at the German and Indian personas that represent specific user groups within the national cultures of these countries.

Trompenaars & Hampden-Turner (1998), as described in Razzaghi (2007), further argue that there are three distinct yet complementary layers within every culture:

1. Explicit products (outer layer): Products and artefacts, or simply observable, explicit cultural manifestations.

2. Norms and values (middle layer): The more profound characteristics of a group of individuals. Norms are the common notion of what is good and bad within a society. Values set the definitions of good and bad, resulting in shared societal ideals. Cultures are considered stable when the norms reflect the values of the society.

3. Assumptions about existence (core): This is related to the notion of the origin of human existence. "Culture comes from the same root as the verb to cultivate, meaning to till the soil: the way people act upon nature" (Trompenaars & Hampden-Turner, 1998, p.23).

Along similar lines, Hofstede's (2001) onion diagram declares the primary manifestations of cultures to be values, rituals, heroes, and symbols, where symbols indicate the outermost layers of culture and values the innermost. Symbols, heroes, and rituals are observable by an outsider, whereas values, as the innermost layer of a person's belief, can only be felt. Figure 4 shows Hofstede's onion diagram as depicted in Razzaghi (2007).

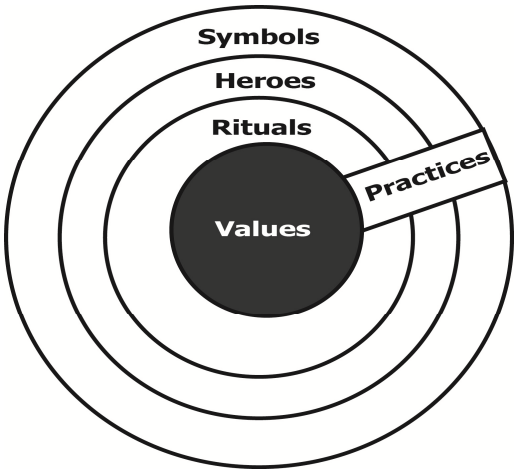


Figure 4: Hofstede's onion diagram of cultural manifestations, adapted from Razzaghi (2007)

Under these two models, this thesis is concerned with products, artefacts, and practices.

Even though culture has been studied from various perspectives (e.g., cultural studies, cultural criticism), the cultural dimensions perspective is by far the most popular approach.

Cultural dimensions: The various meta-models of culture, such as those from Hofstede (2001) and Trompenaars & Hampden-Turner (1998), form the basis for the development of different models of culture. These models provide a more detailed view of culture, by identifying a number of cultural dimensions that are used to organise cultural data (Evers, 2001 from Ford & Kotze, 2005). Cultural dimensions and models such as those by Hofstede (2001) are the most frequently used in cross-cultural research.

Hofstede (2001) focuses his model on determining the patterns of thinking, feeling, and acting that form a culture's mental programming. In this regard, for example, Hofstede identifies five dimensions that can be used to distinguish among different cultures. In this thesis, these cultural dimensions were used to select the two example cultures in which the design studies were to be carried out. The following is a brief description of the five dimensions from Ford & Kotze (2005):

- *Power distance* is the extent to which less powerful members of a society or group of people expect and accept unequal power distribution within that group. High power distant people are afraid to express disagreement with people in authority such as bosses, parents, and teachers. Low power distant people have little difficulty in approaching and contradicting their superiors.
- *Uncertainty avoidance* is the way in which people cope with uncertainty and risk. High uncertainty avoidance individuals tend to be emotional and aggressive, avoid ambiguous situations, prefer to work in a structured and predictable environment, and find change threatening and dangerous.
- *Masculinity vs. femininity* refers to gender roles, not physical characteristics, and is primarily characterised by the levels of assertiveness or tenderness in the user. Masculine individuals tend to be assertive, competitive, and tough. Feminine individuals focus on home, children, and people. Their work goals include good relations with supervisors, peers, and subordinates and good living and working conditions with a sense of security.
- *Individualism vs. collectivism* relates to the role of the individual and the group, and is characterised by the level of ties between an individual and society. Individualists are expected to look after themselves and their immediate family, but no one else. In contrast, collectivists are integrated into strong, cohesive groups that provide protection in exchange for unquestioning loyalty.
- *Time orientation* relates to people's concern with the past, present, and future. In essence, short-term oriented people are concerned with the past and the present, while long-term oriented people are concerned more with the future. Long-term oriented people believe that a stable society requires unequal relations, and that older people and men have more authority than younger people and women. In contrast, short-term oriented people believe in equality of relationships and emphasise individualism.

2.3 Relation between culture and design

This section discusses how culture influences design and culture's influence on the designer and the user.

2.3.1 Culture and design

Early links between culture and design became apparent in social anthropology, where civilisation was evaluated through the evolution of objects and traced through the cultural characteristics embodied in those objects. Culture generates diversity and is revealed through all human action, including the products that people design. Moreover, it is argued that design shapes the culture and lifestyle of modern society. Observing the design of artefacts produced and consumed in a society often reveals the cultural situation and details of people's lives, education, needs, wishes, and fears (Moalsi et al., 2010).

As previously discussed, Trompenaars & Hampden-Turner's (1998) cultural model suggests that products and artefacts are one of the levels of manifestation of any culture. Similarly, Salimi (2002) and Brett et al. (1997) also refer to products as one of the aspects of culture and define culture as the expression of the creations of a group of people – for example, arts, customs, institutions, products, and thoughts – at a particular time within the context of the natural environment. It can be further argued that culture gives products meaning and provides the rituals within which artefacts are used and the values that are often reflected in their form and function (Press and Cooper 2003).

Culture is expressed in design through the integration of cultural values in products. The values integrated into products give users their cultural identity (Moalsi et al., 2010). Usunier (1998) categorises products into two groups: culture-free and culture-bound. For instance, furniture, home appliances, and food highly culture-bound product categories, whereas industrial products like a crankshaft or an electric motor are typically culture-free. Röse & Zuhlke (2001) also define culturally-oriented ("culture-bound" in Usunier (1998)) products as products which integrate the cultural preferences of users.

> Products will be more culture-bound the more closely they relate to elements of the physical environment which influence the local material culture, and which are linked to climate, density of population, housing, flora and fauna, etc.
>
> Usunier, 1998, p.149

The influence of culture on culture-bound product design comes to the fore in many different ways, which can be categorised into two main groups: practical and theoretical (Diehl and Christiaans, 2006).

The practical group comprises aspects from the design process (methodology, procedures), design education (transfer of design knowledge among other cultures), strategy (business strategy and marketing products in other cultures), and designers (cultural influences on the designer himself).

The theoretical group comprises aspects of aesthetics (preference for design in different cultures), semantics (interpretation of design and function), and human-product interaction (the actual use of products in different cultures).

This thesis focuses on the practical aspects of culture's influence on culture-bound design.

Just as culture and design are closely related, the product design process is also closely related to culture and cannot be culture free. Ward (1990) follows Dutton's notion (1987) that knowledge is not (and cannot be) entirely neutral. Similarly, Hofstede (2001) believes that this integration of culture into human thoughts and processes is largely unconscious, since humans' mental activities can never be culture-free. Razzaghi (2007) carries forward the argument made by Lloyd & Snelders (2001), who regarded products as being formed by the interplay of the contributions of designers and wider cultural and social factors. Designing a product can be regarded as a series of decisions concerning cultural dilemmas and the pre-existing frames of meaning the designer may have during the conceptualisation stage of the design process. During this early stage of the design process, designers generate a flurry of ideas through which an approximation to the designer's mentality or impressions can be engendered. Therefore, differences in the final outcome of the design process and the designs themselves are influenced by the designers' individual ideas (Kazmierczak, 2003) and their collective culture (Boym & Boym, 1997), along with other technical factors and constraints (Razzaghi, 2007). Therefore, design activity and the design process can also be unconsciously influenced by designers' cultural preferences.

Despite the cultural influence of the designers' own cultural preferences on the design process, there have been limited studies examining this. Studies such as those by Kruger & Cross (2006), Rahimian & Ibrahim (2011) and Jagtap et al. (2013) have looked into the various aspects of the design process and even compared the design processes followed by different groups of individuals, but comparison of design processes from a cross-cultural perspective is rare, with the only notable exception being from Maurer (2014).

Maurer (2014) compared the procedures for the conceptual design phase in Germany and the United States, in both industry and university settings. Although very insightful, Maurer's work was carried out by comparing the design procedures followed by students of Mechanical Engineering. Also, the findings were born out of experience-based observation of the practices in the respective universities and with the help of interviews with top managers from industry, rather than using established studies to bring out the differences. It is the author's firm view that more studies comparing design procedures/processes must be carried out to clarify the influence of culture on the design process.

2.3.2 Culture and designer, user

Norman & Ortony (2006) describe designers as those in charge of transforming the numerous limitations, multidimensional requirements, and constraints on a product into a single, consistent design. Razzaghi (2007) further describes them as interpretation-trained practitioners who use their insight and vision as tools to develop and redefine a product. Digging deeper, Hertz

(1992, p. 408) states “the designer communicates sets of concepts and sets of subconscious ideas by means of conscious physical expressions which are perceived, more or less precisely, by himself or by others of the same culture”. Hidaka (2003) and Singer (1984) consider design to be a multi-variable dependent activity which cannot be separated from the designer’s personality and nature.

Collins & Pinch (1982) coined the phrase “frame of meaning” to describe the affective role of cultural patterns on designers’ behaviours and preferences. As argued by Razzaghi (2007) and Carlson (1992, from Heaton 2002), designers try to enforce pre-existing frames, based on their past experience, onto new products, rather than inventing new frames. This unconscious process is called “cultural creep” and occurs because designers create artefacts to fit into the cultural spaces suggested by their existing frames of meaning. Honold (2000) provides the example of Siemens washing machines exported to India and the difficulty the users had with the product, suggesting the designers lacked significant understanding of users from other cultures.

It is therefore plausible that factors which are important to a prospective user are imperceptible to a designer from another culture. Thus a designer is influenced by his or her surroundings, and if we consider that each culture has its own particular environment, products and settings, then it follows that designers’ cultural preferences unconsciously influence the product concepts they generate. This point is supported by Ward (2005), who investigated methods used by nine Australian industrial design teams for collecting information on the intended user group. Despite the fact that large-scale companies do extensive research on how the user can be satisfied by their products, Ward concludes that designers prefer to act on their imaginations, informed by experience, when forming an understanding of users for a design project, instead of relying on empirical data.

Zec (2002) further validates this point by considering the bidirectional interaction between culture and products, and emphasising the influence of underlying elements on a designer's decisions about the qualities and quantities through which a product design emerges. This suggests that products carry codes from designers’ aspirations and inspirations and their exterior environment, the society in which the designers were born and have lived. For example, Razzaghi (2007) shows how Australian and Iranian designers incorporate aspects of their own culture and preferences into the design of personal communication devices, thereby confirming the role of a designer’s own culture in both the design and design process. In another example, Roy (1993) studied three cases of product design development and found that the designer always started the concept development stage with a personal approach or attachment towards aspects of the product. This further confirms that products cannot be free from designers’ cultural preferences. However, Razzaghi (2007) did not compare and examine the design process followed by the designers in the different cultures in detail, and Roy (1993) looked at designers belonging to a single culture without looking into the influence of designers from different cultures on the design process. Therefore, this thesis will focus on the influence of culture on both the design and the design process from a designers’ perspective.

The central aim of product design is that the ultimate product must be able to satisfy user needs, with Segall et al. (1990) and Schoen & Wiggins (1992) emphasising that designers are an important factor in determining user satisfaction. Forty (1986) argues that a design will not work unless the product embodies ideas shared by the people for whom the object is intended and designed. This point of view has been supported and elaborated through extensive research by many such as Norman (2002), Cooper (1999), and Honold (2000). The central idea throughout the literature in this area is that the designer and the user for whom the product is designed must connect with each other through the product. The emphasis on establishing a connection between the designer and the user through the product has granted importance to the customer's voice and their requirements, and subsequently led to user-centred design. Among many customer needs, cultural considerations are one of the essential parts of the customer's voice.

When products do not connect with the users they tend to be rejected or used differently from the designer's intention, which can sometimes put the customer at risk. This is illustrated by an example about switches from Powell (2001). A universal device for breaking or connecting an electrical circuit is turned on and off by flipping a switch up or down, but the direction varies between different countries. For instance, in the United States power is connected if switches are flipped up, whereas in the United Kingdom and Australia power is on if switches are flipped down. Flipping a switch up or down could be a source of danger in emergency situations, when people tend to act instinctively, intuitively, or habitually rather than rationally or logically.

As a result of this increased recognition for the voice of the customer or user centeredness, design is moving from a market model towards a social model along the lines suggested by Papanek (1985), where the former involves producing artefacts for sale, while the latter aims to provide user satisfaction. Accordingly, it is evident that users coming from a different culture from the designers can rarely expect to purchase a product matched to their cultural needs and wants and often have to adjust their needs to the products available. From a business perspective, integrating considerations of user culture into a product is an impediment for the global market, but can also be a necessity in customer satisfaction and improving the chance of sales on the global market (Honold, 2000).

It is clear that the user and thereby the culture of the user plays is an essential part of product design. Initiatives such as the "Colour Tool" by Vanka (1997), which assists industrial designers in selecting colours for globally-marketed products to suit customers for a particular region or country, and many other initiatives such as those by Banathy (1992), Bell et al. (2003), De Souza, Pereira, & Dejean (1999), Ellsworth, Magleby, & Todd (2002), Gagliardi (2001), Plocher & Honold (2000), Powell (2001), Diehl & Christiaans (2006), and Moalosi et al. (2010) further emphasise the importance of bringing the user and their cultural needs into focus during design.

Remember that both the designers and the users' cultures affect the design, this thesis focuses on the influence of culture on design from both perspectives.

In summary, the literature reviewed in the previous sections shows how culture manifests itself in terms of products and artefacts, and thereby in design. The literature also provides evidence of human thought and actions being influenced by culture. Like design, the design process is influenced by culture. With the broad framework of research focusing on the influence of culture on design and design process established, the influence of culture on the designer and the user was further explored (Section 2.3.2). The concept of culture creep was used to establish that culture influences the designer during design. Similarly, examples of the possible consequences of ignoring users' culture led to the recognition of the voice of customer and thereby the importance of considering users' culture during design. These factors combine to support the focus of the thesis on the influence of both designers' and users' culture on a design and the design process.

2.4 Strategic aspects of design for different cultures

While the previous section looked at the relation between culture and design from a theoretical perspective, this section focuses on current methods and approaches used to design across different cultures. General approaches of globalisation and localisation/customisation to cater to users from different cultures are first reviewed, followed by a review of some of the different design approaches to design across cultures.

2.4.1 Globalisation and localisation/customisation approaches to design

Organisations normally choose globalisation and localisation/customisation to overcome the challenge of catering to a wide range of users.

Globalisation: Globalisation is the general process of worldwide economic, political, technological, and social integration as defined by the Localisation Industry Primer (Aykin & Milewski 2005). The concept of globalisation favours the unification of products for different countries without taking into account cultural differences between users. The globalisation process has resulted in the creation of a trade structure which requires all products and services to be homogenised and converged, whereas human beings by nature need diversity and variation (ICSID, 2002).

Usunier (1998) classifies the three steps of the globalisation process as: (1) globalisation of demand including the convergence of consumer behaviour and the marketing environment; (2) globalisation of supply and competition; and (3) globalisation of products and marketing. Despite the apparent benefits in terms of increased profits, globalisation has its share of drawbacks and consequences. Athavankar (1996) considers globalisation and the invasion of culture-free western products as lurking threats, particularly to traditional societies. Usunier (2000) disputes globalisation's assumption that people all around the world are converging towards a "modern lifestyle", characterised as an individualistic orientation, material achievements, commoditisation of time, rejection of the past in favour of the future, and a high degree of utilitarianism. Trompenaars & Hampden-Turner (1998) believe that standard-

ised industrial products (undifferentiated, homogenised, mass-produced products resulting from globalisation) are disfigured from the onset by an unending downward cost-price spiral.

Consequently, globalisation has sparked a new awareness of local identity, where variations in national culture remain strong and the process of globalisation is in fact imposed on users. This argument can be expanded by observing that as international contact and exchanges increase, there is an outbreak of attitudes in defence of national and regional identities, and manifestations of the fear of mixing of races, religions, customs, and habits (Van Raaij, 2005). It is clear that contact does not necessarily generate cultural standardisation. Instead, it often exacerbates differences (Moalsi et al. 2010).

The dissatisfaction of consumers, who use products to satisfy their various needs and wants, can be linked to globalisation, as evidenced by studies by De Mooij (2000), De Souza & Dejean (1999), Zec (2002), De Souza et al. (1999) and many others. For example, Moalosi et al. (2010) quote Delaney et al. (2002, p. 46) on a study conducted by Samsung Design where it was revealed that "users around the world are no longer willing to simply settle for one-size-fits-all products with standardised designs". They argue that individual users are demanding a wide range of sizes, shapes, colours, materials, and features, and these have become important factors for creating successful products. In addition, as observed by Aula et al. (2003), the continuous fragmentation of a market suggests that the demand for individuality and user needs and expectations is growing and becoming an important factor for creating successful products. As a result, organisations often adopt the strategy of localisation/customisation to cater to the different kinds of users across countries.

Localisation: To many people, localisation sounds like it is "just a linguistic process", identical or similar to translation. However, while translation plays an important role in the localisation of all text-based products, the process of localisation is actually much broader. The Localisation Industry Standards Association (LISA) defines localisation as "the process of modifying products or services to account for differences in distinct markets" (Fry & Lommel, 2003).

Fry & Lommel (2003) further explain that products have to be internationalised before they are localised. Internationalisation here can be defined as "making all the necessary technical, financial, managerial, personnel, marketing, and other enterprise decisions necessary to facilitate localization". Internationalisation is specifically the preparation of product for localisation at a technical level. In other words, an internationalised product does not require remedial engineering or redesign, merely adaptation to a specific local language or platform. Therefore, in the context of internationalisation, localisation is the process of adapting an internationalised product to make it usable and viable in a particular country, culture, or market. Localisation takes into account visual design, terminology, culture, date/time/currency formats, and many other technical aspects of a product. At a minimum, localisation requires choosing appropriate locale-specific values for parameters. Since globalisation favours the unification of products over the acknowledgement of cultural differences, localisation of products can act as a counterbalancing force for the maintenance and durability of national cultures, for holding

and preserving cultural values, and presenting those values to potential users, i.e., trying to accommodate products to people as opposed to people to products.

Localisation is particularly important as it is believed that consumption experiences remain local (McCracken, 1986; 1991). De Mooij (2000) further argues that people's welfare levels positively correlate to the manifestation of their cultural values, and proposes that the stability of cultural values runs contrary to the expectations of economists, who believe that with converging incomes, cultural values and habits will also converge. The results of her study suggest that the opposite is true, i.e., cultural values are stable and with converging incomes they will become more manifest. This suggests that people like and persist in maintaining their cultural values, and therefore localisation is increasingly important.

At a deeper level, Ono (2000) argues localisation is not enough by itself, and products must be further developed to accommodate regional as well as national requirements. Usunier (2000) also believes that a national design would not satisfy local particularities, and homogeneous national design cannot be expected to be successful; however, this should not be interpreted as meaning that it would be impossible to have design denominations such as "Brazilian design", "Italian design", "Scandinavian design", "German design", or "Japanese design", etc.

Localisation can be manifested and embodied in the design of a product in order to produce culturally-specific products, resulting in the enhancement of consumer satisfaction and pleasure. Other than increased user satisfaction, as per Fry & Lommel (2003), localisation doesn't only allow the benefits of globalisation to accrue to large companies and powerful nations; users with less common languages, cultures and needs enjoy access to the same products and resources as those in major markets. In addition, localisation allows the flow of products and information to be two-way, as dominant countries receive goods and services from smaller countries that have traditionally had no access to their markets. When companies localise their products and services they help to level the playing field and redress economic inequalities, helping to create a better world in which no one is left out.

This level playing field and the consequences of globalisation have resulted in the emergence of global markets in recent years. These trends have led to wide diversity among users of the same product; therefore for a product to be successful in the global market it must accommodate as much diversity as possible. This, in turn, has resulted in increased diversity in designs and cross-cultural product design. Ono (2000) enumerates some of the benefits of product cultural diversity: (1) building strategic potential into the development of products; (2) preservation of cultural patrimony and individuals' identities; and (3) the creation of a dynamic and creative world.

With companies seeking to diversify into the global market, design and product designers play a key role. Designers face the challenge of fostering cultural diversity through localisation of products with the emergence of the global marketplace, i.e., designers have to balance core shared values with local empowerment to best satisfy individual wants and needs (Moalosi et al., 2010). This means that users are demanding that specific needs be satisfied

with more localised solutions (Aula et al., 2003). In addition, the emergence of the global marketplace has led to a situation in which product design teams from one culture or context often have to develop a product which will be used in a (totally) different cultural environment (Diehl & Christiaans, 2006). Therefore it has become essential for the industrial design profession and education to take the context and culture of end-users more seriously. As a result cross-cultural product design has increased in value and interest within the research and education programmes.

Therefore, when a product crosses a cultural border its functionality, appropriateness, desirability, and pleasurability may well differ from those which the creator of the product envisaged. It is argued that users tend to maintain and preserve their culture and identity through various means, including products. The emergence of the global marketplace has forced companies to choose between 'global' or 'local' product designs. With the consideration of diverse users' spiritual necessities, including cultural requirements, becoming more important (Aula et al. 2003; Bjorkman, 2002), designers play a key role in ensuring product diversity, increased user satisfaction, and ultimately the success of companies and organisations. Bjorkman (2002) acknowledges the importance of awareness of cultural heritage for designing products and believes in the beauty ideal as an emergent result of the social and cultural flow. Cultural values influence the perception of what is and is not beautiful. In other words, manufacturers (through designers and others) need to incorporate users' cultural preferences and desires into products if they want their products to represent users' ideals of beauty.

2.4.2 Design for different cultures

Culture and design has been researched by many researchers, such as Diehl & Christiaans (2006), Moalosi et al. (2010), Razzaghi (2007), Shen et al. (2006), and many others. It is generally accepted that that designers obtaining a thorough understanding of customers' latent needs, including cultural concerns and preferences, leads to a successful product. While the previous subsection reviewed the broad approaches to catering for different cultures, this subsection provides an overview of some of the approaches and methods adopted in research to integrate users' cultural concerns and needs into design. This overview, along with the knowledge from the previous sections, feeds into the main research task and key questions of this thesis.

Culture-centred design (Shen et al., 2006): Shen et al. addressed the culturally rooted factors within user interface design, resulting in the development of a design-based system: Culture-centred Design (CCD). The core of the CCD process is the use of metaphors and two cultural filters at the designer and user levels which get the designers and users view of the product interface. With the help of these two filters, the designer can compare his view of the product interface with that of the user and thus improve usability and help convey cultural identity in the design. The designs could further be improved by applying local metaphors and representations. For this, background knowledge of the target user group and its culture and consideration of the cultural filter (language, logic, and taboos) are essential for the anticipation of user

behaviour. In CCD, the appropriate choice of metaphor and its consistent use are the keys to successful interaction through design.

Designer preceded approach (Razzaghi, 2007): As a part of his research on the influence of designers' cultural preferences on product concepts, Razzaghi (2007) suggested the Designer preceded approach (DPA). Here, it is argued that when a brand-new product has to be designed and launched on an international market where the culture of the target user group is different from the product designers', DPA can provide a competitive gain for a higher market share. The process comprises two stages: in the first stage, industrial designers in the target market are approached as potential customers for the proposed products to sketch to a design brief identical to that given to designers in the source country. Results of this exercise are analysed to obtain a more precise idea about the product. Once a selected number of ideas have been generated based on concepts described by designers from the target country, designers from the source country expand on the concepts and themes that have been discovered. Although the approach can bring fruitful results in a short amount of time, access to designers in the target culture is the key, begging the question – why not get designers from the target culture to design completely for their own users?

Kansei design for cross-cultural perspectives (Chen et al., 2007): This research was carried out to understand the cross-cultural perspectives toward Kansei (emotional/affect) design principles via the design of a mobile phone. Following the Kansei engineering procedures, the Kansei needs of consumers from different cultural backgrounds, preferred formal features of a mobile phone among different cultural backgrounds, and the relationship between Kansei words and formal features for different cultural backgrounds were collated. The information obtained was used as a reference for designing cross-cultural mobile phones and other closely related products. Effective use of this methodology depends on previous knowledge of Kansei engineering and its associated procedures to derive the consumers' Kansei needs.

Culture-oriented product design (Moalosi et al., 2010): The culture-oriented design (COD) model is the result of a paper discussing an experimental design approach conducted at the University of Botswana, where participants were challenged to transform and encode socio-cultural factors into product design features. COD was developed into three interrelated phases: categorisation of socio-cultural factors (user domain), integration (designer domain) and cherishable culturally orientated products (product domain). This model allows assessment of how different elements of culture interconnect in the conceptualisation of products with local relevance. This proposed model helps in the design of products that consider user input as much as possible during the early stages of the design process when design concepts are still relatively fluid, allowing cultural identity, meaning, values, and tradition to be truly integrated and conveyed.

Along similar lines, Portigal (1997) suggests a four step process for achieving a balanced cultural fit into products: (1) investigation for cultural configuration; (2) integration of the findings into the design process; (3) development of design concepts based on the model; and (4) contextual evaluation of design by utilising potential users. However, it is presumed here that

the intended user's cultural preferences and expectations can be more appropriately understood if the designer is from the same culture as that of the user.

Although not conducted in terms of a formal model, Honold (2000) studied a German washing machine, designed and manufactured by Siemens and used in India, to investigate which cultural factors weaken the bond between the user and the product and therefore should be taken into account at the design stage. This study suggests that it is crucial to consider the vital effects of culture on the concept of the product from the very beginning of the design process. Along similar lines, Wang et al. (2013) analysed a whole host of culture inspired design principles, methods, and tools in current products. Their exhaustive literature review of methods and tools resulted in culture-inspired design guidelines based on Grounded Theory. From their analysis, it was found that specific design rules such as imitating, deconstructing, following structure or functions, transforming, abstracting, integrating, combinatorics, simile, and metaphor are highlighted. It was further found that artefacts such as paintings, porcelains, bronzes, calligraphy, propitious patterns, and seal cuttings are commonly used cultural characteristics. Traditional art and craft skills and techniques, such as paper cutting or folding, and object forms are also used to create culture-inspired designs. Along these lines, many similar methods to the ones given above have been suggested in the past. It is beyond the purview of this thesis report to describe them all.

In summary, this section reviewed the literature for strategies for design across different cultures. The popular globalisation and localisation approaches were discussed along with their benefits and drawbacks. This was followed by the different models, methods and guidelines for cross-cultural design thereby covering the whole range of research on designing for different cultures.

2.5 Other research in culture and design

Other research in the area of culture and design includes examining cultural differences in the usability or acceptance of products. Examples include a study by Kim et al. (2006), where cultural differences between Dutch and South Korean users was studied with respect to the design characteristics, usability, and sound preferences for a microwave. Chavan et al. (2007) studied the perception, usage, and adoption home entertainment technology across the US, India, and China. Tomico et al. (2009) explored cultural differences in the perceptions on a set of pens between Dutch and Japanese designers. Leiber (2010) in his PhD thesis compared the use of mobile devices in vehicles across Germany, China, and the US. Marcus & Gould (2000) analysed the effect of cultural dimensions on the global web user interface design.

Often, examinations of cultural differences lead to guidelines and strategies for design for different cultures. Leiber (2010) came up with design guidelines for products to be used in intercultural contexts. Chavan (2007) suggests a strategy for creating culture-friendly products and interfaces based on the use of cultural dimensions. Along similar lines, Ford & Kotze (2005) talk about the design of usable interface with cultural dimensions, while Clemmensen (2009) developed a theory of cultural usability where he compares the Cultural Models of Use

(CM-U) theory and Artefact Development Analysis (ADA). Comparison of the two theories concluded that: (1) the theory of cultural usability can account for empirical findings on cultural usability and (2) CM-U and ADA theories seem to fit different user populations' perception of usability.

Another area of research related to culture and design is cross-cultural user research. Cross-cultural user research is different from the cross-cultural studies mentioned earlier in that it focuses exclusively on the development of methods for conducting user research across different cultures. Lee et al. (2007) showed how cultural differences can influence the process and outcome of user research by performing a probe, usability test, and focus group interview in the Netherlands and Korea. Similarly, Clemmensen et al. (2007) discuss how usability tests are not the same worldwide. As a result, some researchers have suggested different ways to deal with cultural differences during user research. For example, Chavan (2005) introduces a number of culture-dependent methods for user research such as the Bollywood Technique and Emotion Ticket. Clemmensen (2011) suggests templates for culture-specific usability testing. Similar research can also be found, suggesting different methods to overcome cultural barriers during user research.

2.6 Deficit analysis

Based on the learning from the previous two sections, this section identifies the gaps in literature which this thesis aims to address.

Design is an agent of change and it is important for designers to know how they can either undermine or support the indigenous cultural systems of a society (Popov, 2002). Cultural values are communicated through artefacts, and in the design of artefacts – product design – cultural respect can be achieved by incorporating the historical and aesthetic values of users (Moalosi et al., 2010). The challenge is therefore to understand what and how cultural norms and values can be integrated into product design. The primary objective of most studies examined and reviewed as a part of this thesis was to develop an understanding of users' values and behaviours that can be translated into viable and powerful visual design, information architecture, and design ideas (Moalosi et al., 2005). This objective of understanding user values and behaviours reveals a deservedly strong focus on the end product and the user, but at the same time the cultural influence on the designer or the design process seems to be ignored. The exceptions are Razzaghi (2007) and Maurer (2014). Razzaghi (2007) looked into the designer's cultural influence on design, while Maurer (2014) compared concept design procedures followed in two cultures. However, there has thus far been no holistic examination of the influence of designers' culture on a design and the design process (i.e., examining the influence of designers' culture on a design and the design process together).

This absence is emphasised in a literature review by Nakata & Sivakumar (1996), where they call for an understanding of the possible links between national culture and new product development. Hence this thesis considers both designers' and users' culture in tandem. Such a holistic consideration provides perspective on the existing methods and guidelines, while po-

tentially making them even more effective. This further crystallises the key task of this thesis, i.e., what is the influence of the designers' and the users' culture on a design and the design process?

A structured examination of this task requires a framework. Given the link between national culture and new product development (Nakata & Sivakumar, 1996), culture in the context of this thesis is taken to mean national culture. This thesis therefore examines the influence of the national cultures of the designer and the user on the design and design process. To further establish the framework, Usunier's (1998) categorisation of products into two groups of culture-free and culture-bound is used. Accordingly, this thesis focuses on the design and design process associated with culture-bound products to ensure stronger differences and contrasts between the designers' and users' cultural perspectives.

Therefore, the main research task and framework can be formulated as examining the influence of designers' and users' culture on a design and the design process. This main task, when further broken down, provides the following questions for research:

1. Influence of culture on the design process
    a. Is there a difference in the design process and approach followed between designers from different cultural backgrounds?
    b. Is there a difference in the design process and approach followed when designing for a familiar culture versus an unfamiliar culture?
2. Influence of culture on design
    a. Does the target users' culture influence the design?
    b. Does the designers' culture influence the design?

These research questions are answered within the framework of India and Germany as the example national cultures of designers and users, with industrial/product design students playing the role of designers asked to design culture-bound products.

Finally, in the context of this literature review, explicit mention of the work of Razzaghi (2007) must be made. Razzaghi conducted an exhaustive literature analysis, which this thesis builds upon, to emphasise the importance of considering designers' own cultural preference in design. Razzaghi then examined the cultural preferences of Australian and Iranian designers in the design of a personal communication device. The cultural preferences in the design sketches and designers' annotations were analysed and compared along cultural dimensions with little focus on the design process. As a result of his research, Razzaghi recommends the designer-preceded approach as one of the possible ways to design for different cultures.

This thesis differentiates itself from the work of Razzaghi by focusing on both design and the design process as well as the designers' and users' cultures. Razzaghi focuses only on design (end product) and the designers' culture without considering the users or users' culture in the design briefs given to the designers for the examination of cultural preferences. Therefore it can be positively stated that this thesis sufficiently differentiates itself from Razzaghi's work while attempting to add and complement the existing body of knowledge.

3 Intercultural Design Studies

The key research questions identified from the state of the art analysis were examined through design studies carried out with seven design students from India and seven product/industrial design students from Germany. This chapter discusses the setup for the study, the key analysis measures, and the results in relation to the research questions.

3.1 Objectives

From the previous chapter, it is clear that there is a need for research into the influence of designers' and target users' cultures on a design and the design process. The analyses under the established research framework led to the four key questions for research:

1. Influence of culture on the design process
    a. Is there a difference in the design process and approach followed between designers from different cultural backgrounds?
    b. Is there a difference in the design process and approach followed when designing for a familiar culture versus an unfamiliar culture?
2. Influence of culture on design
    a. Does the target users' culture influence the design?
    b. Does the designers' culture influence the design?

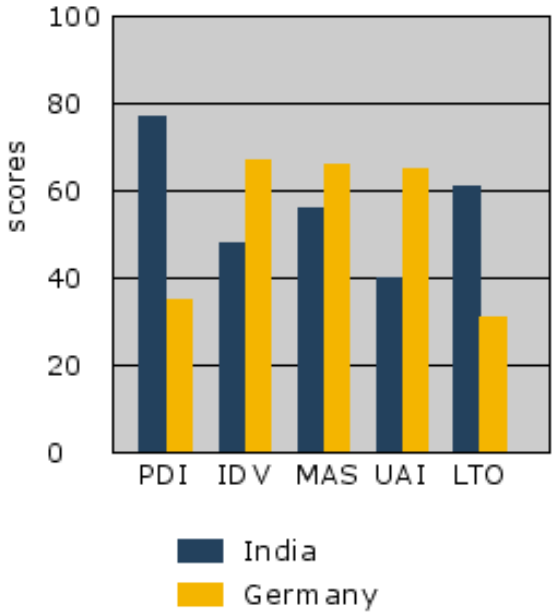
These key questions were answered with the help of 1:1 design studies carried out with seven industrial/product design students from Germany and seven industrial/product design students from India (total n = 14) using the *think aloud* protocol to examine and compare the design processes. The results of the students' design processes (i.e., final designs) were evaluated by a group of four experts (two from Germany, two from India), each with at least five years of professional product/industrial design experience, to understand the influence of culture on the design.

3.2 Study setup

3.2.1 Conditions

Given the link between national culture and new product development (Nakata & Sivakumar, 1996), culture in the context of this thesis is taken to mean national culture. This thesis therefore examines the influence of the national cultures of the designer and the user on the design and design process. Germany and India are used as example national cultures since both countries are culturally different based on Hofstede's dimensions (Figure 5) and Germany is a low context culture and India a high context culture as per Hall (1976). Furthermore, Germany is a developed country whereas India is a developing country, with enormous market potential which German companies are looking to tap. Finally, the fact that the researcher is from India conducting his thesis research in Germany is an added convenience for carrying out these

studies. The research questions were examined in the context of German and Indian designers and users, with design studies conducted with design students in India and Germany in their respective design school environments.



PDI: Power Distance Index - the extent to which less powerful members of institutions and organisations accept that power is distributed unequally

IDV: Individualism vs. Collectivism - the role of the individual and group, and which interest prevails over the other.

MAS: Masculinity vs. Femininity - Gender roles pertaining to societies in which social gender roles are clearly distinct

UAI: Uncertainty Avoidance - the extent to which the members of a culture feel threatened by uncertain or unknown situations

LTO: Long Term Orientation vs. Short Term Orientation - fostering of virtues oriented towards future rewards, in particular perseverance and thrift.

Figure 5: Differences between India and Germany according to Hofstede's dimensions[4]

The nature of the research question requires a detailed examination into the design process and approach followed by the participants, therefore the *think aloud* protocol (Ericsson & Simon, 1993) was used. Briefly, verbal protocol analysis involves having participants perform a task or set of tasks and verbalising their thoughts (*thinking aloud*) while doing so. The basic assumption of verbal protocol analysis is that when people talk aloud while performing a task, the verbal stream functions effectively as a 'dump' of the contents of working memory (Ericsson & Simon, 1993). According to this view, the verbal stream of thoughts can thus be taken as a reflection of the cognitive processes in use and, on analysis, provides the researcher with valuable information about not only these processes, but also the representations which designers operate upon. In addition, verbal protocols can reveal information about misconceptions and conceptual change, strategy acquisition, use and mastery, task performance, affective response, and the like (Trickett & Trafton, 2007). Ericsson and Simon (1993) argue that, done properly, *think aloud* procedures do not influence the sequence of subjects' thoughts and that the resulting data can be treated as objectively as any other data. Many studies, such as those by Christiaans (1992), Dorst (1997), Kruger & Cross (2006), Rahimian & Ibrahim (2011), and Jagtap et al. (2013), have successfully used verbal protocol analysis to analyse different aspects of the design process.

The design study conducted at the respective design school environments involved participants being asked to individually design through sketches a vehicle instrument cluster (CI) to meet the design brief for the Indian and German personas provided (one of each) to ensure the

[4] Source: geert-hofstede.com Last accessed: September, 2012

participants designed for both familiar and unfamiliar cultures. The personas themselves were derived from detailed user studies carried out by the researcher in India and Germany, specific to a target user group and the vehicle instrument cluster. Details about the design brief and the personas used for the studies are presented in Section 3.2.3. This approach is similar to the suggested 'alternative' exercise structure proposed by Razzaghi & Ramirez (2010) although they were proposing it as a part of an educational module and not used in the inter-cultural setting for design studies as proposed in this thesis.

The design brief and the persona document were in English and was easily understood by all participants; however, when thinking aloud the German participants expressed themselves in German while the Indian participants expressed themselves in English. The activity of each participant and a short reflective interview at the end of the activity was recorded (audio and video) and transcribed. In addition, all the sketches and written material produced by the participants during the course of the activity were also taken in for analysis and comparison. During this activity, the participants were given access to a laptop with internet access for any references or information that they might require. The students were also not placed under any sort of time constraints for the activity.

3.2.2 Participants

Seven industrial design students from a leading design school in India and seven industrial design students from a leading design school in Germany participated in this activity on a voluntary basis. The only criteria for participant selection was possession of a driving license and at least a year's experience of driving a car. These criteria were set due to the nature of the design brief (design of vehicle cluster instruments) and to avoid a situation where the participant did not relate to the brief or product to be designed, which would severely skew the data. All participants in this activity were either in their third semester (10 out of 14 students) or fifth semester (4 out of 14 students) of design education. Students in their third or fifth semester were favoured because by the third semester students are exposed to the design process in their coursework and would have employed the processes learnt in one or more of their assignments and projects, thereby making the cultural influences on design and design process observable. In addition, studies by Christiaans & Dorst (1992) and Atman et al. (1999) have shown that freshman design students get stuck in problem definition and do not progress satisfactorily into further stages of the design process, further justifying the choice of third and fifth semester design students for this study.

The sample size of seven participants each from India and Germany is in accordance with similar think aloud protocol studies such as those by Kruger & Cross (2006), Rahimian & Ibrahim (2011), Jagtap et al. (2013), Chakrabarti et al. (2004), etc. As mentioned earlier, each of the participants were required to come up with a separate CI design concept to satisfy the Indian and German personas. Each of the two design activities for the Indian and German persona was carried out with a gap of at least one day in between. For their participation in the study, the participants were compensated with gift vouchers (a €20 Amazon voucher for the German students and Rs 1000 voucher for the Indian students).

3.2.3 Design brief and persona document

To compare the design processes and design so as to address the research questions, each participant was given a design brief along with a persona document representing the target user group from a particular culture. The following section describes the design brief and its contents, along with the persona documents created to represent the two target group cultures.

Design brief

Design briefs used thus far in design studies using the think aloud protocol have revolved around engineering design; e.g., the one used by Chakrabarti et al. (2004) from Blessing (1994) or the one used by Ehrlenspiel & Dylla (1993), or the different kinds of briefs used by Atman et al. (2005) from Mullins et al. (1999). Design briefs used in studies in industrial design (e.g., Jagtap et al., 2013; Razzaghi, 2007; Dorst, 2001) were varied and created specifically to cater to the research question under examination. Since there was no previously used and validated design brief that could be directly adapted to meet the requirements of this study, a new design brief and associated personas were created to provide a common framework for comparison of the design processes and designs.

For the design brief, it was important to choose a popular and well known category of product that had cultural influences but functionally remained universal (i.e., a culture-bound product (Usunier, 1998)) that goes through incremental improvements in design (i.e., incremental improvements to existing product category (Ulrich et al. 2009)). Among the various culture-bound products considered, home/kitchen appliances were discarded because context of use would make the design activity complex for participants from two different cultures. Similarly, consumer electronics were not chosen due to their universal nature, with little or no cultural influences apparent in terms of the exterior design. In the same way, stationery products were eliminated due to their universal nature and lifestyle products were eliminated due to their extreme subjectivity even within a single culture. Other similar products considered were eliminated due to reasons of scope for design within the framework of this study and the context of usage and meaning. Finally, through a process of elimination, the vehicle cluster instrument was chosen as the product to be designed via the design brief.

The cluster instrument panel, typically located behind the steering wheel, is an area of high importance for the driver in interacting with the vehicle as it contains information about the state of the car. The vehicle instrument cluster (CI) is also an object through which designers express the general look of the car, e.g., dynamic, sporty, sober, upmarket, etc. (Herbeth & Blumenthal, 2013). In addition, the universal nature of the car and the cultural influences on the design and treatment of CI, as witnessed by market trends, favoured its inclusion in the design brief, thereby satisfying the two conditions of being culture bound and part of a cycle of continuous incremental improvements. The design brief around the CI also satisfied other criteria of being realistic, appropriate, and relatable for the participants with enough scope for design along with remaining feasible within the logistical constraints of the design study.

With all this in mind, a design brief was developed with a fictitious scenario where the participant would have to design a CI for a specific culture (India or Germany) for an automobile

company based on the provided persona (Indian or German) for the hatchback segment. The design brief contained a list of basic elements that the participant's final concept sketch would have to include: the tachometer, speedometer, fuel gauge, oil gauge, representation of the turn indicators, odometer, headlights, etc. The participants were free to include any other features or elements in addition to the basic elements mentioned in the design brief. The participants were also free to choose analogue or digital display modes, set their maximum ranges, and also choose from standard representations of the basic CI elements or choose to create their own. The final part of the design brief contained general information about the activity such as access to the internet, reference to standard symbols and icons in the CI, and expectations of the final deliverable. The final deliverable was to take the form of one or more legible concept sketches with descriptions of the colour treatment, material, and finish of the final concept. Appendices 10.1 and 10.2 contain the actual design briefs used during the course of the activity.

Persona document

Along with the design brief mentioned above, participants were also given detailed personas representing the target user group in Germany and India, thereby ensuring that they designed for both a familiar and an unfamiliar culture. Personas are hypothetical archetypes of actual users, i.e., personas are in effect representatives of the user group (Cooper, 2004). Personas are a powerful way to communicate the needs, goals and behaviours of the target user group. Although primarily used in the field of user experience and interaction design, personas are increasingly used in product design. Personas have also been used under the name of user or customer profile in the product/industrial design communities (e.g., LeRouge et al., 2013). The automobile industry has been also known to use customer profiles/personas during the planning, design, development, and marketing stages of their product lifecycle (e.g., Ford's use of personas in the design of the 2011 Ford Fiesta[5]).

Personas are based on data, known customers, and interviews. In practice, multiple personas are typically created to achieve a true representation of the target user group; however, here, for the purposes of the design activity and exercise, only one persona was created to represent the target user group from Germany and one persona was created to represent the target user group from India.

These two personas were derived from 17 user interviews (10 Indian, 7 German) conducted in India and Germany with potential users – young people who have been in work for a few years and are looking to buy a new car. The interviews covered a wide range of topics such as general demographics, a typical day in their lives, fashion sense, passions, possessions, attitudes, influences during a purchase decision, etc. so as to best understand and represent the user in the persona document. Based on the analysis of the interviews held in India and Germany, representative persona documents were created for use in the study. Figure 6 below shows the general structure and content of the two-page persona document given to the participants at the start of the activity along with the design brief. The Indian persona document

[5] *New York Times*: Before Creating the Car, Ford Designs the Driver: http://www.nytimes.com/2009/07/19/automobiles/19design.html?_r=1&hpw=&pagewanted=all Last accessed: 25.07.2014

is shown as an example. Appendices 10.3 and 10.4 show the Indian and German personas in detail.

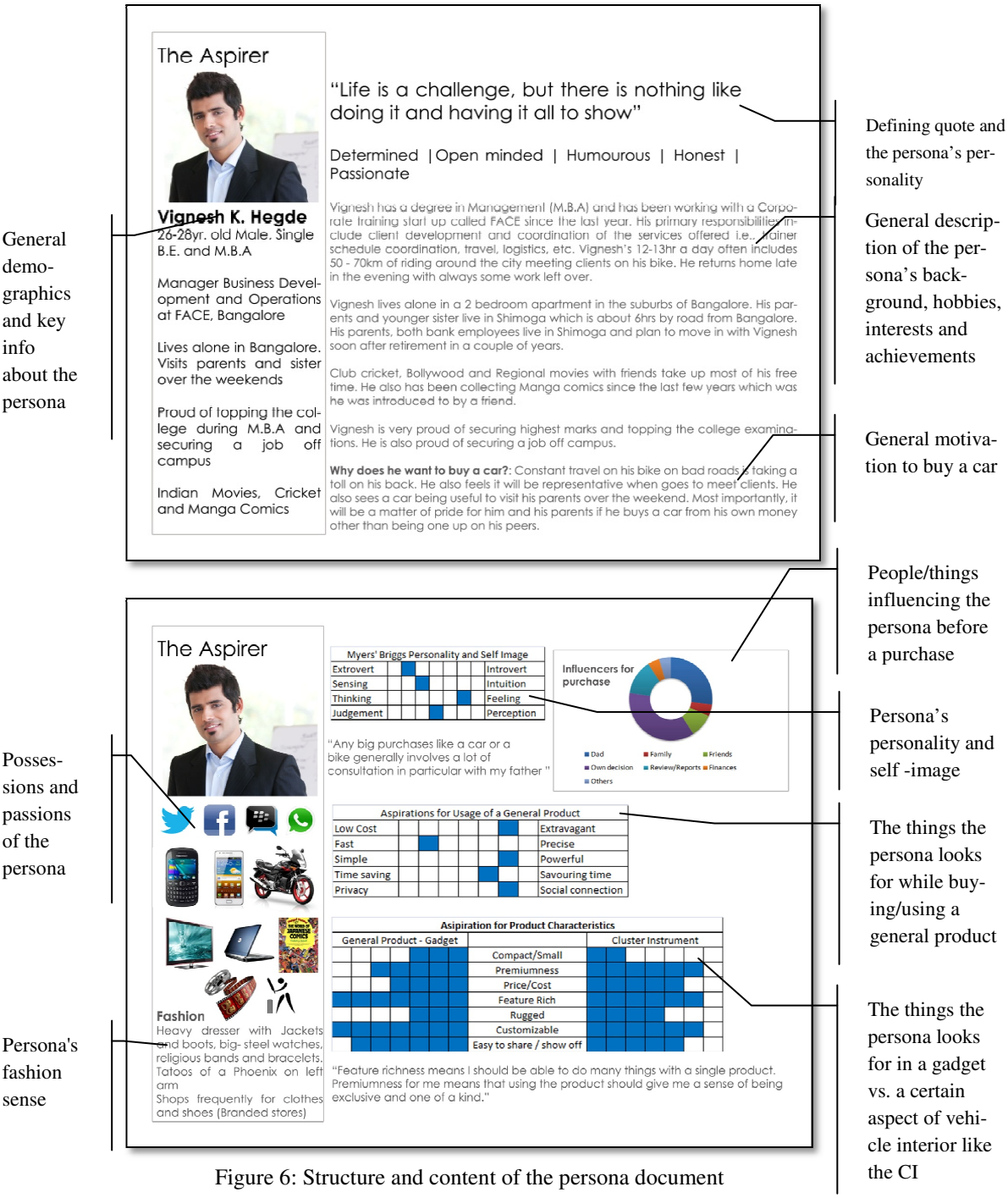


Figure 6: Structure and content of the persona document

3.2.4 **Procedure**

The design activity for each of the participants followed a pre-determined procedure, as shown in Figure 7.

Greet and introduce the participant to the activity
Informed consent form for participant approval
Explanation and practice of *think aloud* protocol
Provide; Overview the design brief and persona document to the participant
Design activity as per the design brief and respective persona
Reflective interview and discussion on the design activity, typical design process, etc
Thank the participant, end the session

Figure 7: The general procedure followed for the design activity

As shown in Figure 7, during the initial introduction to the activity, participants were briefed about the purpose of the activity, the procedure, and the sources of data gathering (audio recording, video recording, and sketches and annotations). A formal agreement to the recording of the activity was obtained from the participant along with basic demographic information such as name, age, sex, field and semester of study, and email address for future correspondence through the informed consent form.

In the next step, the general overview and purpose of the think aloud protocol was explained with an example followed by a short activity for practice. In the practice activity, participants were asked to redesign a normal house telephone for the elderly. Once the participants showed comfort in thinking aloud, the actual design brief and persona document were provided to the participant, along with a quick overview of the contents of the documents. During the course of the design activity, the researcher played the role of passive observer, only interrupting to occasionally remind the participant to think aloud, or for clarifications on certain actions performed by the participant.

After the design activity, a short, 10-15 minute reflective interview session was conducted to ask participants about the activity they had just carried out. After the first activity, the questions were restricted to clarifications of some of the researcher's observations of the activity, whereas after the second activity, the questions covered a wide range of topics. The questions after the second activity covered the following topics:

- Typical design process followed by the participants
- Differences between the typical process and that followed during the activities
- Differences in processes followed while designing for familiar and unfamiliar cultures,
- Opinion on the process and approach if the order of the target personas for design had been switched.

Here it must be re-emphasised that the participant performed the activity for one of the given personas on a particular day and then performed the same activity for the other persona at least a day later, i.e., each participant designs for both the familiar and the unfamiliar personas.

The detailed version of the study protocol used in the study is provided in Appendix 10.5. Although the documents supplied for the activity were all in English and well understood by the participants, the German students preferred to think aloud in German as it was more natural for them. This did not pose any problems due to the researcher's own knowledge of German and the fact that the transcripts from German recordings were translated and verified by a native German speaker with good English language skills.

Based on the procedure described above, each participant performed the activity twice (i.e., once for the familiar persona and once for the unfamiliar persona). Each activity lasted about 60 to 90 minutes, with the second activity taking longer due to the longer reflective interview and discussions. This was despite the fact that participants were not explicitly put under any sort of time pressure to complete the activity. In order to minimise bias with regards to familiarity and unfamiliarity with the persona and the influence of the first activity on the second, the order in which the target personas were presented to the participant was randomised. Table 2 shows the number of students who designed for each persona first.

Table 2: Order for the design activity

	Indian students	**German students**
Indian persona first	4	3
German persona first	3	4

As mentioned previously, the whole activity by the participants and the reflective interviews was audio and video recorded, and transcribed with their consent for further analysis. In addition, the participants also submitted their sketches, notes, and annotations made during the course of the activity for analysis.

3.3 Measures of analysis

Cultural dimensions are popularly used to compare culture in design (e.g., Razzaghi, 2007); however, they were not found to be suitable for analysis and comparison in this thesis. Comparing design processes along cultural dimensions would be difficult given that both the Indian and German students in this activity received the same design brief and persona. In addition, in the author's opinion cultural dimensions are most useful when comparing final designs rather than design processes as is the objective here. Therefore, the nature and the objective of the study along with the difficulty in employing cultural dimensions for comparison resulted in the adoption of the think aloud protocol and the associated measures for analysis, as given in studies by Christiaans (1992), Dorst (1997), Kruger & Cross (2006), Rahimian & Ibrahim (2011), Jagtap et al. (2013), etc.

As mentioned before, the overall design activity involved 14 design students (7 from India and 7 from Germany) wherein each student participated in two activities each (one for each of the personas provided) resulting in a total of 28 separate activities with associated recordings, sketches, notes, and observations. For analysis, all the recordings from the activity were transcribed with time stamps on the audio/video recording. The transcripts were divided into

segments in accordance with Ericssion & Simon's (1993) guidelines for verbal protocol analysis. Each segment in this case referred to a single step, action performed, or train of thought articulated by the participant during the design activity.

A structured analysis of segmented protocols requires the application of a coding scheme. Here, the coding scheme revolved around the various steps and procedures followed by the students during the course of the design activity. The coding scheme was checked for reliability by calculating the percentage agreement among independent coders. Due to logistical constraints, a random selection of eight transcripts (4 from the Indian students, 4 from the German students) covering both groups of students and both personas were checked for reliability. The coding was modified and repeated until a satisfactory inter-rater agreement was reached. The final coding scheme employed for further analysis achieved an inter-rater agreement (Fleiss, Levin & Paik, 2003) of 80.34%, which is deemed satisfactory. Table 3 shows the coding scheme employed for the purposes of the analysis.

Table 3: Coding scheme for the transcripts from the design activity

Code Number	Code Name	Code Description and Actions Performed by Participant
1	**Design Brief**	Reading and understanding the design brief; referring to the design brief; crosschecking with the design brief, etc.
2	**Persona**	Reading and understanding the persona document; referring to the persona; crosschecking references related to information in the persona document, etc.
3	**Requirements and Specifications**	Listing design requirements, evaluation and review with respect to specifications list, referring to list generated, etc.
3a	**Mood board**	Creating a mood board, referring to the mood board, internet search for images for mood board, etc.
4	**State of the Art**	Competitive products research/recall, standards, symbols, template, internet research for examples, etc.
5	**Form Exploration**	Sketching related to housing, overall design, design language, positioning of the console, etc.
6	**Detailing**	Layout and positioning of the elements, colour treatment, material treatment, functionality detailing, etc.
7	**Future**	Additional functionality and features, future scope beyond the requirements of the design brief.
8	**Final Concept**	Final concept sketch as the end deliverable of the activity.

All transcripts in the study were individually studied with reference to the coding scheme. Since the coding scheme essentially reflected the steps in the design process, the time spent by each of the participant in each of the design steps was also calculated.

The nature of the research questions and the chosen methodology to answer the questions required for the gathered data to be analysed from both quantitative and qualitative perspectives. These quantitative and qualitative measures are described in the following section.

3.3.1 Quantitative measures

- *Total percentage time:* The total percentage time in this context is understood as the percentage of the total time spent by the participant on a particular step as identified by coding scheme in the design activity. This data is extracted from the coded transcripts, which also recorded the time spent at every step of the design activity.

For example, if a student spends 10 mins of the total 90 mins in the 'form exploration' step then, it is recorded that the student spent 11.1% of the total time on 'form exploration'. The percentage time for all the steps in the activity was calculated for all 28 activities (14 students x 2 activities per student). This parameter is used in this context exactly as in previous studies such as Mullins et al. (1999), Ehrlenspiel & Dylla (1993), and Atman et al. (2005).

- *Number of transitions:* Research into the design process followed by engineers has shown that engineers do not simply progress step by step through the design process but instead iterate through cycles of proposal, testing, and modification (Atman et al. 2005). From this it is plausible that the design process followed by the design students of this study would also follow an iterative design process through multiple steps. Therefore, the number of transitions is defined as the change the participant makes from a particular step during the activity to another step.

  For example, if a student is exploring forms ('form exploration' in the coding scheme) and then decides to refer to the persona document for more information ('persona' in the coding scheme) then this change is identified and calculated as one transition. In the same way, all the transitions made by the participants during the course of the activity – linear as per the coding scheme or otherwise – are calculated manually from the activity's audio and video transcripts. To answer the study's research questions, the total number of transitions by participants in a group and the average number of transitions per design activity were considered, along with the standard.

- *Number of information units considered from the persona document:* The design activity provided the participants with a persona to design for. The persona document provided various types of information such as general demographics, day in the life, fashion sense, passions, possessions, attitudes, influences during a purchase decision, etc. To answer the research questions, it is of interest to examine the amount of information the participants considered from the persona document. In order to measure the amount of information considered, the persona document was broken down into 10 categories of information:
  1. General demographics
  2. Day in the Life, hobbies
  3. Keywords describing the persona
  4. Motivation to buy car
  5. Possessions and passions
  6. Fashion sense
  7. Influencers/influences in buying decision
  8. Personality and self-image
  9. Aspirations for product usage and product characteristics
  10. Quotes from the persona

Each of these categories was further subdivided into smaller units of information. After removing repeated units of information, there were a total of 44 and 49 units for the German and Indian personas, respectively.

For example, for the German persona, under the "day in the life, hobbies" category, the persona's hobbies of scuba diving and hiking were considered to be two separate units of information. Obviously each participant will find certain units more important than the others and extract only those specific units as the basis for their design, in addition to considering certain units of information for general understanding.

For this measure, only those units explicitly mentioned (said aloud or written down by the participant) were considered. Therefore, these scores cannot be directly associated with percentage of time spent in either the persona step or the requirements and specification step. The total and average number of units of information considered by the participants were considered for analysis.

- *Number of explicit assumptions made:* Despite the detailed persona document, the participant made certain assumptions to proceed in the activity. Assumptions in the context of this study are defined as pieces of information outside of the persona document and design brief which the participant considered to help in design.

  For example, the influence of the father in the Indian persona might make the participant assume that the father would be a potential user of the car and therefore look to satisfy the father's tastes as well. As in the previous measure, here only the assumptions explicitly mentioned by the participant as seen in the transcripts and notes are considered. Again, the total number of assumptions and average number of assumptions per participant were considered.

- *Number of exploration sketches:* Sketching as a way of saving and communicating ideas is attractive to designers (Goldschmidt, 2003). Schön (1983) described design sketches as containing "stable residual traces" of designers' preferences while being rapid and spontaneous. Therefore, the exploration and concept sketches made by the participants are considered for this study as they communicate the participants' intentions regarding the product being designed. In order to remove any sort of ambiguity regarding the freehand sketches, the participants were asked to annotate their sketches whenever possible. In this study, all the sketches by the students are classified into two categories: exploratory sketches and final concept sketches.

  Exploratory sketches are those sketches the participant produced during the course of the activity where different possibilities and options are being explored. The final concept sketches were those the participant believed to be their final recommendation of the CI for the particular persona. Sometimes a student provided multiple perspectives of their final concept, resulting in more than one final concept sketch per activity.

  The final concept sketch proposed by the student contains details about the material, colour, and finish. The number of exploration sketches and final concept sketches were manually counted from the sketches, annotations, and material submitted by the

participants at the end of the activity. The total number of exploratory and final concept sketches by a particular group was considered.

3.3.2 Qualitative measures

In addition to the quantitative aspects mentioned above, the qualitative aspects of the design activity were observed to discern the difference in the design, design process, and approach between German and Indian design students. These qualitative observations and comparisons were important because the nature of the design activity and the think aloud protocol used in this study provides little scope for extensive statistical analysis. In order to incorporate reliability into the qualitative data, the data was verified with the following sources:

1. Researcher's observations from the recording transcripts and notes from the researcher as an observer during the exercise
2. Concept sketches and worksheets from the activity
3. Reflective interviews with the students after the design activity

Each observation from any one of the above sources was validated with the other two sources to verify the data. The observations were examined for consistency across all participants to further classify them as a one-off occurrence specific to an individual, an occurrence specific to a particular group (Indians or Germans), or a practice common to both groups. The main parameters of qualitative observation and analysis will now be briefly described:

- *Design brief and persona interpretation:* It was interesting here to observe how exactly the design briefs and personas were interpreted and employed during the design activity, i.e., was there an influence of the designer's own culture in the interpretation of the design brief and persona which in turn had an influence on the overall design and design process? These observations were based on the transcripts of the recordings and the notes the participants made during the activity.

- *Specific information and research employed:* Over and above the design brief and persona provided, it is typical for designers to inform themselves a little more about the persona or task at hand. This parameter considers the specific kinds of information the participants looked for and employed during the research phase of their activity. The observations for this parameter were primarily based on the internet searches the participants carried out and the questions and clarifications the participants sought from the researcher.

- *Inspiration for concepts:* It is common practice among designers to base their designs on some sort of theme or inspiration. These inspirations are typically derived from many sources such as a mood board, persona document, assumptions and understanding about the user/user group, competing products, technology, etc. The observations in this parameter were based on the sources of inspiration which the students used for their design. The observations were derived from the exploration and final concept

sketches, mood boards, and the portions of the transcripts where the participants were explaining their designs.

- *Sketching:* The act of putting pen to paper is the most important part of the design process, where thoughts and ideas in the mind are translated to a tangible form. The importance of sketching and the reason for considering the sketches has already mentioned (Section 3.3.1 – Number of exploration sketches). While the number of exploration and concept sketches has already been considered, this parameter is concerned with qualitative aspects such as view (front view, profile view, top view, or in perspective), which suggests a preferred visualisation form, the transformations observed from one sketch to another and the level of abstraction in the sketches.

  According to Goel (1995), as the design process moves from the preliminary stage towards the detail design, design sketches also move from being unstructured to more precise, with two kinds of transformations occurring: lateral and vertical. Lateral transformation is associated with more unstructured sketching along with leaping from one idea to another. Vertical transformation is associated with more detailed and structured sketching in conjunction with detailing aspects of the product being designed. Similarly, the level of abstraction for the sketches was examined, i.e., detailed exploration sketches versus abstract exploration sketches. The main sources of observations for this sketching parameter were the sketches submitted by the participants and the video recordings of the participants during the sketching activity.

  The final concept sketches were evaluated separately along various parameters by a panel of experts consisting of experienced practising designers from India and Germany. This aspect of the expert evaluation is dealt with in detail later in Section 3.3.4.

- *Layout and positioning of the elements within the CI:* The design brief for the activity required a plausible solution for the CI including the layout and positioning of the individual CI elements. This parameter considers the actual positioning of the CI and the different strategies used by the participants to arrive at their layout of elements. The main sources for observing the strategies employed were the video recordings and the sketches submitted by the participants.

- *Innovation and extra features:* It was of interest to examine whether the participants included aspects and features beyond those mentioned in the design brief. Here, the inclusion and the basis for inclusion of these 'extra features' to suit the persona were examined. The final concept sketches, the annotation of the sketches, and the participant's explanation of the concept were considered for examination and comparison.

The final analysis to answer the research questions was based on all the quantitative and qualitative aspects given above. Since these are interconnected and cannot be considered in isolation, the results are therefore presented as a combination of the quantitative and qualitative aspects. Analysing and presenting the results in a combined fashion also provides the

relevant explanations and justification of the various similarities and differences observed in the design and design process of the participants.

3.3.3 Reflective interviews

As mentioned earlier (Section 3.2.4), reflective interviews with participants were an important source of information and data to answer the research questions. The reflective interviews served the dual purpose of clarifying and validating the researcher's observations and providing an insight into the design process the participants follow for other industrial/product design projects. The basic contents of the reflective interview revolved around clarifications of certain observations made by the researcher during the activity, the typical design process the participants would follow for other normal design projects, and a reflection and comparison of the participant's approach during the two activities. The reflective interviews were transcribed just like the other parts of the activity (but not coded for time or transitions) and these transcripts are the main source of data for the analysis. The data from these interviews were compared to the actual approach and process followed during the design activities to draw overall comparisons and conclusions.

3.3.4 Expert evaluation of the final designs

As the research questions involve both the design and design process, it was necessary to evaluate the final concept sketches produced by the participants. Evaluation of the concepts by a group of experts was the most suitable method for obtaining insightful and unbiased opinions on the concepts. The final concepts were in the form of sketches and 28 sketches would be a challenge for actual users to evaluate.

In this regard, Razzaghi (2007) has effectively employed the derived cultural dimensions of CPR (Continuum of People Relations), CCC (Continuum of Context Communication) and CUS (Continuum of Uncertain Situations) as the parameters to understand the influence of the designer's culture on their design. However, the set of dimensions used by Razzaghi (2007) or Hofstede (2001) are not applicable in the context of this thesis. The lack of clear understanding of relationships between the dimensions and the relationship between personal versus cultural limits the use of dimensions to compare designs (Taras et al., 2009). The nature of the design brief compared to that by Razzaghi (2007), who provided a more open and general design brief for designing a personal communication device, further limits the use of cultural dimensions for evaluation. Therefore, it was decided to adopt an approach followed by Dorst (2001), where the overall quality of the design was measured by group of experts along a set of parameters that were created to suit the purposes of the study.

As in Dorst (2001), evaluation parameters were created to not only evaluate the general usability, expressiveness, and aesthetics of the proposed concepts but also evaluate how well the designed concept would be acceptable to the target personas. In order to obtain a fair evaluation of the concepts from the perspective of both cultures, experts from both India and Germany were contacted for the evaluation.

For the evaluation exercise, experts with a minimum of 5 years of professional experience in industrial/product or automobile design were approached. All experts who participated in the evaluation were also experienced in designing for both international and local markets and therefore were able to relate the study and its evaluation. In all, 28 final concepts (not sketches, i.e., a final concept was sometimes represented by more than one sketch) were generated (14 participants x 2 concepts per student) that were evaluated individually by a group of four experts (two from India, two from Germany). Some examples of the final concept sketches considered for evaluation are shown in Appendix 10.7

Parameters for evaluation

The evaluation parameters were broadly categorised as "Culture-concept Fit (CCF)", "Usability", and "General Impressions". The CCF and usability categories were evaluated from the perspective of target persona documents. The general impressions category was based on the experts' personal opinions and judgements of the concepts. The various parameters in these categories are listed below.

The CCF category was evaluated from the target persona's perspective and is a summation of the following parameters scored on a scale of 1 to 10 by the experts, for a maximum of 50.

- *Form:* The three dimensional aspects of the concept such as the housing, the shape of dials, etc.
- *Layout of elements:* The overall arrangement and positioning of the individual elements of the CI, such as the indicator lights, speedometer, odometer, etc.
- *Features:* The inclusion of additional features or possibilities beyond the requirements of the design brief to suit the needs of the persona OR the re-representation of the elements in the design brief to suit the needs of the persona.
- *Colour treatment and finish:* The overall colour treatment for the CI housing, the dial, and the various elements of the CI along with the material and surface finish suggested for the housing. To reiterate: even though the concept sketches were made with little or no use of colour, the participants described the desired colour treatment and finish for their concept either verbally to the researcher or through annotations on the sketch made. These descriptions were explained to the experts individually before evaluation.
- *Overall impressions:* This parameter concerns the experts' overall impressions of the concept's suitability to the target persona. The 'overall impressions' score is not necessarily related to the other scores in the CCF category because there is a possibility some concepts could be individually very good but might fail to impress as a whole. This parameter is introduced to accommodate aspects of CCF that the expert might consider are not covered in the other parameters.

Like the CCF category, the usability category was evaluated from the perspective of the target persona. It is identified here as a summation of the following parameters, once again scored on a scale of 1 to 10 by the experts, adding up to a maximum of 40.

- *Visibility of system status:* The ability of the concept to clearly display the current status of the vehicle such as the speed, fuel situation, engine temperature, etc.

- *Prioritisation of information/elements:* Since the CI display supports different kinds of information, it is important that the information the user (target persona) requires is easily accessible when needed. The prioritisation and layout of the various information units and elements are evaluated under this parameter.
- *Consistency and standards:* Given the different kinds of elements and information supported by the CI, the information presentation (text, symbols, colour, etc.) must be consistent so as to not overwhelm and confuse the user. This parameter evaluates the consistency of information representation from the target persona's perspective.
- *Overall usability:* The general impression of the usability of the concept in relation to the target persona. This parameter was introduced to cover aspects of usability the experts might consider in addition to the other parameters.

The above parameters were derived from Nielsen's heuristics (Nielsen, 1994), which describes the various parameters for heuristics evaluation of usability. Although these parameters are primarily for the evaluation of human-computer interfaces, some aspects are applicable in the context of this study.

The "general impressions" category is a summation of the parameters such as Clarity and presentation of the concept, Aesthetics and design, Expressiveness (referring to the emotion of the concept), and Completeness of the concept with respect to the design brief (where it is seen whether the elements from the design brief have been considered in the final concept). These parameters were not based on the target persona but instead based on the expert's personal opinion and judgement of the concepts.

The evaluation of the concepts according to the parameters in the "general impressions" category helps to answer the question of the influence of the designer's culture on design, while the CCF and usability scores help answer the question of the influence of culture on design for familiar and unfamiliar cultures. The individual scores for all the concepts given by all the experts were added together and averaged for the various groups as per the requirements of the research question. For example, the CCF score for Indian students designing for the German persona was compared with the CCF score for the Indian students designing for the Indian persona. The parameters listed above, in combination with the reflective discussions and comments during the in-depth expert evaluations, were used for the analysis to answer the research questions.

Procedure for the evaluation exercise

Each of the four experts evaluated the final concept sketches individually, with each round of evaluation of the 28 concepts lasting about 60-70 minutes. The expert evaluation procedure was divided into four phases (preparation, closed card sorting, and in-depth evaluation, which had two sub phases, and reflective discussions of the evaluations). The activities in each of the four phases were as follows:

Phase 1 – Preparation: The preparation phase entailed describing the purpose and structure of the evaluation exercise. Since two of the parameters for evaluation were CCF and usability, it was necessary to explain the two personas in detail and reach a common understanding with

the experts of the requirements for the two personas. This was done to minimise the influence of the expert's own culture on the CCF and usability scores, which seemed to play a role during the pilot studies of the expert evaluation. It was found that all experts had up to 80% common understanding (based on the keywords generated by each of the experts for the personas) of the personas and, therefore, there was no additional requirement to develop a common framework to evaluate the CCF and usability. Once the experts were clear about the personas and the structure of the evaluation exercise, the researcher moved on to the card sorting phase of the activity.

Phase 2 – Closed card sorting: In this phase, the experts were asked to guess the country of origin of the concept sketch (German or Indian student) and also the target persona of the concept sketch (German or Indian persona), i.e., by a German student for the German persona, by an Indian student for the Indian persona, by a German student for the Indian persona, or by an Indian student for the German persona. The objective of this phase was to capture the qualitative information in terms of the obvious cues from the concept sketch that the experts picked up on to decide on the classification, which in turn would indicate typicality of design by an Indian or German student or for the Indian or German persona. The card sorting data was not subjected to any sort of quantitative analysis.

For this phase of the evaluation, the annotations on the concept sketches were digitally removed before presenting them to the experts for sorting/classification. This was done to remove clues regarding the country of origin, as the German students annotated in German and the Indians in English. However, each concept was briefly explained to the expert by the researcher before the expert sorted the concept into one of the four categories mentioned earlier. Figure 8 shows an example of one of the concept sketches that was presented for card sorting with digitally removed annotations. All the concepts generated by the participants were sorted in this manner by each of the experts.

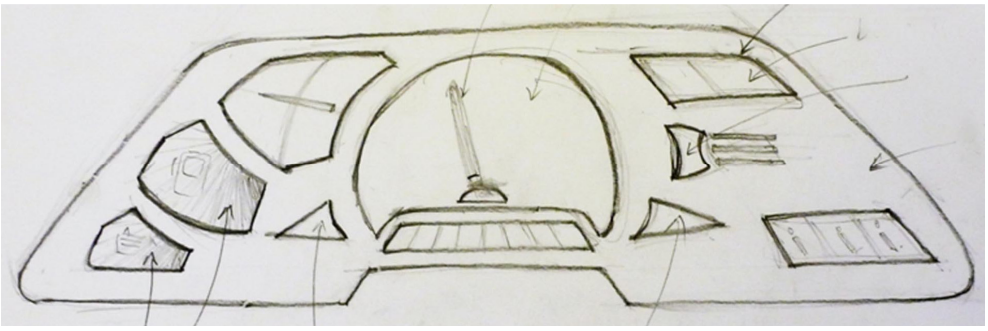


Figure 8: Example sketch used for card sorting with the annotations removed

Phase 3 – In-depth evaluation: In this phase, the researcher individually showed the expert the original annotated concept sketches and explained the concept in detail as described by the student during the activity. Figure 9 shows an example of one of the concept sketches with annotations used for in-depth evaluation. The explanation of the concept included aspects such as the target persona for the concept, colour combination, material, finish, positioning of the CI in the dashboard, and other details of the final concept as per the student's description.

Based on the explanation from the researcher, the expert evaluated the concept along the parameters described earlier.

This in-depth evaluation from the experts was divided into two sub-parts. During the first part of the evaluation, the parameter categories of CCF and usability were evaluated from the perspective of the target persona. In the second apart of the evaluation, the expert evaluated the design in terms of the parameters in the general impressions category from their own personal standpoint. This two-part in-depth evaluation was repeated individually for all the concepts generated by the participants. The comments from the experts during the course of the evaluation were also recorded and used as additional inputs for the analysis. Here, it must be noted that in order to reduce the burden on the experts, all concepts made for a particular persona were evaluated together before moving on to the concepts made for the other persona.

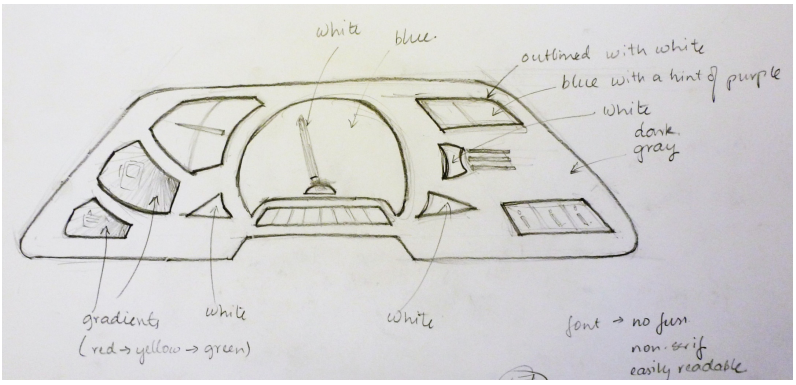


Figure 9: Example sketch used for in-depth evaluation with all annotations and descriptions

Phase 4 – Reflective discussions of the evaluation: The final phase of the expert evaluation was an open-ended discussion with the experts on the cultural influence on the concepts generated. During this discussion, the experts shared their opinion about “typical design for Germany”, “typical design for India”, “typical design by an Indian” and “typical design by a German” based on the concept sketches they had just evaluated. Key aspects of these discussions and opinions were noted down by the researcher and used as further inputs during analysis.

Appendix 10.6 shows the evaluation form that indicates the procedure followed during the course of the evaluation. Appendix 10.7 shows some examples of the concepts from the design activity evaluated by the experts.

3.4 Results

From the analysis measures described, it is clear that some measures can be associated with each other. For example, percentage of time spent on ‘form exploration’ could be related to the number of exploration sketches done by the participants of the study. Therefore, the description of the results here combines multiple qualitative and quantitative measures to answer the four research questions. This combination of multiple measures to present results also helps in validating the findings. The results presented here are further discussed in Chapter 6. The first two research questions were answered using the measures and observations from the

participants' recorded design activity and the reflective interviews; the final two were answered using the expert evaluation of the final concepts and the associated comments and feedback.

In this section, the results are first described in relation to each of the research questions individually, followed by a general description of the typical design process as captured by the reflective interviews with the participants.

1a. Is there a difference in the design process and approach followed between designers from different cultural backgrounds?

The main parameters to compare the design process and approach followed by German and Indian students while designing for the two target personas (cultures) were the total percentage time, the number of transitions, the number of exploration sketches, and the associated qualitative measures.

Figure 10 shows the percentage of total time spent by the two groups of students in the various steps of the design activity. It must be noted that these measures include both activities performed by each student, i.e., the design activity for both the Indian persona and the German persona (n = 14 x 2).

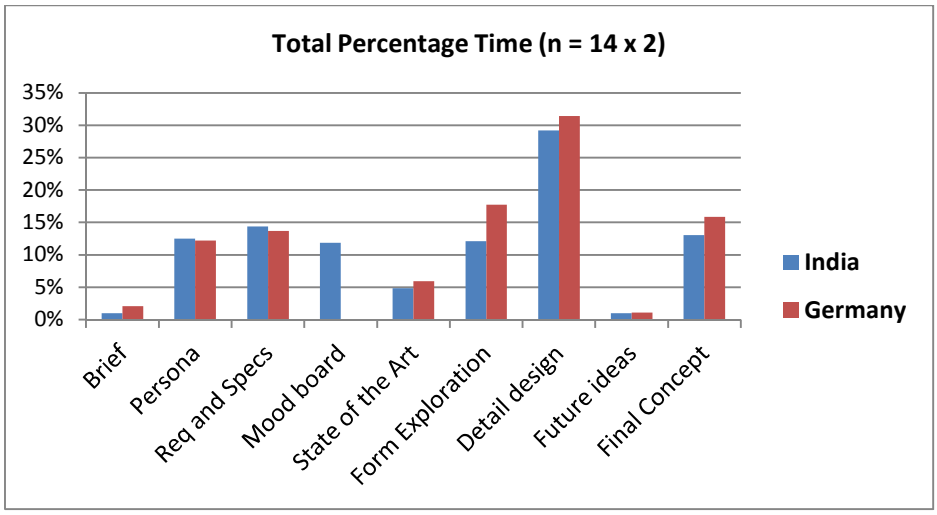


Figure 10: Total percentage time spent by participants in the various steps of the design activity

From Figure 10, there is little difference visible in the percentage time spent by each group on most steps of the design process. However, differences can be observed for two specific steps: use of the mood board and form exploration. These two differences are associated with each other and the other measures of analysis.

Mood boards – It was found that most Indian students created a mood board in order to better guide their design efforts. The mood boards were combined with image searches on the internet around the keywords and images extracted from the persona document. Students went through the mood board exercise for inspiration and used state of the art research through competitor product evaluation to benchmark the trends and designs. However, none of the German students created any sort of mood board for their design, although they did employ some benchmarking and state of the art research. German students were also seen to be guided to some extent by the images presented in the persona document. Tables 4 and 5 show

how the difference in using and not using mood boards translated to the number of transitions and the number of units of information considered from the persona document.

Table 4: The number of transitions between the various steps within the design activity

	Total
Indian Students (Avg / SD)	488 (35/7)
German Students (Avg/SD)	366 (26/6)

Table 5: The number of units of information from the persona document considered during the design activity

	Total
Indian Students (Average)	**130 (9.2)**
German Students (Average)	**114 (8.1)**

As seen from Table 4, the increased number of transitions by the Indian students is because of the mood board exercises, which involved constant referring to the persona document to extract keywords and to search for images related to the keywords on the internet. This fact is further emphasised in Table 5, which shows the Indian students considered more units of information from the persona document compared to the German students, even though the percentage time spent was similar. Here, it must be noted that the measure of number of units is based only on those units explicitly mentioned (said aloud or written down by the participant); therefore, these scores cannot be directly associated with the percentage of time spent in either the persona step or the requirements and specification step.

The use (or not) of a mood board also results in different amounts of time spent in form exploration, as seen in Figure 10. Since the German students did not carry out the mood board exercise, they spent more time exploring forms. The Indian students, on the other hand, spent comparatively less time on exploring forms as their mood board exercise tended to give them a definite direction for design. This fact is emphasised by Table 6, which shows the number of exploration and concept sketches made by the Indian and German students. From Table 6 we can see the comparatively higher percentage of time spent by German students in form exploration (Figure 10) translates to more exploration and final concept sketches.

Table 6: The number of exploration and concept sketches carried out by the Indian and German students

	Total
Indian Students (Final concept sketches)	**44 (18)**
German Students (Final concept sketches)	**58 (22)**

Even though the German students did not perform the mood board step during the activity, the students derived inspiration for design from various sources. The sources included competitor products, state of the art research, the persona's passions and possessions as described in the persona document, and general impressions and understandings of the target culture. Some German students also used an existing CI design as a guide for their design. On the other hand, the Indian students almost exclusively relied on mood boards and the semantic activity thereafter for inspiration. An interesting characteristic observed among the Indian students was the practice of *image mapping*. During image mapping, a particular image or form is force-fitted into the required product, i.e., a literal 1:1 transfer of a form created for a different purpose being translated to suit the needs of the current design brief (Figure 11). The reflective interviews with the Indian students regarding their inspiration for concepts further emphasised the reliance on the mood board exercise and subsequent semantic activity for design.

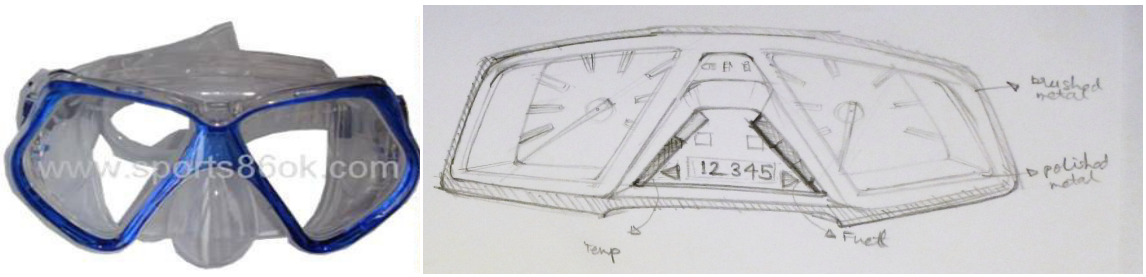


Figure 11: An example of the practice of image mapping by some of the Indian students[6]

Even though Figure 10 shows there was not much difference in the percentage time spent in detail design, qualitatively there were differences to be found. It was observed from the sketches and the overall design activity that the German students tried to address the whole persona and his requirements via features and aesthetics within the space of the CI and its elements, whereas the Indian students considered only the CI and its elements to be expressed according to tastes and preferences of the persona.

Another qualitative difference pertained to the layout and positioning of the CI and the individual elements of the CI. The two groups of students had different approaches to the overall positioning or consideration of the positioning of the CI. None of the Indian students exclusively thought about the actual positioning of the CI in the context of the car interior. All their designs had the CI positioned in the traditional space (i.e., behind the steering wheel). However, a couple of designs did have specific elements of the CI such as outside temperature being displayed on either side of the steering wheel or on the middle console. In contrast, all the German students consciously went through the process of considering the overall positioning of the CI in the context of the dashboard and car interior. This was typically done by drawing a rough sketch of the car interior and/or imagining themselves viewing and using the CI at different positions, with the final decision being based on personal choice and comfort.

[6] Image Source: http://img.diytrade.com/cdimg/1061512/11886847/0/1275297082/scuba_diving_gear_dive_mask_diving_mask_diving_accessories_swimming_goggles.jpg Last accessed 1.09.2014

As well as the points of difference given above, the actual layout and positioning of the different elements of the CI were subject to a variety of strategies from both groups of students. All students were seen to employ some sort of prioritisation and grouping to the individual elements of the CI. The prioritisation was broadly based on three criteria, albeit used differently by different students. The first approach of prioritisation and grouping was based on the functionality of the elements, independent of the persona, e.g., one student grouped and prioritised safety-related information, engine-related information, and driving-related information. The second approach for prioritisation and grouping was based on the importance of a particular kind of information to the driver while driving (here too the persona was not considered), e.g., driving-related information, safety-related information, and non-driving related information. These two approaches to prioritisation were based purely on the students' personal preferences and understanding of the elements and their functionality. The third approach to prioritisation was based on the needs and requirements of the persona. For example, one Indian student decided that fuel and economy and mileage were important and therefore were important to the Indian persona, and therefore these were given prominence in the design. Overall, the German students tended to choose between the first and third approaches depending on the target persona, while the Indian students tended to choose between the first two approaches, wherein the prioritisation of the elements was almost exclusively based on the functionality of the elements and importance to the driver.

Two similarities and differences observed between the German and Indian students which cannot be captured quantitatively were related to the sketching activity and approach to innovation and extra features beyond those mentioned in the design brief. In general, students from both India and Germany approached the sketching activity in a similar fashion. Students always sketched the outer form of the CI first and then began sketching the layout and positioning of the individual elements. It was observed that students from both groups sketched fairly abstract forms and elements during the exploration phases of the activity. At this level of abstraction, the students focused on the overall form, i.e., housing of the CI, the main dials (speedometer and tachometer) and some placeholders for the other main elements such as fuel and indicators. The final concept sketch, however, was fairly detailed, with descriptions for colour treatment, material, and the states of the elements in different scenarios, with placeholders or actual icons for most or all of the elements mentioned in the design brief. Similar practices were observed with regard to transformations during the sketching activity (see Section 3.3.2 for the definition of transformations): for both groups, lateral transformations were practised for the housing/outer form of the CI and vertical transformations for the layout and positioning of the individual elements. Similarly, the sketches were primarily expressed in the front view, with some students expressing the housing aspect of the CI in perspective. However, this can be put down to the nature of the design brief/product.

The differences between the two groups during sketching was the consideration of the context of the CI, i.e., car interiors and steering wheel, position of the steering wheel (left-hand drive vs. right-hand drive). It was observed that most German students sketched out the car interior for a better understanding and explanation of the final concept. Taking the car interiors into consideration also helped them better decide on the final form selection and positioning of the

CI. However, the Indian students, other than a couple of exceptions, seemed to consider and sketch the CI as a single unit without taking the car interior into consideration. Even among the two who did, one only did so for the final explanation of the concept while the other did so to help decide and later explain the angle at which the CI would be housed on the dashboard.

A further difference between the groups was observed with the exploration sketches. Most of the German students tended to explore symmetric design options, with only three exceptions among the 14 design activities. The three asymmetric options were explored for the Indian persona. While the Indians also mostly explored symmetric options, there were a higher number of exceptions: 7 asymmetric options were explored across the 14 design activities. These seven asymmetric options were explored for both Indian and German profiles (three for the Indian persona, four for the German persona).

In addition, there was a tendency among some German and Indian students to interpret the design brief and persona document in relation to their own cultural context. This led to explicit focus on a certain aspect, thereby affecting the overall design. For example, the Indian persona rides a motorbike to work. Although owning a motorbike is very common in India, it is rather uncommon in Germany. Thus a German student interpreted the Indian persona as someone “sporty” and “active”. This interpretation resulted in a conscious effort to evoke a sporty form and an extra effort by the German students to incorporate design elements from the motorbike into the CI.

The final difference observed in the design process and approach followed by the Indian and German students related to innovation and extra features incorporated into the designs. The German students included many features in addition to those listed in the design brief for the persona within the CI. This was particularly done for the Indian persona, who was understood to have a very active social life and therefore various social networking features (e.g., video phone, ability to read Facebook message feed, etc.) were included in the CI. These features were also detailed in terms of their functionality and states in different scenarios. This can be related to the positioning of the CI in the dashboard, i.e., the inclusion of these extra features warranted a review of the positioning of the CI on the dashboard, which in turn meant considering the whole context of the car interior. These extra features were persona-specific and derived by taking the whole dashboard into consideration. For example, one student integrated the CI into the middle console, which in turn was integrated into the entertainment, navigation, and climate control units.

On the other hand, while few Indian students provided a space for additional features, none of them described precisely what those features would be, and loosely labelled them as “future expansions” or “extra info”.

In summary, except for the differences created by the use (or not) of mood boards (i.e., differences observed in percentage time spent on form exploration, number of transitions, number of exploration sketches, number of units considered from the persona document), quantitatively there were little difference in the overall steps in the process taken by the Indian and German students. Qualitatively, however, there were many differences, seen in the sources of

inspiration for design, strategies employed for the layout and positioning of the CI and its individual elements, the context considered for design and the sketching activity, and differences in the features incorporated into the design above and beyond those mentioned in the design brief.

1b. Is there a difference in the design process and approach followed when designing for a familiar culture versus an unfamiliar culture?

For this question, an Indian student designing for the Indian persona and a German student designing for the German persona is referred to as 'designing for the familiar', whereas the design process and approach followed by Indian and German students when designing for the other persona/culture is referred to as 'designing for the unfamiliar'. The main parameters considered to answer this research question are once again total percentage time taken, number of transitions, number of exploration sketches, and the associated qualitative measures derived from the reflective interviews, transcripts of the recordings, notes, sketches, and annotations from the participants.

Figures 12 and 13 show the total percentage time spent by Indian and German students while designing for the familiar and unfamiliar audiences respectively. Since each student designed for both the familiar and unfamiliar, we get seven designs for the familiar and seven designs for the unfamiliar (n = 7+7) from each of the two groups of students.

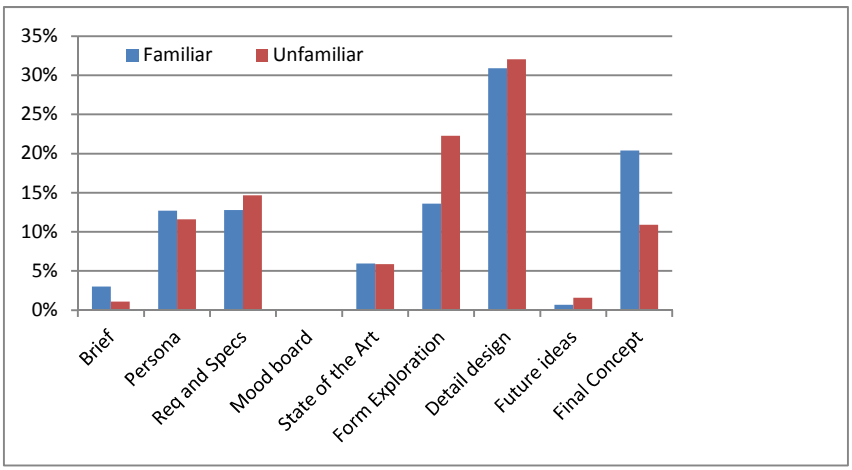


Figure 12: Percentage times while designing for familiar vs. unfamiliar – Germany (n = 7 + 7)

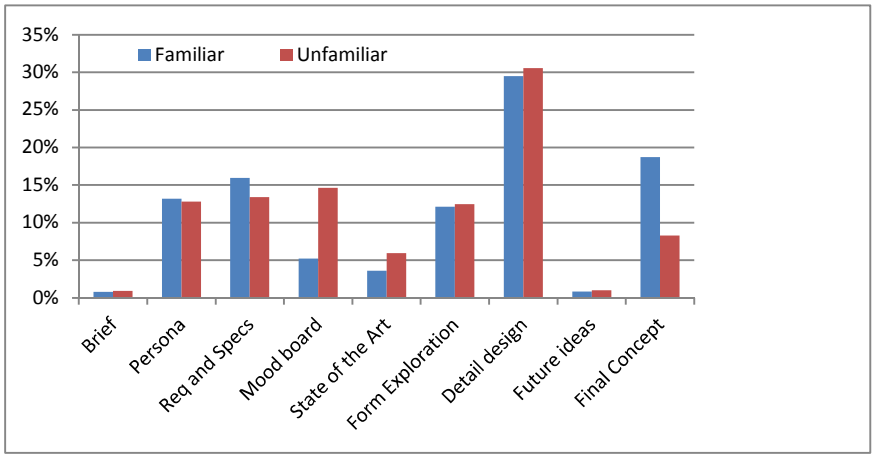


Figure 13: Percentage times while designing for familiar versus unfamiliar – India (n =7 + 7)

From Figures 12 and 13, it can be seen that overall there is little difference between the process steps and the percentage time spent in each step between familiar and unfamiliar, except for the mood board step for the Indian students, the form exploration step for the German students, and the final concept for both groups. The figures above confirm that the target culture (persona) did not influence the process in terms of the steps followed; however, the target culture influenced the effort (time spent) and approach during certain individual steps.

A similarity observed across both groups of students was increased percentage time spent on the final concept for the familiar in comparison to that for unfamiliar. This suggests that familiarity of the profile gives students confidence to detail out the final concept in terms of colour combinations, suggestion of material, detailing and placement of the individual elements, etc. On the other hand, while designing for the unfamiliar target audience, the students seem to be less confident and assured about the colour combinations, the materials, and finish despite the availability of a detailed persona document, their own state of the art research, and mood boards. This uncertainty led to a relatively quick description of the final concept.

Qualitatively, it was seen that a lot of the aspects of the design were decided based on the students' own perceptions and understanding of the unfamiliar persona. There were differences observed in the students' approach in certain individual steps of the design process while dealing with a familiar and unfamiliar target culture. Table 7 shows the differences in the numbers of transitions for the familiar and unfamiliar. The Indian students spent comparatively more time on the mood board step for the unfamiliar, which meant they had more transitions because they considered more units of information from the persona document (see Table 8). This suggests that the Indian students dealt with the unfamiliarity of the culture by considering more units of information to come up with a more informative mood board to guide their design. But the smaller number of exploration sketches for the unfamiliar compared to the familiar (see Table 9) can be attributed to the use of the image mapping technique described earlier, where the unfamiliarity with the cultures led to more image mapping being used. The intimate knowledge of the familiar culture, on the other hand, gave the students more confidence to explore variations and options, resulting in comparatively more explorations. This accords with the findings from the previous section: that the increased percentage of time spent by the Indian students on the mood board steps resulted in more transitions and more units considered from the persona document.

In contrast, the German students had fewer transitions for the unfamiliar (Table 7) but considered more units of information (Table 8) and had more exploration sketches for the unfamiliar (Table 9). An insight into these findings can be obtained from the reflective interviews and notes taken during the activity, which indicated that the Indian persona was so different from the familiar German persona that the students extracted a lot more units of information from the Indian persona document compared to that for the familiar German persona (Table 8). These extracted units of information were then taken forward to the sketching activity. The smaller number of transitions (Table 7) is a direct reflection of the form exploration exercise, which involves exploring multiple options around a set theme or keyword. This is further emphasised by the number of exploration sketches for the unfamiliar, which was comparatively higher than the number for the familiar (Table 9).

In general, the unfamiliarity of the target persona resulted in the students from both cultures considering more units of information for the unfamiliar than the familiar. However, the different strategies of mood boards and form exploration employed as a result produced a disparity in the numbers for transitions and exploration sketches. Design for the familiar also resulted in more explicit assumptions being made by the students, as seen in Table 10. These assumptions on some occasions resulted in the students' personal preferences overruling those of the persona.

Table 7: The number of transitions between the various steps within the design activity

	India	**Germany**
Indian Students (Avg / SD)	230 (34/5)	258 (35/7)
German Students (Avg/SD)	173 (24/6)	193 (27/6)

Table 8: The number of units of information from the persona document considered during the design activity

	India	**Germany**
Indian Students (Average)	56 (8.0)	74 (10.5)
German Students (Average)	67 (9.5)	47 (6.7)

Table 9: The number exploration and concept sketches made by the students during their design activity

	India	**Germany**
Indian Students (Final concept sketches)	26 (8)	18 (9)
German Students (Final concept sketches)	34 (12)	24 (9)

Table 10: The number of explicit assumptions mentioned during the design activity

	India	**Germany**
Indian Students (Average)	15 (2.1)	9 (1.2)
German Students (Average)	7 (1)	11 (1.5)

It was observed that students focussed on different aspects of the persona document while designing for the familiar and the unfamiliar. For example, if the persona's fashion sense and possession was the focus while designing for the unfamiliar, the persona's comments and lifestyle was the focus while designing for the familiar.

The location of the steering wheel (right-hand drive/left-hand drive) did not seem to influence the design or the approach, per se, but it did affect the sketching activity. The students found

sketching for the unfamiliar difficult and limiting, especially the German students who kept the whole context of the car interior in mind during sketching. The workaround adopted was therefore to sketch for the familiar and then swap it around for the final concept sketch. This factor did not affect the Indian students, because they considered the CI as an independent unit for design.

The other important difference observed was in the strategies employed with regard to the layout and positioning of the CI and its elements. As mentioned in the previous sub-section, the students used three main strategies to decide upon the prioritisation of the CI elements. These strategies were based on the functionality of the individual elements, their importance to the driver, and the requirements of the persona. The German students tended to choose between the first and third approaches depending on the target culture/persona, i.e., based on the functionality of the elements for the familiar but based on the requirements of the persona for the unfamiliar. On the other hand, Indian students tended to use the two strategies of either prioritising based on the functionality of the elements or based on the importance of the element to the driver interchangeably, without any particular trend towards the familiar or unfamiliar.

Reflective interviews about the design process for familiar vs. unfamiliar outside of this activity revealed a few differences (i.e., how would the student typically go about designing for the unfamiliar without the constraints or conditions of this activity)? Every student said they would carry out additional research while designing for the unfamiliar, whereas they would assume and design based on personal experience while designing for the familiar. This additional research would typically involve benchmarking of competitors, colour trends, lifestyle, communication aspects, context of use, etc. For the overall approach, some students mentioned that designing for the familiar gave them a wider perspective and easier orientation for design, whereas designing for the unfamiliar resulted in the focus being restricted to the design brief, making orientation harder. This agrees with the findings from Kruger & Cross (2006), who differentiated between knowledge-driven design and information-driven design. Design for the familiar generally meant knowledge-driven design, whereas design for the unfamiliar meant information-driven design.

Despite these similarities and differences and the general comfort and confidence of the students in designing for the familiar, several students mentioned that their design was based solely on the persona, and the culture or country of the persona played a minor role in their design. In addition, one of the students mentioned that designing for the unfamiliar is a better way to ensure “good” design, because the designer is forced to distance himself from his own environment and therefore pays more attention to the persona and the target culture. When designing for the familiar, there is a risk of the designer designing for himself under the assumption that all users are like him.

In summary, it was found that the target culture did not influence the steps followed during the design process; however, it did affect the approaches within particular steps of the process. The design for the unfamiliar resulted in more units of information being considered from the persona, which led to different approaches from the two groups of students. The Indian

students invested more effort in the mood board exercise, whereas the German students invested more effort in form exploration. Differences were also found in the strategies employed to prioritise the elements of the CI, the assumptions made, and the kinds of information considered from the persona document. Similarities were found with respect to the time and effort invested in the final concept step of the design process, where familiarity led to greater time being spent in detailing of the final concept.

Influence of the first design activity on the second in the study: As mentioned at the beginning of the chapter, the study design required each student to design for two personas. In order to minimise the influence from one activity to another, the order in which the design personas were presented to the students was randomised (Table 2), with at least a day between the two activities. Looking at the total percentage time (Figure 14) and the number of transitions (Table 11), the first activity had little influence on the second activity, i.e., the steps and percentage of time spent on each step of the design activity were similar.

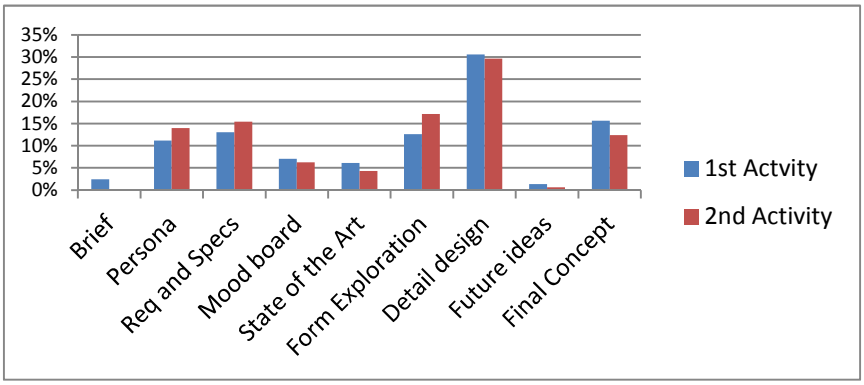


Figure 14: Total percentage times for the first design activity versus the second (n = 14 + 14)

Table 11: Number of transitions in the two design activities (n = 14 + 14)

First activity	424
Second activity	413

Even though the numbers did not show any major difference between the two activities, some general trends were observed; however, these trends did not adversely affect the data gathered for this study. First, it was found that there was a certain optimisation between the first and second activities, primarily in terms of not repeating certain fixed aspects of the activity. For example, researching the standard symbols and icons for the various elements of the CI was not repeated. Further, there was some knowledge transfer from the first activity to the second, with some Indian students employing the same prioritisation and grouping strategy for the CI elements between activities, with few decisions based on the persona.

Second, even though there was a gap of at least a day between the two activities and no sketches from the previous activity were shown, there was a subconscious effort by the students to compare the outcomes of the two activities and therefore attempt to do something

“different”. This led some students to believe that the outcomes could change from one activity to another.

Both of these effects were neutralised to a large extent by the fact that the designs were to be based on a particular persona and not a simple repetition of the previous activity. In addition, the randomisation ensured that no one persona got the “different” ideas. Further proof that there was minimal influence was provided by the reflective interviews, during which the students were asked to imagine possible changes in the process had the order of the activities been reversed. None of the students believed that their process and approach would change.

Unfortunately, an in-depth examination of the effects of the first activity on the second is beyond the scope of this study. However, the measures adopted are believed to have kept the effects to a minimum.

Typical design process

One of the most important parts of the design study was the reflective interview after the design activity. During these reflective interviews, amongst other things, the students were specifically asked about their typical design process. This was done to compare and validate the design process followed during the course of the activity with the typical process followed outside of the activity. Descriptions in the previous sub-sections provide a clear understanding of the process and steps followed by the student during the design activity. Here, those steps are compared to the typical process followed by the students.

State of the art: Students from both the groups seem to follow similar activities and look for similar kinds of information during this phase. The types of information include culture-specific information about the target user group (lifestyle, context, fashion trends, etc.), benchmarking of competitive and parallel products, information about the technology and its possibilities, and often videos and movies representing popular culture if required. Despite the shared topics, the German students seemed to be more inclined towards researching the technology and competing products, whereas the Indians expressed a tendency for very broad and general research.

User research and contact: Another important step typically practiced but not carried out during the design activity is interaction and contact with the potential end user. This was seen as a step that would be carried out irrespective of how detailed the design brief and persona document were. When designing for an unfamiliar culture, both groups of designers expressed a desire to explore and immerse themselves in the culture and context of the user in person, if possible, to better orient them during design.

Mood board exercises: Even though the two groups used mood boards differently during the design activity, there seem to be similarities in the use of mood boards in the typical design process. Both groups of students stated that mood boards are an important source of information for design. Even though the German students did not use them during the activity, they mentioned it as part of their process, although one considered as generally less important. Once mood boards are created, the Indian students said they typically perform a conscious semantic exercise on the mood board to derive specific design elements from the keywords

for design. This semantic exercise is typically done with colleagues and rarely individually. The German students did not explicitly mention the use of this semantic exercise, but the researcher understood it as subconsciously being carried out.

Prioritisation and grouping of elements: Both groups of students mentioned prioritisation and grouping of elements based on different strategies of element functionality, importance to the driver, and based on the persona. This was witnessed in the design activity.

Concept iteration: One of the critical differences between the typical process and the one followed during the design activity was the involvement of the computer and mock-ups during concept iteration. German students particularly mentioned the use of rough physical mock-ups of different aspects of the design to help in explorations and iterations. Here, the German students make rough mock-ups at intermediate stages of the process to get a feel for the final design and product. Based on the understanding and evaluation of the mock-ups, they come back to sketching and exploring the concepts. The German students also stated that they would use the computer extensively for the detailing aspects of the design. This is also consistent with the practice among Indian students. However, the Indian students did not mention the use of prototypes or mock-ups at intermediate stages. It is understood based on the researcher's experience that the prototypes and mock-ups created by the Indian students are essentially used to explore and detail the final concept; they are not used in the conceptualisation and brainstorming phases of the design activity. Interestingly, the Germans mentioned using a template of an existing or parallel product to guide conceptualisation. The Indian students tended not to use this.

Selection of final concept: The most fascinating and important difference between the two groups is the conscious effort on the part of the German students to achieve a certain amount of distance between the various ideas before making the final selection. The German designers generate a lot of concepts simultaneously and then completely distance themselves from their ideas for a day or two before returning to select the final concept. Conversely, the Indian students see the selection of the final concept sketch as part of the flow of the design activity.

In addition, the German students placed a lot of importance on the creation and retention of intuitive insight and ideas. The German students would immediately explore concepts just based on the brief and persona document before doing any research, so that all the intuitive thoughts and ideas could be expressed and preserved. With these intuitive ideas expressed, they then return to the typical phases of the design process listed above. Once these phases are completed, they go back to their intuitive ideas and reconsider them during the conceptualisation and iteration phases before finalising a concept. The final concept happens as mentioned earlier, with a little distance achieved before selection.

2a. Does the target users' culture influence the design?

Although the process followed during the design activity is important, it is of equal interest to compare the outcomes of the design activity, i.e., the final design concepts. The final concepts were evaluated and compared to determine whether the target users' culture influences the design (design for familiar versus unfamiliar audience) and whether the designers' culture influences the design. The final concepts were evaluated via expert evaluation as described in

Section 3.3.4, where the broad categories for evaluation were culture-concept fit (CCF), usability, and general impressions.

The CCF and usability results pointed to the influence of the target users' culture on the design, i.e., research question 2a. The CCF score consists of parameters such as form, layout of elements, features, colour treatment and finish, and overall impressions (Section 3.3.4). Each of these parameters was rated on a scale on a scale of 1 to 10, with 10 meaning 'best fit'. The CCF score was a summation of the average scores for these individual parameters and had a maximum of 50. Similarly, the Usability scores were a summation of average scores for the individual parameters visibility of system status, prioritisation of information/elements, consistency of elements and standards, and overall usability. The usability score had a maximum of 40.

The average scores from all experts across all concepts for CCF and usability were considered for a particular target persona or group of students. Table 12 shows the average CCF and usability scores given by the experts for concepts from both groups of students (14 students in total) for the Indian and German target user personas (28 concepts). A detailed breakdown of the scores for the individual parameters is provided in Appendix 10.8.

Table 12: Average CCF and usability scores for both groups of students for both user personas

		Culture-Concept Fit (max 50) / SD	**Usability (max 40) / SD**
Indian students (n = 7)	India (n = 7)	34.52 / 1.99	26.52 / 1.50
	Germany (n = 7)	25.00 / 1.60	24.05 / 1.20
German students (n = 7)	Germany (n = 7)	33.05 / 1.83	27.71 / 1.43
	India (n = 7)	28.90 / 1.89	24.48 / 1.57

From Table 12, it can be seen that the usability scores were similar for both groups of students. This indicates that students were sensitive to usability and addressed certain usability issues. This is further evidenced in the qualitative observations during the design activity where the German students used different strategies to prioritise and group elements of the CI, and the Indian students tactically retained and added to their prioritisation and grouping of elements of the CI.

As expected, the CCF score for the familiar culture was higher than the CCF score for the unfamiliar one across both groups of students. This was observed despite the fact that the students carried out extra mood board exercises and form exploration exercises along with state of the art research on the internet and received a detailed persona document. On the other hand, it is possible that the extra time (Figures 12 and 13) the students took detailing their final concept contributed to the higher CCF score for the familiar target persona, but this is effect is kept at a minimum due the evaluation procedure followed.

The differences in the CCF scores indicate that, first, intimate knowledge of the persona/target users' culture plays an extremely important role in ensuring better designs, i.e., higher CCF and usability score. Secondly, the usefulness of detailed persona can be limiting, i.e., even

though the design activity employed similar persona documents providing similar units of information in a similar format, the familiar persona document yielded higher CCF and usability scores than the unfamiliar persona document. This further proves the point that culture (in this case target culture) plays an important role in the design process and its outcomes. This follows the qualitative observation made earlier that there was extensive use of intimate, tacit knowledge in the interpretation and usage of information that led to certainty during the design process and subsequently higher CCF scores for the designs.

In conclusion, the outcomes of the evaluation and the differences in the processes followed indicate that the students needed more information which they could relate to and employ directly in their design process to ensure better designs for unfamiliar cultures.

2b. Does the designers' culture influence the design?

The second research question with regard to the students' final concept sketches was to examine whether the designers' culture influences the final design. A two-pronged approach was taken. First, a direct evaluation of the concepts was conducted, as explained earlier (Section 3.3.4), and second, the qualitative observations and opinions of the four experts over the course of the evaluation were considered. The qualitative observations were taken from the closed card sort activity carried out by the experts before the in-depth evaluation of the concepts.

From the in-depth evaluation, the general impressions category was considered. This category consisted of individual parameters such as clarity and presentation, aesthetics and design, and expressiveness. Each of these parameters was scored on a scale of 1 to 10, with 10 being the highest. It must be reiterated that the critical difference between the evaluation for CCF and usability versus general impressions is that the former were persona-specific whereas the latter was based on the experts' individual opinions and preferences. Table 13 shows the average scores for all concepts across the two groups of students, as scored by the group of experts for the general impressions category.

Table 13: Average and standard deviation scores for all concepts by the 4 experts under General impressions

		Clarity and Presentation (max 10)		Aesthetics and Design (max 10)		Expressiveness (max 10)	
Indian students (n = 7 x 2) concepts	IND	**6.45 (SD 1.4)**	6.71 (SD 1.66)	**5.78 (SD 1.8)**	6.33 (SD 1.77)	**6.16 (SD 1.8)**	6.57 (SD 1.94)
	GER		6.19 (SD 0.90)		5.24 (SD 1.03)		5.76 (SD 1.20)
German students (n = 7 x 2) concepts	IND	**6.40 (SD 0.9)**	6.24 (SD 1.12)	**5.81 (SD 1.5)**	5.52 (SD 1.75)	**5.81 (SD 1.6)**	6.10 (SD 1.81)
	GER		6.57 (SD 1.37)		6.10 (SD 1.96)		5.52 (SD 2.19)

The expressiveness scores indicate the Indian students were more expressive with their final designs than the German students. The expressiveness scores follow a trend of popular belief that Indian audiences prefer loud, playful, and emotional design (i.e., more expressive) in comparison to German audiences, who are believed to prefer minimal, conservative designs (i.e., less expressive). Despite the general trend mentioned above, it is difficult to discern specific trends in the influence of the designers' culture on the final concept from the expert evaluation numbers shown in Table 13. Therefore, to sufficiently answer the question it is necessary to look into the qualitative aspects of the design, based on the opinions and comments of the experts from the card sort, during and after the evaluation.

As expected, some concepts were difficult to classify in the card sort due to their neutral nature, but most concept sketches produced a clear guess on the part of the experts regarding the country of origin. Based on the qualitative inputs from the card sorting activity, it was observed that the experts were able to guess the country of origin with a fair degree of success, although there was only moderate success in guessing the target persona/culture of the final concept. The most obvious reasoning for classification was based on overall form of the CI concept and the layout of elements within the CI. The concepts generated by the German students tended to have a traditional layout, with a minimalistic form for the CI. On the other hand, the concepts by the Indian students tended to be more playful and non-traditional. Figures 15 and 16 show examples of designs by a German and an Indian student for both personas, to further illustrate the point made by the experts.

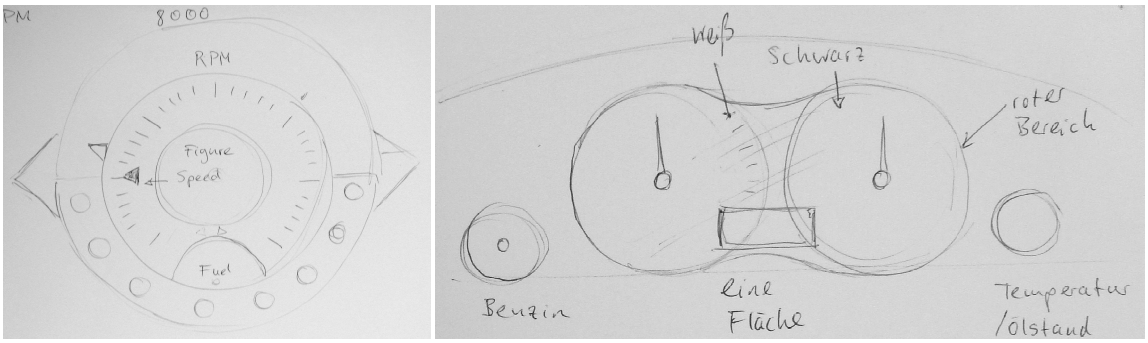


Figure 15: Final concept sketches by a German student for Indian and German personas respectively

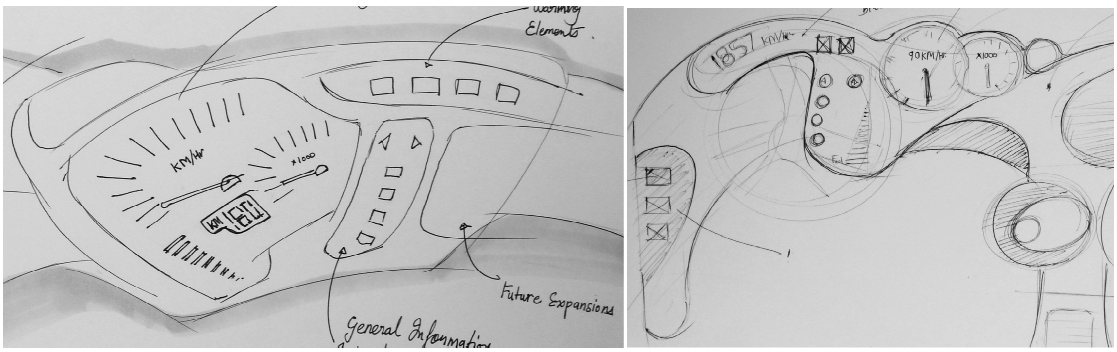


Figure 16: Final concept sketches by an Indian student for Indian and German personas respectively

In addition, the experts noticed several overarching trends across the designs. As seen in the earlier subsection on the design process, the designers' culture influenced the design process in qualitative ways, and the final concept also showed some influences from the designers'

culture. For example, Indian students tended to use “loud” colours and colour combinations such as incorporating blues, whites, and gradients in the CI, even when designing for the German persona which required a slightly more “sober” colour treatment. One of the experts commented that even a “conservative” design by an Indian student would come across as “a little over the top” for the German persona. Although the differences were most obvious in the colour treatment of the CI, differences were also observed in the “forms” for the CI concepts. The German students mostly restricted themselves to relatively simple and minimal forms, with a little bit of play in the “layout of elements”, even while designing for the Indian persona, whereas the Indian students tended to be extravagant and experimental with forms and the layout of elements, even while designing for the German persona. Figures 17 and 18 show examples of the final concept, illustrating the differences in the forms generated for the final concept by an Indian and German student. This complements the reasoning given by the experts during the initial card sorting phase of the evaluation.

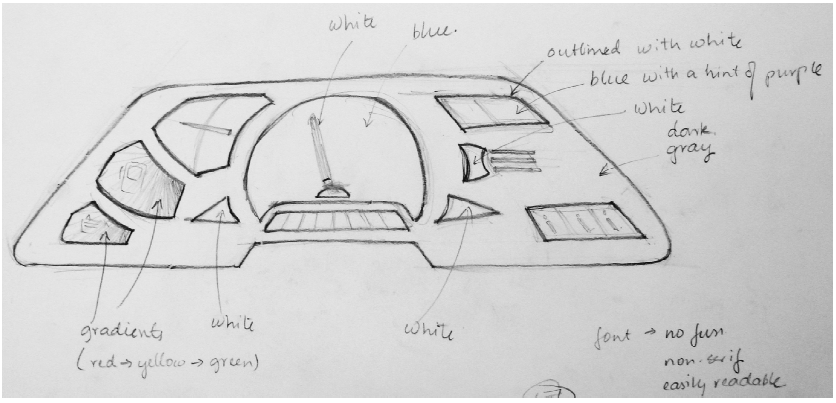


Figure 17: Concept sketch by an Indian student for the German persona

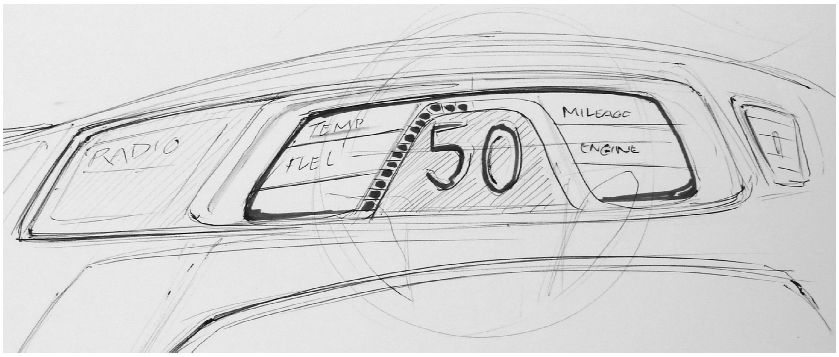


Figure 18: Concept sketch by a German student for the Indian persona

Further qualitative observations on the researcher’s part concerned the symmetric and asymmetric forms of the final concepts. As mentioned previously, the German students generally produced symmetric final concept sketches for both Indian and German personas. Only 3 out of the 14 final concept sketches by the German students were asymmetric, and these asymmetric concept sketches were primarily for the Indian persona. On the other hand, half of the final concepts produced by the Indian students were symmetric, with 4 of them for the German persona and 3 for the Indian persona. These observations are consistent with the comments and opinions from the experts during the card sort activity, where it was mentioned that

the forms by Indian students were more experimental and playful than those by the German students.

Therefore, one can see the designers' own culture, experiences and background influencing the design outcomes. A typical Indian's exposure to colour through Bollywood, traditional festivals and celebrations, traditional Indian clothing, etc. is played out in the choice of colours and colour treatment for concepts, irrespective of the target persona. Similarly, the choice of forms, layout, and priority given to the elements of the CI is influenced by the designers' own experiences of how the CI is used and perceived in their culture. For example, Indian students provided differentiated priorities for the tachometer and speedometer for the German persona, even though the Germans generally prefer an equal priority for these two elements. This was based on the Indian students' experience: the tachometer is not very important in their culture, which in turn translates to asymmetric forms which might not be preferred by the German audience.

In the same way, the German students' culture and experiences influenced the design outcomes. German culture's emphasis on functionality and pragmatism in everyday life translates to a simple, clean, usable layout of elements in the CI, even though the Indian target persona afforded some amount of experimentation. The different colour sensibilities of the Germans in comparison to the Indians meant a "sober" and "subtle" colour palette was preferred, irrespective of the target persona. The word "premium" for example was understood and translated with features into the final concept differently by the two groups of students. A couple of Indian students used cove and/or LED lighting to highlight certain aspects of the CI, while, the German students tended to use a "clean" finish and chrome elements to highlight and express the concept of *premium*. This was observed despite explicit descriptions of what *premium* meant to each of the personas and the students themselves being made aware of the general tastes and preferences of the two cultures through the persona document.

Another interesting trend observed by the experts was that most concepts by the German students, irrespective of the target persona, tended to integrate all the elements and additional features – including the elements mentioned in the design brief – within a single unit of CI. On the other hand, the concepts by the Indian students had the traditional CI elements within the CI and the additional features (if any) laid out on the dashboard. For example, Figure 19 shows how a German student incorporated a social task menu in the CI for the Indian persona in addition to the traditional CI elements mentioned in the design brief. This further emphasizes the difference in approach between the German and Indian students mentioned while answering research question 1a.

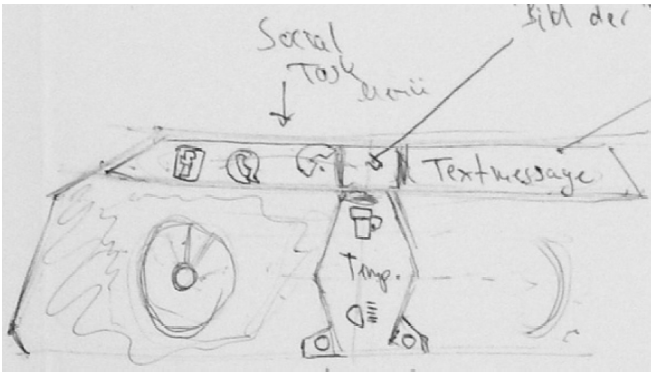


Figure 19: Final concept sketch by German design student showing the integrated social task menu for the Indian persona

From the results, there were obvious influences from the designer students' own culture on the final designs, irrespective of the target persona/culture. These findings are in line with the findings from Razzaghi (2007), where designers' cultural influences and preferences strongly influenced their design outcomes. The differences observed in the end designs in this study can be attributed to the differences in the perceptions and understanding of certain aspects of the design brief.

In conclusion, the expert evaluation and examination of the designs give out two clear messages in addition to confirming the influence of the designer's culture on the design. Firstly, intimate knowledge and understanding of the target persona/culture plays an important role in the success of a design. Secondly, the difference in perception between the designer and the target user/culture is an important parameter to consider when designing for different cultures.

3.5 Summary

Sections 3.1 and 3.2 illustrated the objectives of this study in terms of the research questions, the participants, the design brief and the persona document used in the study, along with the procedure of the design activity.

Section 3.3 described the coding scheme employed for analysis and the various quantitative measures such as percentage of total time, number of transitions, number of units of information considered, number of sketches, etc. Also described were the various qualitative measures for analysis such as interpretation of the design brief and persona, sketching activity, inspiration for the design concepts, strategies employed for the layout of the different elements of the CI, etc. Section 3.3 also described the structure of the reflective interview carried out at the end of the design activity and concluded with a description of the expert evaluation procedure and evaluation parameters under the categories of culture-concept fit, usability and general impressions.

Section 3.4 described the results of the study with regard to each of the research questions along the identified parameters. Due to the nature of the research questions, the questions were answered by considering the qualitative and quantitative perspectives together. For the research question on the influence of the designer's own culture on the design process (1a), it

was found that, except for the differences created by the use (or not) of mood boards, quantitatively there was little difference between the overall steps in the process for the Indian and German students. Qualitatively, however, there were differences seen in the sources of inspiration for design, the strategies employed for the layout and positioning of the CI and its individual elements, the context considered for design and the sketching activity, and the difference in the features/elements incorporated into the design beyond those mentioned in the design brief.

For the second research question (1b), i.e., is there a difference in the design process and approach followed while designing for a familiar versus an unfamiliar culture, it was found that the target culture did not influence the steps followed in the design process. However, it did affect the approaches within particular steps of the process. For example, designing for the unfamiliar resulted in more units of information from the persona being considered, which led to different approaches by the two groups of students. The Indian students invested more effort in the mood board exercise whereas the German students invested more effort in the form exploration step. Differences were also found in the strategies employed to prioritise the elements of the CI, the assumptions made, and the sorts of information considered from the persona document.

Based on the reflective interviews, the typical design process followed by the students of the two cultures was presented in relation to the steps followed by the students during the design activity. Here, it was particularly interesting that the German students consciously tried to achieve some distance from their concept before final selection and made efforts to retain intuitive ideas.

The final part of Section 3.4 dealt with the results related to the research questions on the influence of the target culture and the designer's own culture on the designs. Expert evaluation found that intimate knowledge and understanding of the target persona/culture plays an important role in the success of a design. In addition, it was found that the difference in perception between the designer and the target user/culture is an important parameter to be considered when designing for different cultures. The expert evaluations also confirmed the influence of the designer's own culture on the design, in line with the findings of Razzaghi (2007).

4 A Design Process to Design for Unfamiliar Cultures

Learning from the 1:1 intercultural design studies carried out in the previous chapter led to the development of the modified design process. This chapter begins with a brief overview of the knowledge gained from the intercultural design studies carried out in Chapter 3. The modified design process developed for this thesis is described in Section 4.2. Section 4.2 also describes two studies which were carried out to explain how to conduct perception studies and the difference they make to design.

4.1 Learning from the results of the design study

The influence of culture (both the designers' and target users') on a design and the design process was examined using 1:1 design studies with two groups of seven design students from India and Germany using the think aloud protocol. The results of the analysis provided key insights into the influence of culture on a design and the design process. The study found that the steps followed by the Indian and German students were similar, with the exception of use of mood boards (or not) and certain qualitative differences. Similarly, there was little difference in the overall steps followed by the students when designing for a familiar persona/culture versus an unfamiliar persona/culture. The differences observed related to extra focus on a particular step or adapting a particular strategy within a step of the design activity rather than a total change in the steps followed.

While examining the influence of culture on the final design (research questions 2a and 2b), it was found that the culture-concept fit (CCF) and usability scores were lower for designs made for the unfamiliar culture than the familiar culture, despite the presence of detailed persona documents. This indicates that intimate knowledge and understanding of the target culture lead to higher CCF and usability scores for the familiar culture. From the expert evaluations carried out in this thesis and previous research such as that by Razzaghi (2007), it is clear there was a definite influence of the designers' own culture, preferences, and understanding on the final design, even though the target personas used in the study had different preferences and requirements.

From the above results, it can inferred that to achieve higher CCF and usability scores, tacit knowledge of the culture/persona in addition to that provided in the persona document is required. This entails moving from an information-based design to a knowledge-based design (Kruger & Cross, 2006). The difference in perception and interpretations of the designer from those of the persona/culture was also seen as a contributing factor for the difference in the CCF and usability scores, as illustrated by the different ways in which the concept of premium was interpreted by the two groups of students. These insights suggest strategic interventions are necessary to help improve the overall design for different cultures. This is especially critical given the globalised market, where designers from one culture are often asked to design for users in another, unfamiliar culture (Diehl & Christiaans, 2006).

Therefore, it is the recommendation of this thesis to provide this strategic intervention where tacit and more importantly explicit knowledge regarding perceptions of the target persona/culture can be provided, without bringing about a drastic change in the design process already being followed. This is achieved through the modified design process.

4.2 Modified design process to design for unfamiliar cultures

4.2.1 Explanation of the design process

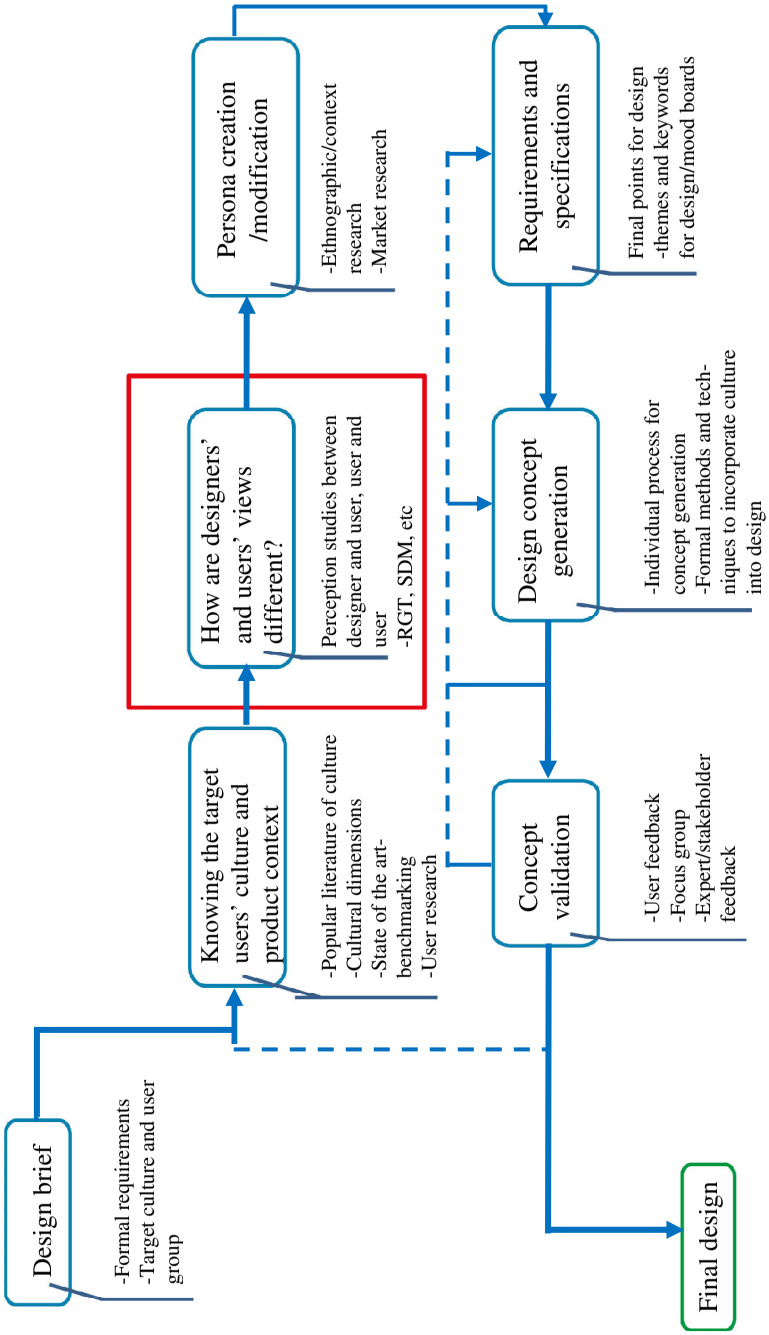


Figure 20: The modified design process to design for different cultures with the perception studies block highlighted

Figure 20 shows the modified design process to help improve design for different cultures. Except for the strategic intervention, the design process being suggested is not very different in terms of the main phases of design from the typical design process followed by the students in their design activity (see Section 3.4) and some standard design processes described in the literature (see Section 2.2). The strategic intervention is a call for designers to understand the difference in perception between themselves as designers and their target user/culture through the block "How are designers' and users' views different?" (i.e., perception studies block), highlighted in Figure 20. As is evident from Figure 20 and a general understanding of the design process, the process is an iterative activity with constant back and forth between blocks as required.

This section begins by briefly describing the blocks (steps) of the process illustrated in Figure 20 from the designer's perspective, along with typical sources of information and the activities associated with each block. This general description is then followed by a detailed explanation of the "How are designers' and users' views different?" block, with two studies illustrating how perceptions can be studied (Section 4.2.2). These studies also provide further insights into how perceptions can be used for design.

Design brief: Typically, a designer receives the design brief from the project stakeholder. The design brief triggers all the other activities in the design process. The design brief is a written explanation outlining the aims, objectives, milestones, and expected outcomes from the design project.[7] The design brief also contains information about the background of the project, target audience, competition, deliverables, timelines, and budgets involved. The design brief can sometimes be complemented with a product design specification (PDS). While the design brief outlines the design goal and major constraints and considerations, the PDS is more details about the precise limits for the full set of requirements for the product being designed.[8] The PDS can be understood to evolve through the design brief. In the intercultural design studies carried out in this thesis (Section 3.2.3), the design brief and PDS were combined, as is the case with most design briefs in the creative space (also called creative briefs).

Knowing the target users' culture and product context: To understand the context in which the product would be used and the users' culture, the designer chooses from a variety of sources including competitor product benchmarking, literature on popular culture, cultural dimensions (Section 2.2.3), state of the art research in terms of technological possibilities in the given product space, direct contact with potential users through user research, etc. From the reflective interviews during the design activity, it was seen that designers – based on individual preference and the brief at hand – would look at the different kinds of information mentioned above and immerse themselves in the target culture at varying levels.

How are the designers' and users' views different?: Even though the designers learned quite a bit about the users' tastes and preferences through his own research, persona docu-

[7] http://www.cleardesignuk.com/design-brief.html Last accessed: 08.05.2014

[8] http://en.wikipedia.org/wiki/Product_design_specification Last accessed: 08.05.2014

ment, etc., it was observed during the course of the design study and subsequent reflective interviews that, despite in-depth information, subsequent design decisions were based on the designers' own background and preferences i.e., the designers' own culture influenced the design. This block in the modified design process explicitly calls upon the designer to examine and understand the difference between their perceptions and those of the target audience. This step brings the designer more in tune with the product-specific tastes and preferences of their target audience. The difference in perceptions can be elucidated by carrying out studies with potential users using various methods such as the Repertory Grid Technique and the Semantic Differential Method. Section 4.2.2 describes this block in greater detail along with examples of these methods.

Persona creation/modification: As seen in Chapter 3, personas are hypothetical archetypes of actual users i.e., personas are representatives of the user group. Personas are a powerful way to communicate the needs, goals, and behaviours of the target user group and are essential for quashing feature debates during the design process (Cooper 2004, p 123). This particular block in the modified design process allows the designer to either create a new persona based on his understanding from the previous steps or appropriately modify an existing persona/customer profile. It is generally the combination of this persona document and the design brief (along with the PDS) from which the final requirements and specifications for the design are extracted. Although the use of personas is popular in interaction and user experience design, their use in product design is less widespread. Therefore, the designer might choose to skip this particular step. However, this is not recommended. But even if the designer chooses to skip the process of creating or modifying the persona, knowledge from previous steps such as the difference in perceptions can still positively influence the end design of the product.

Requirements and specifications: In this block, the designer extracts the final set of requirements for the design. Here, in addition to the PDS, the final list of aesthetics and experiential requirements are also extracted from the persona document. The list of aesthetics and experiential requirements could be extracted in terms of keywords for the mood board or design themes. This final list of requirements and specifications is then fed into the design concept generation block.

Design concept generation: This block of the modified design process deals with the actual act of design and concept generation. This phase is predominantly dependent on the designers' individual skills and preferences. In this phase, concepts can be derived and inspired from various sources, such as the mood board (as seen during the 1:1 design studies). Here, other aspects of the design activity such as sketching, detailed design, mock-ups and prototypes are explored. Occasionally designers might resort to formal methods or models to incorporate culture into design. These include models such as the cultural transformation model (Lin, Cheng, & Sun, 2007) or techniques such as those extensively examined in Wang et al. (2013), which include TRIZ; Transform and combine; Transform, abstract, and integrate, etc. Once the designers believe they have a suitable concept for the target audience, the design is sent for feedback from the users and/or stake holders in the form of a digital or physical prototype.

Concept validation: Here, the concept designed is tested and validated, keeping in mind the target audience and PDS. The testing/validation can employ many methods such as a focus group with potential users, 1:1 user feedback, expert evaluation, stakeholder feedback, etc. These exercises are typically carried out with reference to certain fixed measures and/or with respect to the needs and requirements of the target audience. Fixed measures of analysis could be satisfaction scores based on survey feedback from users, organisational objectives, analysis with respect to competition, usability objectives, etc. Depending on the results of this validation exercise, the designer has the option to end the process by moving on to the final design, or – if feedback warrants – return to any of the previous steps. Normally, a return to any of the initial steps such as knowing the users' culture and context of the product, perception studies, or the persona creation/modification steps is more for reference and better understanding than for to repeat any of the steps. However, returning to any of the other previous steps (i.e., requirements and specification, concept generation) could entail repeating the activities of that particular step in addition to referencing.

Final design: Once the results of the validation and testing phase are satisfactory, the designer can move onto the final concept phase. In the final concept phase, the design is fine-tuned and prepared either in terms of the final digital/physical prototype or whatever form of deliverable is required by the design brief.

As mentioned earlier, the modified design process described in this section is based on the general design process followed by the students in the 1:1 design studies, but with an added call for perception studies. The next section explains the perceptions studies block in detail.

4.2.2 Explanation of the perception studies block

In this subsection, following a description of the importance of perception studies, two possible methods for understanding perceptions are described: the Repertory Grid Technique and Semantic Differential Method. These are explained with the help of two studies commissioned in connection with the intercultural design studies carried out earlier. This subsection concludes with the implications of the results of perception studies for design and a general reflection on the studies.

The need and importance for perceptions studies

Section 2.2.3 explained how culture provides people a learned, shared, and interrelated set of symbols, codes, and values that direct and justify human behaviour (Harris and Moran, 1987 in *Information Science Today*, 2009). Every culture has its own thoughts about buying or using a product; therefore, it is important to consider cultural factor during design. If the design of a product does not match the user's understanding and expectations, the product's success will be directly affected. This has attained special importance with the emergence of the global marketplace, where cross-cultural differences are increasingly recognised as a key factor in the successful adoption of new products (Lee & Harada, 2000). The results of the 1:1 design studies carried out as a part of this research further emphasise this point: differences in

perception was identified as one of the main reasons for the difference between the CCF and usability scores for familiar and unfamiliar cultures.

Studies using the Repertory Grid Technique (RGT) and Semantic Differential Method (SDM) will be described to explain the difference in perceptions between designers and users across different cultures.

Study of design perceptions across India and Germany using the RGT

One of the methods to study the differences in design perceptions in a cross-cultural context is the Repertory Grid Technique (RGT). The repertory grid is a technique for identifying the ways that a person construes (interprets/gives meaning to) his or her experiences. It provides information from which inferences about personality can be made, but it is not a personality test in the conventional sense. It is underpinned by the Personal Construct Theory developed by George Kelly first published in 1955[9].

The advantage of the RGT is that the information obtained is of a hybrid qualitative/quantitative kind, allowing for a wide range of statistical analysis from different grids without losing the individuality of the results (Tomico et al., 2009). The RGT has been successfully used by Tomico, et al. (2009) to study the design perceptions on a set of pens in Japan and the Netherlands. In this thesis, a similar methodology was employed to compare the design perceptions of designers and non-designers in India and Germany with regard to vehicle cluster instruments. While a brief overview of the study and its results is given here, a detailed description of the study can be found in the author's paper Sudarshan et al. (2014).

Objective: The study aimed to see how designers and non-designers in India and Germany perceive and differentiate different designs, and thereby attempt to understand the sets of product attributes they value.

Study setup and procedure: Fifty-two individuals, 13 designers and 13 non-designers from India and 13 designers and 13 non-designers from Germany, were chosen to participate in this study using the RGT. Six vehicle cluster instrument designs belonging to popular hatchback cars in India and Germany were chosen as stimuli for the study (Figure 21).

[9] http://en.wikipedia.org/wiki/Repertory_grid Last accessed 19.11.2014

Figure 21: The six cluster instrument designs selected as stimulus for this study. Left to Right - Suzuki Swift (India), Chevrolet Beat (Unique), Ford Figo (India), Honda Brio (Unique), BMW 1er (Germany), and VW Golf (Germany).

A structured interview using RGT involves triading, where the participant is presented with the stimuli in sets of three. In this study, the six product images (Figure 21) were first combined into randomly selected triads. The order in which the triads were presented to the participant ensured that no two images were repeated from the previous set. For every triad of images presented, participants were asked to "think of any one feature or quality of the product (image) that differentiates one from the other two products (images) presented". A laddering approach (Easterby-Smith, 1980) was then used to get to the core of the answer. The preferred pole from the pair of constructs elicited was considered as a construct, with the opposing pole as the contrast. The procedure was repeated until no new attributes were elicited by participants for two consecutive triads. The bipolar constructs that appear for a specific individual for this specific set of products is a Repertory Grid. Each Repertory Grid is unique, and varies for each participant in topic and number of constructs elicited. Each participant's Repertory Grid is his or her personal semantic differential questionnaire and can be used to rate the products (Tomico et al. 2009). A minimum of 12 and a maximum of 20 constructs were elicited by the participants in this study.

The interview procedure in this study was as follows: first the participants were familiarised with eliciting constructs through a practice activity. The participants then elicited constructs to the stimulus of CI designs presented, identifying and ranking the most important and least important of their constructs. The six CI designs were then evaluated based on constructs they

elicited. Finally, the six CI designs were ranked based on preference along with reasoning for their ranking.

Analysis measures: Since each participant in the study generates their own Repertory Grid, direct comparisons between participants is difficult. In order to overcome the idiosyncratic nature of the results and create a standardised classification scheme, content analysis was applied as per Krippendorff (2004). A detailed coding scheme emerged from the data, as shown in Table 14. The elicited categories were then grouped into the overall categories that reflected Hassenzahl's (2004) distinction between pragmatic and hedonic product qualities. Pragmatic qualities are the instrumental aspects of a product, such as its usefulness, practicality and ease of use. Hedonic qualities are more experiential facets of product use and consist of two distinct categories: stimulation, which refers to a product's ability to address the human need for novelty and challenge, and identification, which refers to a product's ability to address the need for expressing oneself through the objects one owns. This classification was done by independent raters on random sets of data and achieved an inter-rater agreement (Fleiss, Levin & Paik, 2003) of k = 0.806, which is deemed to be satisfactory.

Table 14: The elicited constructs classified into thematic categories with examples from participants

Category / Subcategory		***Examples***
Pragmatic	**Usability**	Information prioritised and structured. Instrument positioned at an angle for easier view. Easy to understand
	Information Layout and Presentation	Separate fuel and coolant indicator. Tachometer on the left. Additional information in the centre.
	Facts and Tell-Tales	Digital tachometer. Parallel display of odometer and trip. Integrated tell-tales.
Stimulation	**Form**	Asymmetric. Overhanging and projecting. Mixture of circular and other forms.
	Visual Aesthetics	Chrome highlights. Backlit fonts. Stylised fonts.
Identification		Sporty. Luxurious / posh looking. Sophisticated.

With all the data coded according to the coding scheme shown above, the three measures of analysis described in Tomico et al. (2009) were used to determine differences in product attribute prioritisation. The three measures were dominance, importance, and descriptive richness.

- Dominance refers to product attributes that were most frequently observed and elicited by the participants. Dominance was measured by calculating the relative percentage

for a given category/subcategory of constructs for a group of individuals when they differentiated among a set of products.

- Importance refers to the attributes the participants found to be most important in the cluster instrument designs. Importance was calculated using the weighted average method on the constructs elicited by the users. The difference between the dominance and importance measures is that dominance is a measure of how often constructs in a category are elicited, while importance refers to the category of constructs that a particular group of participants find important for purchasing and using the product.
- Descriptive richness is used to determine the reach of each category. It is defined as the range of different personal constructs (attributes) elicited within the same category. The different ways in which participants refer to the same categories relate to how the personal constructs elicited are related to each other and how large the clusters of constructs are. For instance, a construct category such as "novelty" might have a single facet relating to the novelty and innovativeness of a product, while "ease-of-use," might tap into more than one facet, for example understandability, clarity, and navigability (Tomico et al., 2009). The descriptive richness was calculated following the procedure described in Tomico et al. (2009), where subtle differences in the individual constructs were ascribed increased importance. In assessing the semantic similarities between constructs, two kinds of information were taken into account. The first was qualitative information such as the definition of each pole for the constructs elicited. Second, every construct was characterised by the participants' ratings for the set of stimuli. Quantitative techniques such as hierarchical cluster analysis provided information on the cognitive similarity of the constructs (i.e., how similarly two constructs were being used in differentiating the items in the set of products). This was an iterative procedure in which both qualitative and quantitative information was used to inform the grouping process.

  The hierarchical cluster analysis augmented qualitative understanding by highlighting: a) constructs that displayed a high correlation in the ratings, but for which there was no *a priori* identified semantic similarity (from the content analysis), and b) the cognitive dissimilarity of two constructs that displayed high semantic similarity. For two constructs to be judged as similar, they not only had to agree with regard to semantic information, but also with regard to participants' ratings for the set of products. This process was found to provide a rich qualitative understanding of non-contiguous constructs, in which the opposite pole does not constitute a negation or a linguistic opposition (Karapanos & Martens, 2007 in Tomico et al., 2009).

Results: Using the measures of analysis described above, Tables 15 and 16 show the values for dominance and importance with standard deviations given in parenthesis, and a sample of the result of the descriptive richness of the different thematic categories.

Table 15: Dominance and Importance Measures for Indian and German Designers and Non-designers

Category	***Dominance (%)***				***Importance***			
	Indian Non Designers	***Indian Designers***	***German Designers***	***German Non Designers***	***Indian Non Designers***	***Indian Designers***	***German Designers***	***German Non Designers***
Pragmatic	**55.35**	**50.77**	**42.84**	**49.74**	**0.61 (0.21)**	**0.46 (0.14)**	**0.44 (0.12)**	**0.49 (0.12)**
Usability	6.86	4.66	9.69	16.58	0.09 (0.11)	0.04 (0.06)	0.23 (0.11)	0.15 (0.07)
Tell-tale	33.04	29.01	21.42	12.56	0.33 (0.16)	0.16 (0.12)	0.08 (0.08)	0.21 (0.12)
Layout	15.45	17.09	11.73	20.60	0.17 (0.12)	0.25 (0.13)	0.12 (0.09)	0.12 (0.07)
Stimulation	**37.33**	**38.86**	**41.32**	**41.2**	**0.27 (0.11)**	**0.39 (0.13)**	**0.39 (0.14)**	**0.39 (0.13)**
Form	18.88	21.76	28.06	21.10	0.12 (0.07)	0.19 (0.14)	0.24 (0.12)	0.16 (0.08)
Aesthetics	18.45	17.09	13.26	20.10	0.14 (0.07)	0.19 (0.14)	0.14 (0.09)	0.22 (0.14)
Identifica-tion	***7.29***	***10.36***	***15.81***	***6.53***	***0.03 (0.07)***	***0.08 (0.14)***	***0.16 (0.12)***	***0.07 (0.07)***

Table 16: A sample of descriptive richness for the different thematic categories

	PARAMETER	***INDIA Designers***	***GERMANY Non-designers***
Pragmatic Aspects	***Usability***	• Easy to read • Important data big and clean • Clearly visible	• Clear / clearly laid out • Information priority / Info structured / Fo-cused information • Detailed scaling • Clear function from the display elements
	Tell-Tale	• Integrated functionalities • Fuel representation unique • Innovative	• Typical - used to / familiar • Integrated tell-tales • Separate tank and temp info
	Layout	• Minimalistic • Separate space of additional info • Layered information presentation	• Full of info • Informative • Same-sized elements
Stimulation	***Form***	• Sleek • Basic elements • Curvy form • Central main element	• Overhanging, projecting • Separate main element • Symmetric
	Aesthetics	• More black • Non-black finish of the mould • Contrast, high contrast	• Light • Aesthetic • Chrome
	Identification	• Rugged, masculine • Luxury • Elegant	• Displays – professional • Sophisticated, complete

The general overview of the results obtained from the three calculated indices is shown in Tables 17 and 18. Small differences in the scores are shown by a single plus or minus, whereas larger significant differences are shown with a double plus or minus. The methodology followed to assign strong (++) and weak (+) associations is as follows.

Dominance: Any difference greater than or equal to 5% is considered a significant difference. For example, from Table 15 dominance of tell-tale for Indian designers is about 29.01% but 12.56% for the German non-designers, so tell-tale is assigned a '++' for the Indian designers and a '- -' for the German non-designers.

Importance: Any difference equal to or greater than 0.05 is considered a significant difference. Here, the lower (LCL) and upper control limits (UCL) are calculated and the difference of at least one control limit must satisfy the said condition. For example, from Table 15 layout for Indian designers is 0.25(0.13) and for the German non-designers is 0.12(0.07). UCL and LCL for Indians are 0.38 and 0.12 respectively. The same for Germans are 0.19 and 0.05 respectively. The difference of both control limits satisfies the condition, hence layout has been assigned a '++' for the Indian designers.

Descriptive richness is related to the other two indices, thus adding redundancy to the analysis (Tomico et al., 2009).

Table 17: Overview of dominance, importance and descriptive richness measures for Indian designers and German non-designers

Category	***Dominance***		***Importance***		***Descriptive Richness***	
	Indian Designers	***German Non-designers***	***Indian Designers***	***German Non-designers***	***Indian Designers***	***German Non-designers***
Pragmatic						
Usability	- -	++	- -	++	- -	++
Tell-Tale	++	- -	- -	++	- -	++
Layout	-	+	++	- -	++	- -
Stimulation						
Form	+	-	+	-	+	-
Aesthetics	-	+	-	+	-	+
Identification	+	-	++	- -	++	- -

Table 18: Overview of dominance, importance, and descriptive richness measures for Indian non-designers and German designers

Category	***Dominance***		***Importance***		***Descriptive Richness***	
	Indian Non-designers	***German Designers***	***Indian Non-designers***	***German Designers***	***Indian Non-designers***	***German Designers***
Pragmatic						
Usability	-	+	- -	++	- -	++
Tell-Tale	++	- -	++	- -	++	- -
Layout	+	-	++	- -	++	- -
Stimulation						
Form	- -	++	- -	++	- -	++
Aesthetics	++	- -	-	+	++	- -
Identification	- -	++	- -	++	- -	++

Discussion: Comparing designers in India and non-designers in Germany (Table 17), 'usability' was more dominant and important to the German non-designers than the Indian designers. This can be attributed to the functional importance of the cluster instrument in the car. These points are emphasised by the descriptive richness, where German non-designers used terms such as "Information structured, clear function of display elements, etc.". Formal design education sensitised the Indian designers to the 'layout' aspect, which is seen as being an important feature in the design of vehicle cluster instruments. Therefore, they ascribe it with significantly higher importance than German non-designers.

The significant dominance by Indian designers in the 'tell-tale' subcategory was mainly because many features and elements or their representation shown in the cluster instruments were considered non-standard in Indian vehicles and therefore mentioned more often (dominance). Further, the tell-tales have higher importance scores for the German non-designers than Indian designers. This suggests that German non-designers place higher importance on having all the elements they consider as standard being present in the cluster instrument panel. This is further emphasised by looking at the descriptive richness data, where Germans used terms like "used to/familiar, integrated tell-tales, etc." whereas the Indian designers used terms such as "Innovative, Unique fuel representation, etc.".

The dominance and significantly higher importance of identification shown by Indian designers is primarily due to their education background. Design students are consciously trained in design schools to express their designs through various expressions and emotions such as elegant, luxury, rugged, etc. (identification). However, the interdisciplinary background of the Indian designers in this study (i.e., typically a Bachelor's in Engineering and then a Master's in Design) explains the counterintuitive dominance and importance of the form and aesthetics sub-categories (Table 17) which is further reflected in their descriptive richness.

Similarly, comparing designers in Germany and non-designers in India (Table 18), the dominance and importance of tell-tale is again observed. However, the Indian non-designers also considered tell-tales more important than German designers. Referring to the qualitative feedback during the interviews, it was seen that the Indian non-designers considered something non-standard and unique as important and therefore a 'must have' in their cluster instrument panel. As mentioned in the previous comparison, Germans (German designers in this case) place more importance on 'usability' aspects of the cluster instrument. An interesting result is the dominance and importance shown by the Indian non-designers for 'layout' compared with the German designers. Although there is no concrete explanation, it can be speculated based on qualitative feedback that the German designers believed that high usability would automatically mean a good layout of elements, thus placing more importance and dominance on 'usability' and less on 'layout'.

The counterintuitive dominance scores for 'form' and 'aesthetics' between Indian non-designers and German designers can be attributed to the German designers' design education. The German designers can appreciate aspects of form, whereas the Indian non designers focused more on aspects of aesthetics. This can be derived from the descriptive richness, where

for form the German designers used forms like ‘symmetric, traditional, boxy, geometric, etc.’, whereas the Indian non-designers used terms such as ‘projected display, two different units, etc.’. Similarly with aesthetics, German designers used terms such as ‘accents, brushed metal, matte, etc.’, whereas Indian non designers used terms such as ‘chrome, silver, multi-coloured, neon colours, red needle, etc.’ In summary, the German designer focused on form, whereas the Indian non-designers focused on aesthetics. These differences are also seen in the general design of German products, where the colour treatment and finish tend to be sober and conservative in comparison with Indian products, which tend to be more extravagant.

The comparison with the identification category is similar to the previous comparison. Here too the German designers, due to their education, ascribe more dominance and importance to the identification aspects. A comparison of the descriptive richness scores further emphasises this point. The Indian non-designers used terms such as ‘expensive, modern, imported, etc.’, whereas the German designers used terms such as ‘sporty, premium, classic, elegant, etc.’

In both comparisons, it was found that the stimulation category, comprised of the subcategories of form and aesthetics, showed no clear trend. However, going by the ratings and ranking of the designs, the following general statements of comparison between Indians and Germans are possible. The Germans in general were very critical of the form and aesthetic aspects of the ‘unconventional designs’ shown. Therefore, they placed more importance on having ‘conservative’, ‘familiar’, ‘traditional’ forms, and ‘traditional’ and ‘sober’ colour combinations (aesthetics) with respect to cluster instrument designs. On the other hand, Indians rated the ‘unconventional’ designs higher than the German participants.

Conclusions: Comparing Indians and Germans as a whole (designers and non-designers), for Indians, something non-standard/unique was dominant and considered important for non-designers. From the scores and ranking of the cluster instruments used in the study, it seems Indians were generally more open to new forms, colours, and colour combinations. For the Germans, the usability of the cluster instrument panel is of major importance. In terms of preferences, the Germans are more conservative and sober in terms of form and colour treatment of the cluster instruments than the Indians.

The design implications indicate how the designer could go about designing for Indian and German audiences. For example, when designing cluster instruments for the Indian audience, the German designer could look to express designs more through colour and colour combinations to communicate the hedonic and identification characteristics, rather than through form and relatively neutral and subtle colours as done for the German audience. Therefore, this study shows the difference in perceptions between designers and non-designers across cultures play an important role in the acceptability and success of the product. The results and the design implications of the study further emphasise the need for the designers to be sensitised and made aware of these differences in perception during the design for unfamiliar audiences.

In the context of this thesis, this study with the RGT illustrated one of the possible methods for understanding the perceptions of the target audience. Such a study forms a critical part of

the modified design process (Figure 20) where there is an explicit call made for designers to be aware of the aesthetic perception of the users with regard to the object being designed.

Study of design perceptions across India and Germany using the SDM

One of the other methods to study the differences in the design perceptions in a cross-cultural context is using the Semantic Differential Method (SDM). The SDM is one of the most popular methods of studying perceptions and has numerous application areas such as psychology, media analysis, market research, etc. (Stauche, 2012). The SDM is particularly useful in settings where multiple groups or objects are to be compared (Stauche, 2012). For this thesis, the difference in perceptions of vehicle cluster instruments was carried out using SDM based on a previous study from Herbeth & Blumenthal (2013), which was also based on the study of perceptions of vehicle instrument clusters. As with the Repertory Grid Technique, only a brief overview of the study and its results is given here. A detailed description of the study can be found in the author's paper Kalenahalli Sudarshan et al. (2015).

Objective: To examine the differences in user perceptions on vehicle cluster instruments in US, Indian, and German culture.

The US was chosen as a third culture to examine whether adjective pairs generated for the semantic differential exercise can be employed equally in multiple cultures and if there were similarities in the perceptions of western users compared to that of the Indian users.

Study setup and procedure: 46 participants from each of the three chosen cultures were selected to participate in this online study. Here, the six chosen designs belonged to vehicles from the popular hatchback vehicle segment in the three countries (Figure 22), with the adjectives to define the semantic space being directly adopted from the study by Herbeth & Blumenthal (2013). The online study procedure used here involved users evaluating the six vehicle cluster instrument designs based on 13 pairs of pre-defined adjectives on a 7-point Likert scale, ranking the six designs and describing the reasons for the most and least preferred.

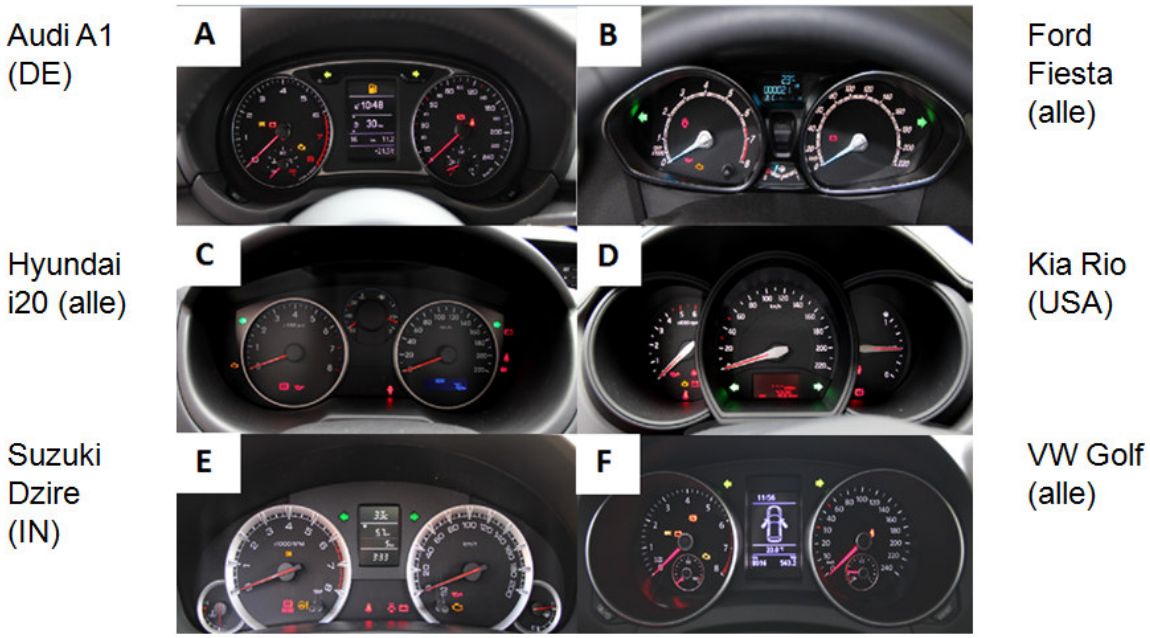


Figure 22: The six vehicle cluster instrument designs used in the study using SDM

Data analysis: From the raw data from the participants from the three cultures, a factor analysis was performed to reduce the adjectives to the two dimensions of hedonic and pragmatic as per Hassenzhal (2004). From the factor analysis, adjective pairs with inconsistent loading and loading on both factors were eliminated, resulting in a final set of nine adjective pairs that were suitable for comparing perceptions across cultures.

Results: The average scores for the pragmatic and hedonic parameters for the data obtained from the three countries for the six cluster instrument designs is as shown in Table 19.

Table 19: Average scores for the six CIs across the two dimensions for the three cultures

Cluster instrument	**Germany**		**USA**		**India**	
	Pragmatic (avg)	**Hedonic (avg)**	**Pragmatic (avg)**	**Hedonic (avg)**	**Pragmatic (avg)**	**Hedonic (avg)**
Audi A1	5.4	4.0	5.1	4.3	5.2	4.2
Ford Fiesta	3.4	4.5	4.1	4.7	4.7	4.7
Hyundai i20	5.4	2.6	5.4	3.2	5.4	3.8
Kia Rio	4.0	4.0	4.5	4.3	5.0	4.7
Suzuki Dzire	4.3	3.8	4.7	3.9	5.1	4.2
VW Golf	5.8	5.2	5.1	5.1	5.2	5.2

Figures 23-25 illustrate the participants' responses to the CIs along the two dimensions of hedonic and pragmatic. The figures also show the preference and ranking of the cluster instruments by the participants of each country along with some of reasoning given for the highest and lowest preferences.

From Figure 23, it can be seen that the German participants assigned the first three ranks to those designs that performed best on the pragmatic level. The CI of the Ford Fiesta was rated lowest in the pragmatic assessment by the German participants, thus making it the least preferred. The VW Golf, whose cluster instrument had the highest expression along both the pragmatic and hedonic dimensions, was most preferred.

From Figure 24, a similar picture emerges for the US participants, with the designs of the VW Golf, Audi A1 and Hyundai i20 being rated the best on the pragmatic scale, although with slightly lower scores than those for Germany. The same can be observed with the scores along the hedonic dimension, with the scores from the American participants being slightly lower than those from the German participants. This similarity is further reflected in the participants' preference ranking and the associated reasoning.

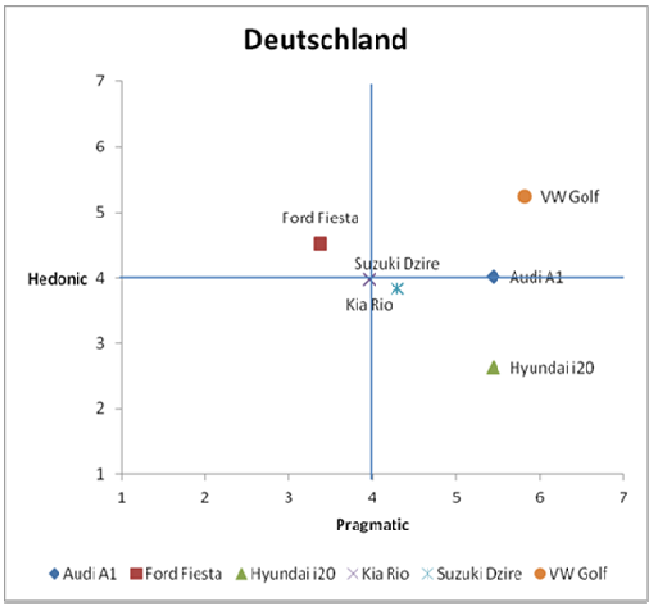
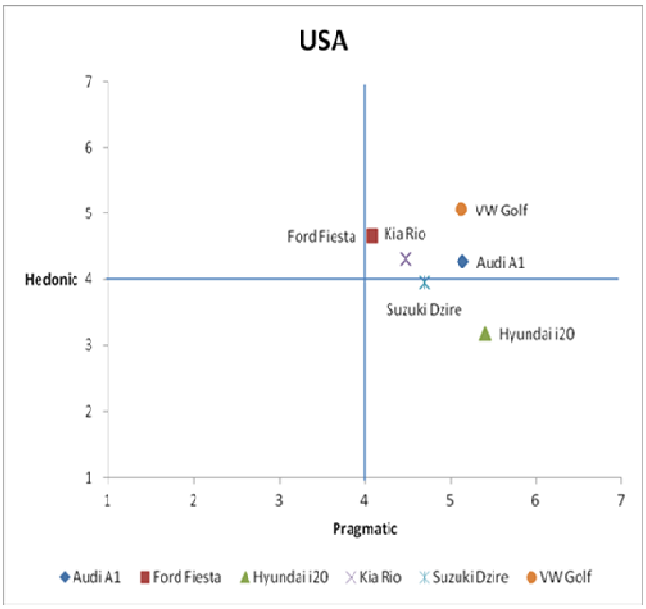


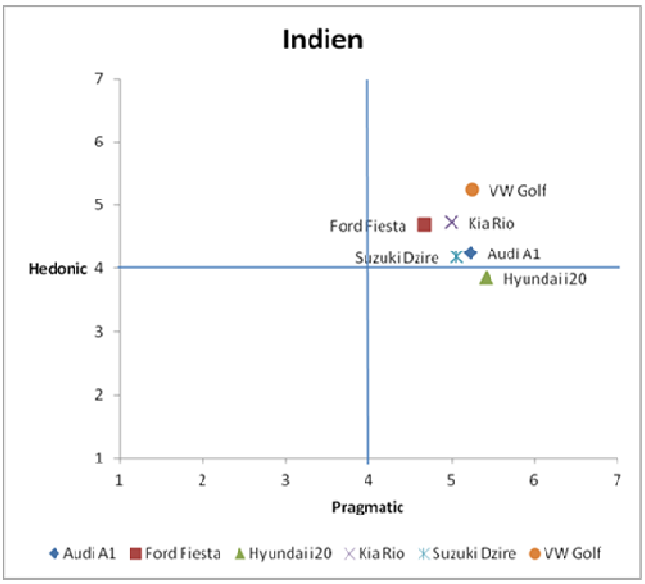
Figure 23: Factor analysis for participants' responses from Germany along the two dimensions

Car	Average Preference Score	Ranking Preference
Audi A1	2.5	2
Ford Fiesta	5.0	6
Hyundai i20	3.8	3
Kia Rio	4.1	5
Suzuki Dzire	4.0	4
VW Golf	1.6	1
Reasons for 1st and 6th preferences		
Clear	Playful	
Simple	Too bright	
Readable	Cheap	
Premium	Distracting	



Car	Average Preference Score	Ranking Preference
Audi A1	2.5	2
Ford Fiesta	4.8	6
Hyundai i20	3.7	3
Kia Rio	3.9	5
Suzuki Dzire	3.9	4
VW Golf	2.1	1
Reasons for 1st and 6th preferences		
Clear	Overloaded	
Simple	Shape	
Easy to read	Looks old	

Figure 24: Factor analysis for participants' responses from USA along the two dimensions



Car	Average Preference Score	Ranking Preference
Audi A1	3.2	2
Ford Fiesta	3.9	5
Hyundai i20	4.3	6
Kia Rio	3.7	4
Suzuki Dzire	3.4	3
VW Golf	2.6	1
Reasons for 1st and 6th preferences		
Technically rich	Looks old	
Digitisation	Not clear	
Exclusive	Low-tech	
Stylish		

Figure 25: Factor analysis for participants' responses from India along the two dimensions

From Figure 25, it is seen that the Indian participants considered the pragmatic qualities to be more or less equal for all the designs. However, despite this small difference the perceptions were very different from those of their western counterparts. The differences are stronger in the evaluation of the hedonic aspects, where the values are higher than those of the western participants. In terms of the rankings, the VW Golf and Audi A1 had similar rankings across the three cultures. The least preferred design for the Indian participants was the Hyundai i20. It is interesting to note that both the most preferred (VW Golf) and the least preferred (Hyundai i20) scored the most and least with respect to the hedonic aspects.

Discussion and implication of results: Looking further into the results, for Germany, the results suggest German participants prefer CI designs with both pragmatic and hedonic features, with the pragmatic aspects dominating. This can be explained by general impressions of Germans as pragmatic, reliable and well-organised.[10] This is further supported by the qualitative reasoning given by the participants for their ranking. Similarly, the American participants also prefer CI designs which consider both pragmatic and hedonic aspects, with a preference for higher pragmatic value.

In contrast to the other two countries, hedonic attributes play an important role for Indian participants. This finding is in line with culture-specific features of the Indian culture as being open to new stimuli and showing a greater enthusiasm towards more playful or unusual features. Qualitatively, it was also observed that "digital" displays were favoured by the Indian participants. Furthermore, Indian participants highlighted aspects of style and exclusivity, whereas the least preferred design was described as being old fashioned and low-tech.

Therefore, for the German and US markets the CI should be pragmatic but ideally also have hedonic aspects, with clarity and concise structure. In contrast, for the Indian population the CI design should focus on the hedonic aspects to a greater extent. It can also be noted that unusual shapes and colours must be avoided for Germany and the United States, with a focus on a simple, clear, and unambiguous choice of shapes and colours. In contrast, original shapes and colours are perceived as a positive feature in India.

This study has shown how to identify differences in perceptions between users from US, Indian and German cultures. The results and design implications further emphasise the need for the designers to be sensitised and made aware of these differences in perceptions when designing for different cultures. As a caveat to this study, it must be acknowledged the comparison was across the three cultures and not specifically comparing designers and non-designers as in the RGT study.

Reflections on the perception studies using RGT and SDM

So far, this section has emphasised the usefulness and implications of the perception studies block for the modified design process (Figure 20) through a detailed explanation of the block with two example studies. The two studies showed how differences in perceptions across cultures (SDM study) and specifically between designers and users (RGT study) can be captured along with the possible design implications from such studies.

Although the studies here dealt with differences in perception with regard to vehicle cluster instruments, they can be easily customised to suit the needs of other products being designed. The methods described here are robust and useful; however, caveats must be provided. The RGT provides an in-depth understanding of users' perceptions of a design in the users' own terms, making it easy to employ in cross-cultural contexts. However, the method and subsequent analysis is extremely time intensive due to the coding and other activities involved. The

[10] http://geert-hofstede.com/germany.html Last accessed: 01.08.2014

use of this method also requires a prior knowledge and understanding of quantitative and qualitative data analysis methods for effective use.

Conversely, the SDM is comparatively easy to employ and analyse but caution is required. First, because user perceptions are recorded along a set of predefined adjective pairs, the idiosyncrasies of individual results is lost. Second, since similar pairs of adjectives are used in a cross-cultural context, the suitability of these adjectives for cross-cultural comparison must be determined in advance (beyond the simple language differences and translation of adjectives).

The final choice of which method to use is ultimately left of the designer based on the requirements of the project and the available time and skill for analysis. The designer can choose a variation of one of the two methods or even a completely different one. For example, inputs regarding perceptions can be obtained by simply using the profile plots obtained from the SDM.

4.3 Summary

Based on the results from Chapter 3, this chapter dealt with the modified design process suggested in this thesis to help improve the design for unfamiliar audiences. The modified design process described in this chapter is not very different from the design process typically followed by the students, apart from the incorporation of a strategic intervention: the perception studies block.

The perception studies block explicitly calls for the designers to understand the difference in perception between themselves and their target users. This block was explained in detail with two example studies using the Repertory Grid Technique and Semantic Differential Method. These showed how the difference in perceptions can be captured along with possible design implications from the results of such perception studies.

5 Validation of the Modified Design Process

Chapter 4 described the modified design process, one of the possibilities to help designers design for unfamiliar cultures with greater success. This chapter deals with the validation of the proposed design process by comparing designs created using the modified the process with those created without. The chapter begins by describing the objectives of the validation exercise, followed by the study setup, analysis measures, and the final results of the validation.

5.1 Objectives

The goal is to examine the effectiveness of the modified design process in helping design better for different cultures.

This objective can be fulfilled by considering one of the key research questions examined earlier in this thesis ("Does the target users' culture influence the design?"), and comparing the culture-concept fit and usability scores of the designs created as a result of the modified design process with the scores of designs created without it.

This is achieved with the help of design activities from design students in India and Germany, with the final designs once again being evaluated by a group of experts.

5.2 Study setup

5.2.1 Participants

Even though over 30 industrial design students from various design schools in Germany and India were contacted to participate in this activity, only 14 followed through on all the assignments related to the validation exercise: 4 German design students and 10 Indian design students. It is important to note that the participants of the validation exercise were different to those who participated in the 1:1 design activity described in Chapter 3. As before, the only criterion for selection was that participants must have a valid driving licence and at least one year's experience of driving a car. The 14 students who participated in this validation experiment produced a total of 41 complete design concepts to examine and validate the modified design process. Although more students and designs were wanted for strong empirical investigation, this number is considered sufficient to obtain initial feedback and insight into the effectiveness of the modified design process.

5.2.2 Conditions and procedure

The modified design process can only be validated via a comparison between designs created with the help of the process and those without. Therefore it was crucial for the students to be formally introduced to the modified design process (through a workshop) before employing

the process in their design activity. Therefore, three sets of designs were produced through this validation procedure: designs from the pre-workshop design activity, where students were free to follow their own process; designs from the post-workshop design activity with the modified design process; and designs from the post-workshop design activity without the modified design process. This latter acted as a control group.

The procedure to validate the modified design process consisted of three phases. The first phase involved the students designing a concept to meet the design brief for the German and Indian personas provided. The personas used in Chapter 3 in the 1:1 design study were reemployed here. The design briefs, however, provided the students a choice between designing a vehicle cluster instrument, vehicle entertainment console, or vehicle climate console. After choosing a particular aspect of the vehicle interior, the students had stick with this choice throughout the validation study to enable direct comparisons between their designs. During this first phase, the students were given 2-3 weeks to design for the two personas. At the end of the stipulated time, the students turned in their designs with a brief documentation of the process they had followed. When the students turned in their designs, a short interview was carried out to better understand the design and the process followed.

In the second phase the researcher conducted a workshop with the students to provide a formal introduction to the modified design process. The workshops were conducted at the students' universities and colleges and also involved an initial sensitisation to culture and user research in design.

In the third the students repeated the activity from the first phase; however, some students were randomly selected to explicitly follow the modified design process, with the rest free to follow their own process to arrive at their designs. The students who carried out the post-workshop design activity following the modified design process were provided with the results of the perception studies (Section 4.2.2) to help with their design. The results of the perception studies were tuned through further perception studies in accordance with the design brief (CI, entertainment console, or climate control console). The post workshop design activities were also 2-3 week long take home assignments. As before, once the student turned in their designs, a short interview was conducted to better understand the design and process followed. In addition, brief qualitative feedback was obtained on the modified design process and the experience of the students in employing the process.

Since the 1:1 design studies did not show much difference between the steps of the design process when designing for the familiar and unfamiliar, the students were given the 2-3 weeks of time for the design activities to ensure the students had as much freedom as possible and an opportunity to follow either a typical design process or the modified design process. The end deliverables were digital renders of their final concepts along with a brief description of the design process followed during the course of the activities. The description of the design process followed was used to crosscheck with the typical design process derived from the reflective interview and to ensure students followed all the steps of the modified design proc-

ess. Figure 26 shows a few of the final design concepts created during the activity, with a few more examples given in Appendix 10.9.

Figure 26: Examples of end deliverable. Pre-workshop (upper left – India, lower left – Germany) and post-workshop concepts (upper right – India, lower right – Germany)

5.2.3 Measures of analysis

The aim of the modified design process is to help designers improve their design for unfamiliar cultures. The anticipated result is that the designs created with the process will achieve higher acceptance in the target culture, seen in the form of higher CCF and usability scores (see Section 3.3.4). To check this hypothesis, the pre-workshop and post-workshop designs submitted by the students during the validation exercise were considered along with qualitative input acquired during the interviews about using the modified design process.

In order to evaluate the final designs, a similar approach to that followed in Section 3.3.4 with the expert evaluations was employed. Here again, experts were chosen for the final evaluation of concepts, since the number of concepts completed generated (41 in all) would prove difficult for users to evaluate. As in Section 3.3.4, experts with a minimum of 5 years of professional experience in industrial/product or automobile design were chosen. Each of the design concepts submitted were evaluated individually by a group of three experts (one from India, two from Germany).

The experts evaluated the final design concepts generated by the students across the CCF and usability categories and their respective parameters, as described in Section 3.3.4. These were both evaluated from the perspective of the appropriate target persona. Crucially, the experts were not told which designs were pre-workshop designs and which were post-workshop designs. It is also important that the experts chosen here were different from those who evaluated the design concepts from the 1:1 design study.

The experts' individual scores for all the concepts were added together and averaged for the various sets of designs, in accordance with the objectives of the validation exercise. The

evaluation procedure employed involved a preparation phase and an in-depth evaluation phase, exactly as in Chapter 3.

5.3 Results

The average scores from all experts for every design across all three concepts (i.e., pre-workshop, post-workshop without process and post-workshop with process) were considered for comparison and validation. Table 20 below shows the comparative CCF and usability scores for the pre-workshop and post-workshop design concepts; the detailed evaluation of concepts is presented in Appendix 10.9.

From Table 20 it is evident that the number of designs considered for the evaluation is different for the various conditions. This is because some of the design concepts submitted by the students were incomplete, either with respect to the design brief and/or lack of clarity and explanation about the concept and were thus eliminated from the expert evaluation. Therefore, out of a possible 56 design concepts (14 participants * (2 pre-workshop designs + 2 post-workshop designs)), 41 design concepts were considered for the expert evaluation and comparison. Of these 41 design concepts, 18 were pre-workshop concepts, 12 post-workshop concepts following the modified design process and 11 post-workshop concepts created independent of the process, for both the Indian and German personas.

Table 20: Comparative pre-workshop and post-workshop scores for culture-concept fit and usability

		CCF (max 50)	**Usability (max 40)**	**CCF Average (max 50)**	**Usability Average (max 40)**
Pre-workshop	**Familiar (n = 10)**	30.53	24.92	29.41	24.65
	Unfamiliar (n = 8)	28.29	24.38		
Post-workshop (with modified process)	**Familiar (n = 6)**	35.17	28.39	34.19	28.44
	Unfamiliar (n = 6)	33.22	28.50		
Post-workshop (without modified process)	**Familiar (n =6)**	29.53	23.13	29.27	23.20
	Unfamiliar (n =5)	29.06	23.28		

As seen from Table 20, there is little difference between the overall CCF and usability scores for the pre-workshop and post-workshop designs without following the modified process.

On the other hand, overall the CCF and usability scores improved by 4.78 and 3.79, respectively, between the pre-workshop designs and the post-workshop designs using the modified

process. These improved scores are especially significant given that the CCF measure has a maximum of 50 and usability has a maximum of 40. The CCF and usability scores when the students designed for a familiar audience improved by 4.64 and 3.47 respectively. The CCF and usability scores when the students designed for an unfamiliar audience improved by 4.93 and 4.12 respectively. These improvements clearly indicate that the modified design process has a positive influence. Here, it was interesting to note scores related to the familiar culture also saw an improvement, suggesting that the process better sensitised the designer to the needs of the target culture in comparison to the designer who thinks they intuitively know what the user likes. The results based on this initial validation study clearly suggest that the modified design process – particularly the perception studies block – positively impacts designs for both familiar and unfamiliar users.

The qualitative feedback from the students on using the modified design process highlighted this positive impact as well as areas of improvement. The students said the use of the modified design process gave them a sense of direction and clarity on the design requirements for the two cultures from both aesthetic and functional perspectives. The results of the perception studies (using both the Repertory Grid Technique and the Semantic Differential Method) that were provided as a part of the modified design process were seen to be extremely beneficial, as they provided key insights into the aesthetic perceptions and preferences of the respective cultures. The perception studies were especially useful as they were product-specific and not general in nature.

In addition, and perhaps critically, the use of the process itself was not seen as a hindrance, as the process did not require the students to make drastic changes from the design process they were used to. The students provided feedback about using typical steps of their process such as employing mood boards, state of the art research, etc., as described in chapter 3. As expected, the only exception to their typical process was being asked to consider information about perceptions which they would not typically consider. The students also claimed they would consider the modified design process in future assignments involving design for different cultures.

Along with this positive feedback, the students also provided some observations and suggestions. One of the main points of reflective feedback concerned the execution of the perception studies, even though the results were directly provided during the validation study. The perception studies carried out in this thesis (RGT and SDM studies) were considered to require proficient knowledge of statistics for effective execution, which was seen as an issue for adopting the suggested process. This feedback was given even though the results of the product specific perceptions were highly valued and considered a key factor in guiding their designs. This calls for the development of a simpler method to understand user perceptions, one which enables students to obtain a direct sense of users' perception of a product without the exhaustive involvement of any statistical methods or analysis. The new method must also be scalable and flexible for the students to use regardless of project scale, skill and, time available.

5.4 Summary

The validation procedure carried out with design students had the students design for German and Indian cultures with and without the suggested modified design process, in addition to a pre-workshop design activity. The resulting design concepts were evaluated by a group of experts and their success measured along the parameters of culture-concept fit (CCF) and usability. The scores from the expert evaluation showed a marked improvement in the CCF and usability scores of those designs created with the modified process in comparison to designs created without. The qualitative feedback from the students further confirmed the effectiveness of the suggested design process, with the perception studies block being seen as the key differentiator. Along with the positive feedback, the students also recommended the development of an easier tool/method for directly understand perceptions.

6 Discussion of Results

Chapters 3, 4 and 5 described the core of the thesis. In this chapter, the key results from the three chapters are taken up for discussion. The discussion in this chapter is with respect to the key research questions and the modified design process and its validation.

6.1 Influence of designers' and users' culture on the design process

The influence of the designers' own culture and the influence of the target user's culture on the design process was examined in Chapter 3 with the help of 1:1 design studies with two groups of seven design students from India and Germany using the think aloud protocol. The design students were asked to design through concept sketches the vehicle cluster instrument for the provided Indian and German personas. The data from the design activity, along with the notes and sketches from the activity was analysed quantitatively (total percentage time, no. of transitions, no. of explorations, etc.) and qualitatively (strategies for layout and positioning of elements, kinds of transformations during sketching, sources of inspiration, etc.).

6.1.1 Influence of the designers' culture on the design process

The analysis of the data to examine the influence of the designer's own culture on the design process revealed that Indian and German students both followed similar steps during the course of the design activity. This similarity is attributed to the history of design education in India, which is based on European design philosophies and pedagogy such as Bauhaus and Ulm (Kuriachan, 2014). This similarity in background means students from both cultures were educated according to similar philosophies, therefore similar steps were followed. The similarity in the steps followed in the process could also be due to the "tight" design brief and associated documentation used in the activity. This is discussed later in Chapter 7.

The major difference in the steps followed was that Indian students performed the mood board exercise to help guide their design, whereas none of the Germans used mood boards. The reflective interviews with the German students revealed that they would carry out the mood board activity in their typical process, but it was not one of the steps they relied heavily upon for design. Further probing during the reflective interviews revealed that design with the help of mood boards was not specifically encouraged in the design school the students came from (all the German students who participated in this activity came from the same design school). Another reason for the students not to perform the mood board was that some German students considered the images provided in the persona document and the state of the art studies they carried out as providing sufficient information for design. This was different for the Indian students, where mostly all performed the mood board exercise in various ways, such as attitude-based mood boards, culture-based mood boards, preference-based mood boards, etc. This difference in applying the mood board exercise (or not) had a cumulative effect on the other analysis measures such as the number of transitions considered for analysis, the number of exploration sketches, etc.

Another curious difference in the design processes was observed with regard to the sources of inspiration for design. It was observed the Indian students used the technique of image mapping where there was a tendency to directly translate the inspiration into the design. This can be attributed to the practice of using mood boards, which the German students did not do. Although there was a direct translation from inspiration to design, the Indian students said the inspiration form would typically be translated into the design in an abstract way and/or only certain elements of the inspiration would be considered for design. This abstraction of the inspiration was consistent with what the German students said they would do in their typical design process.

In addition to the similarities in education background discussed above, the fact that the participants of this study were students and are still in the process of developing their own design philosophy and process is another reason for the similarities in the steps followed in the design process i.e., they tried to employ what they had been taught in class. This agrees with Lawson (2005), who says that the decisions designers make depend on their own knowledge, experience, education, and the impact of others, including colleagues, clients, and end users. Therefore, it is recommended that future research in this area involves professional designers where stronger influences of the designer's own culture can be expected, possibly leading to greater differences in the design process.

From a qualitative perspective, differences were found in the interpretation of the design brief and persona. The German students looked to incorporate additional functional features to satisfy the persona, whereas the Indian students only looked to incorporate the persona's aesthetic preferences. In addition, there was a tendency for both groups of students to interpret information about the persona in relation to their own context. This seemed to have influenced the inspirations chosen for the final design and the design itself. In this regard, a further study with different products and cultures needs to be carried out to determine whether it is a design brief/persona specific trend or a tendency for students/designers belonging to a particular culture to interpret briefs and personas in a certain way.

Further qualitative differences were in the approaches to sketching, where German students considered the whole context of the car before sketching the CI but the Indian students considered the CI as an independent unit. However, similarities were observed in the kind of transformations used by the students during the sketching activity. Both groups of students used lateral transformations while exploring aspects related to the form of the CI and used vertical transformation for aspects related to the layout and positioning of the individual elements within the CI. These similarities can be attributed to the nature of the design brief, where the positioning and layout of the individual elements is influenced by the overall form and therefore tends to dictate vertical transformations. On the other hand, since the form aspects are relatively independent, they enable easy lateral transformation from one exploration to another.

As illustrated in Chapter 3, the reflective interviews of the typical design process also revealed highly similar processes being followed. One difference observed between the two groups of students was in the selection of the final concept. The German students said they

would consciously achieve a little distance from their design before making a final selection. This is once again believed to be strongly connected to the practice at a particular design school, where the faculty consciously encourage the students to achieve a little distance from their design so they can better evaluate and select the final concept. This was in addition to the recognition and conscious effort to value intuitive ideas. Some German students made a conscious effort to express and document all their intuitive ideas before getting into any sort of state of the art or user research. This is in line with the author's belief that intuitive ideas are sometimes the best ideas, and often get lost during the research and other phases of the process. On the other hand, some of the Indian students consciously performed a semantic exercise on the mood boards to extract relevant elements for design. This again is seen as a practice of the design school: the students were taught a course on product semantics and extraction of semantic cues from products for design.

In summary, the design processes followed by the two groups of students were generally similar in terms of the steps followed. Among the differences observed, some were attributed to culture, while others were attributed to the influence of the students' design education and the practice of their design school.

6.1.2 Influence of the target users' culture on the design process

The analysis of the data to examine the influence of the target users' culture on the design process found no major changes in terms of the steps the students followed. However, it was observed that students adopted different strategies within particular steps or spent more or less time in certain steps to deal with the familiar and unfamiliar personas.

Quantitatively, when faced with the task of designing for the unfamiliar persona, the German students spent more time on the 'form exploration' step, whereas the Indian students spent more time in the mood board exercise. This indicates that the unfamiliarity of the persona resulted in conscious decisions on the part of the students to make up for the 'missing' information. Throughout the 1:1 design study, use of the mood boards was one of most important steps the Indian students followed before generating a design, therefore it was natural for students to spend more time here. This difference is further reflected in the increased number of transitions the Indian students made while designing for the unfamiliar persona. Meanwhile, none of the German students used mood boards for design during the activity, which led to more time being spent on the form exploration step. As a result, they produced more exploration sketches.

The familiarity and intimate knowledge of a culture resulted in both groups spending more time in the final concept step while designing for the familiar. The familiarity and intimate knowledge with the particular culture meant more explicit assumptions and fewer units of information from the persona document were considered. This could possibly also indicate a general, overall trend where designers believe they are sufficiently familiar with the persona and culture and therefore do not need to pay too much attention to the persona and design brief. This can lead to designs that do not fully meet the persona's requirements.

From a qualitative perspective, designing for the familiar resulted in a focus on lifestyle aspects, leading to knowledge-driven designs (Kruger & Cross, 2006). Designing for the unfamiliar resulted in a focus on information such as the persona's fashion sense and possessions, leading to information-driven designs (Kruger & Cross, 2006). The German students' information-driven design while designing for the Indian persona resulted in a strategy for the layout of elements within the CI based on persona preferences, whereas the functionality of the elements was the basis for the layout while designing for the familiar German persona.

Reflective interviews indicated that students would normally perform additional research with regard to competitive benchmarking, lifestyles, communication within the culture, and direct contact with users from the target culture, etc. to better inform and guide their design. As expected, these additional research steps would not be performed/given less importance if the student were to design for a familiar culture/user group. As seen earlier, familiarity and intimate knowledge of the target culture leads to more assumptions being made, with the risk of designing for oneself rather than the actual needs of the user. However, intimate knowledge and familiarity is essential to come up with creative workable solutions, as unfamiliarity either leads to variations of existing designs based on benchmarking, or designs that do not work in the context of the unfamiliar culture. Therefore, a balance needs to be struck between ensuring the designer does not design for oneself and effectively using the intimate knowledge of the culture to create innovative, workable solutions.

6.2 Influence of designers' and users' culture on a design

The influence of the designers' and users' culture on the final designs was examined via expert evaluations of the final concept sketches produced during the 1:1 design studies. The experts evaluated the concepts based on three broad categories of culture-concept fit (CCF), usability and general impressions. CCF and usability, along with their sub-parameters, were evaluated with respect to the target persona. The general impressions category was evaluated based on the experts' own impressions of the quality of the concepts produced. In addition to the evaluation of the concepts, the comments and observations by the experts during evaluation were also considered when evaluating the research questions.

6.2.1 Influence of the users' culture on a design

In order to examine the influence of the users' culture on the final designs, the evaluation categories of culture-concept fit (CCF) and Usability were considered. The CCF and usability scores (Table 12, Chapter 3) revealed differences between the scores for the designs made for the familiar and those made for the unfamiliar, with the CCF scores showing a greater difference for both German and Indian students.

One of the reasons for the difference in the CCF scores is the students' intimate knowledge and understanding of the familiar culture/persona. Familiarity with the culture and the target persona meant better design decisions and choices in terms of aesthetics. This familiarity also meant that the students were able to directly relate with the given persona, whereas unfamili-

arity with a persona meant a heavy reliance on the information in the persona document and the internet research carried out during the activity i.e., information-driven design. This in turn led to less-informed and uncertain decisions during design, where often the students' own perception and influence were unknowingly substituted for the lack of in-depth knowledge about the unfamiliar culture/persona.

In this regard, as seen in McGinley (2012), a typical designer will draw upon their own knowledge, experiences (Norman, 2002; Cardoso et al., 2005), and resources at their immediate disposal (e.g., hard-drive contents, internet, etc.). Next they might try and access the knowledge held within their environment (i.e., studio, bookshelves, company reports, etc.) through resources such as colleagues and previous project records/reports (Hasdogan, 1996). If this produces little yield, they will look outward, consulting existing networks, eventually leaving their personal spheres altogether and attempting to enter the user domain, either directly or through representative bodies (Strickler, 1999). Accessing this domain can prove difficult (Dong et al., 2005; Crilly & Clarkson, 2006), and hence is frequently omitted from the design process. Further, consulting external users is often (incorrectly) judged as an inappropriate use of valuable time and outside of the designer's remit (Warburton, 2003). This can lead to a hasty approximation of end users, at best well-informed due to relevant previous experience and knowledge, at worst a superficial and inaccurate representation with little or no basis in genuine user insights

In light of the above and the results of the 1:1 design studies, designers/students must have a reliable understanding of the target users' culture through direct contact and/or other means. However, practicalities such as time constraints, ethics procedures, lack of experience, and lack of access can hinder this approach (Goodman et al., 2007). This is especially the case if the persona/user research is not created by the designers themselves.

The second possible reason for higher CCF and usability scores for the familiar in comparison to the unfamiliar can be derived from the results of the 1:1 design study, where the influence of culture on the design process was examined. The fact that a relatively higher percentage of time was spent on the final concept for the familiar in comparison to the unfamiliar indicates greater detail and effort in the illustration of the final concept, born out of familiarity with the culture/persona. Therefore, the influence of more detailed graphical illustrations of the concept cannot be ruled out. However, the method employed (the researcher verbally describing every concept as envisioned by the students, irrespective of the quality), and detailing in the sketch, along with fairly similar general impressions scores indicate a minimal influence.

Therefore, familiarity with the culture brings knowledge and understanding into play beyond the information given in the persona document, which positively impacts the design. Unfamiliarity with the target culture resulted in the students' own perceptions about the target culture being employed, rather than the design being purely based on the information provided in the persona document and its interpretation, which in turn is influenced by the designers' own culture and experiences. These results indicate the need for designers to deeply understand their target users, specifically their perceptions, for more acceptable designs.

6.2.2 Influence of the designers' culture on a design

The influence of the designers' culture on the final designs was examined with the help of the expert evaluation of the general impressions parameter category. The parameters in this category included clarity and presentation, aesthetics and design, and expressiveness. The experts' comments and observations during the evaluation were also taken into consideration.

No specific trends were observed in the evaluation, except that the expressiveness scores for the Indian students were higher than those for the German students. This accords with general impressions about India being a colourful and emotive culture, with the influence of Bollywood, traditional festivals, environment, etc. As no other discernible trends were found in the evaluation that could be logically justified, the comments and observations from the experts during evaluation were considered.

The qualitative observations from the experts revolved around specific factors. The German students tended to create traditional and minimalistic forms for the CI, whereas the Indian students tended to create non-traditional and playful forms. This was further evidenced by the Indian students suggesting a lot more asymmetrical forms than the German students, who tended to stick to symmetric forms. The choice of a symmetric form is driven by the function and value of the elements within the CI in the two cultures, particularly the speedometer and the tachometer. In Germany, both groundspeed and engine RPM are considered equally important, favouring symmetric forms, whereas in India the speedometer and tachometer are not always considered equally important, favouring asymmetric forms. Similarly, the culture of the designer influenced the choice of colour and colour combinations, where the Indian students (as expected due to the influences mentioned earlier) chose brighter, louder colours whereas the German students preferred a comparatively sober colour palette for their designs. Therefore, one can clearly say that the designers' own culture and experiences influenced the designs, even though they were provided with a detailed persona representing the target culture. These results once again call for the designers to better understand the perceptions of their target users in addition to the persona document to produce more compatible designs.

Therefore Section 6.2 indicates that intimate knowledge and understanding of the target persona/culture play an important role in the success of a design. Secondly, the difference in perception between the designer and the target user/culture is an important parameter to be considered in the design for unfamiliar cultures.

6.3 Modified design process to design for unfamiliar cultures

The results of the 1:1 design studies in Chapter 3 pointed to the necessity for students to appreciate the difference in perceptions between themselves and the users of the target culture or the difference in perception between users of their own culture and users in the target culture for better designs. Therefore, this thesis suggests a modified design process to enable designers to better design for unfamiliar cultures (i.e., obtain better CCF and usability scores). The modified design process retains the same general steps followed by the students with an addi-

tional step where they carry out perception studies. The perception studies block calls upon the designer to understand the product-specific differences in perceptions between them and the target users. In this regard, two example studies using the Repertory Grid Technique and the Semantic Differential method were carried out to better illustrate the differences to the designers (Section 4.2). Both studies indicated a positive potential for the perception studies block within the modified design process.

Comparing the suggested modified design process to other possible alternatives to designing for unfamiliar cultures, the modified design process should complement some of the methods while providing an alternative to some others. For example, the modified design process complements and adds value to the Culture-centred Design (CCD) and Culture-oriented Design (COD) methodologies suggested by Shen et al. (2006) and Moalosi et al. (2008) respectively (Section 2.4.2). In the CCD, the use of culture-specific metaphors can be complemented and enhanced by product-specific perceptions of the product obtained via the modified design process. Similarly, the modified design process complements the COD through the possibility of it being used in its integration and cherishability phases. In the same way, other methods to derive culture-inspired products as suggested by Wang et al. (2013) could use perceptions studies to help map the various cultural elements to product design features.

The modified design process provides an alternative to cultural dimensions such as those by Hofstede (2000), which are known to guide designers during the design for different cultures. Although applied successfully in the fields of interface and interaction design (e.g., Marcus, 2006; Marcus & Gould, 2000) they have found little application in product design due to the lack of established understanding of how the cultural dimensions are related to different aspects of product design. The modified design process is an alternative here, as the designer can directly obtain product-specific perceptions from the users. Similarly, the modified design process a possible alternative to the Designer Precedent Approach (DPA) suggested by Razzaghi (2007). In the DPA, the designer is required to approach industrial designers from the target culture for initial design sketches to obtain a more precise idea about the requirements of the target culture. In the event these contacts are not available, the modified design process is a suitable alternative.

To validate this potential, it was necessary to confirm the real effectiveness of the perception studies block. This was achieved through a three-phase design activity, followed by expert evaluation of the resulting design concepts. The expert evaluation of the design concepts along the CCF and usability parameters from pre-workshop design activity was compared with design concepts from post-workshop design activity with and without the modified process. The students' feedback and experience on using the modified design process was also considered.

The results of the validation study showed the modified design process had a positive impact on the designs for both the familiar and unfamiliar cultures through better CCF and usability scores. While there was an obvious expected influence of additional perspective into the un-

familiar culture, the improvement in scores for the familiar culture suggests added perspective here as well.

From the results of the 1:1 design studies it was seen that more assumptions were made by the students when designing for a familiar culture, therefore bringing in the tendency of the students unconsciously designing for themselves. But, with the modified design process, the students designed less for themselves and more for the target audience. This is primarily due to the sensitisation of the students to the design brief and personas through the workshop on the modified design process between the pre- and post-workshop activities and also the ability of the perception studies block to not only compare the perceptions of designers and users across cultures but also within a culture (results from the perception studies using Repertory Grid Technique).

The students' qualitative feedback corroborated the positive influence of the modified design process. The fact that the difference in perceptions brought out through the perceptions studies directly compares intimate knowledge of the familiar and the unfamiliar was seen to be extremely useful. It is further believed that the difference in perceptions added perspective to the findings from other user research and state of the art research, irrespective of whether the students performed it themselves. In this regard, the methods used to understand perceptions were seen to be robust and effective, making it possible to study perceptions of different products across different cultures. Finally, the fact that the modified design process did not require any drastic changes to the typical process the students follow was seen as an added positive.

For the perception studies, although the Repertory Grid Technique provides detailed insights, it requires a lot of time and effort. The method also requires prior knowledge of statistics and support for the coding and analysis of the data collected from the participants. On the other hand, understanding perceptions via the Semantic Differential Method is relatively easy; however, the challenge here is to ensure the adjective pairs chosen for comparison are product-specific and valid for cross-cultural comparisons, i.e., ensuring the adjectives are perceived the same way across cultures. Kalenahalli Sudarshan et al. (2015) showed that only 9 out of 14 adjectives were suitable for cross-cultural comparisons. The use of adjective pairs that would be interpreted differently across cultures could ultimately lead to misguided design.

In addition to the students' feedback and the researcher's observations, certain limitations and possible improvements were identified during the validation study. The effectiveness of the modified design process is restricted to iterative design products and their aesthetic perceptions i.e., the modified design process is most effective when redesigning/improving upon the design of an existing product and not necessarily for the design of fundamentally new product. This is because the perception studies block is most effective in obtaining perceptions about existing products, i.e., product-specific perceptions. The single biggest point of improvement suggested by the students was in the tools used in the perception studies block. Although the perception studies results were seen to be extremely useful, the procedure for

obtaining these results was seen to be time consuming and complicated, requiring knowledge about statistics and other analysis methods. This proves to be especially limiting, given that students are not particularly exposed to statistical tools and methods in their design curriculum.

The feedback from the validation exercise and the shortcomings of the methods for understanding perception, combined with the fact that designers often feel mistrust towards data that has already been through a process of interpretation (Restrepo, 2004), mean a simple and more flexible way for designers themselves to administer perception studies is needed.

In this regard, an adaptation of the card sorting methodology is suggested as a simpler way to understand perceptions. Card sorting (Morville & Rosenfeld, 2006; Hudson, 2013) applies to a wide variety of activities involving the grouping and/or naming of objects or concepts. The card sorting activity can be conducted on a one-to-one basis as a tool for discovery (knowledge elicitation) and a means of generating meaningful discussion between participants and researchers (Weller & Romney, 1988; Bernard & Ryan, 2009).

In the adapted card sort method suggested in this thesis, the designer first has a collection of product specific images which the target user is asked to sort into predefined groups (closed card sort). These groups from the designer's perspective could be the keywords or themes around which the designer intends to design their object (Figure 27). Once the user has sorted all of the presented images (Figure 28), the designer can interact with the user to further understand the reasoning behind their decision. Questions during this interaction could include: "Were the images classified as premium because of form, colour treatment, or material?", or "What aspect of each of the images classified as premium category signify this quality?", etc. The designer thus obtains a direct understanding of the user's product-specific preferences and tastes, which in turn can be used in design.

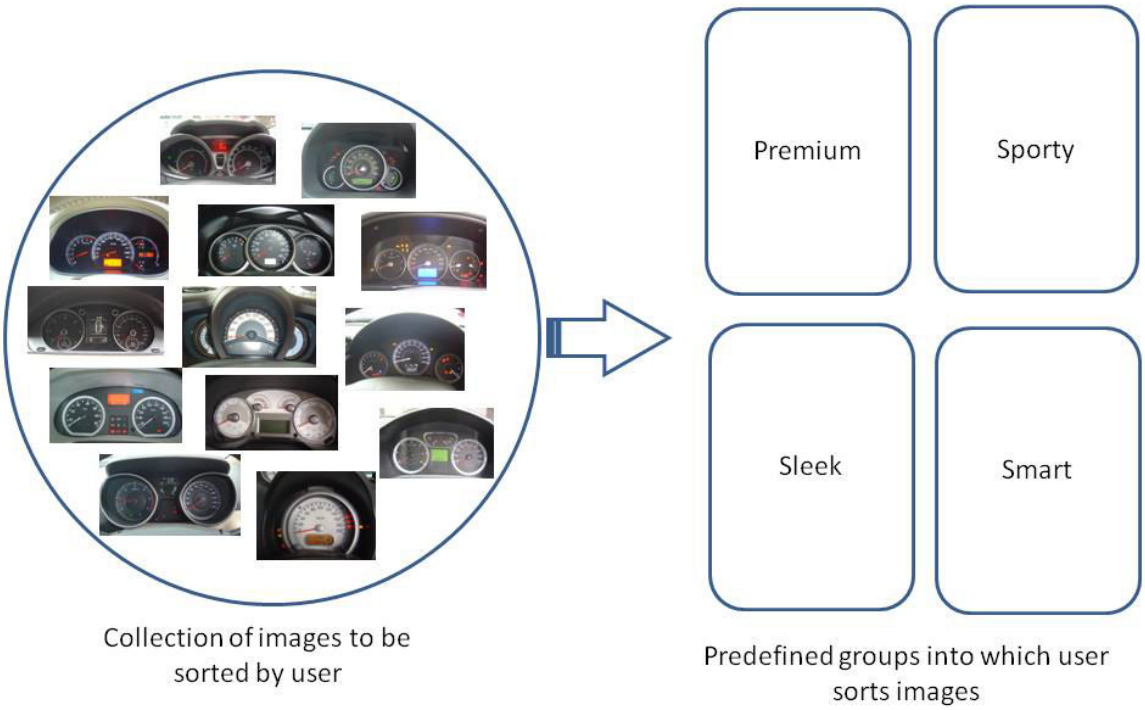


Figure 27: The initial set of images for the user to sort into predefined categories

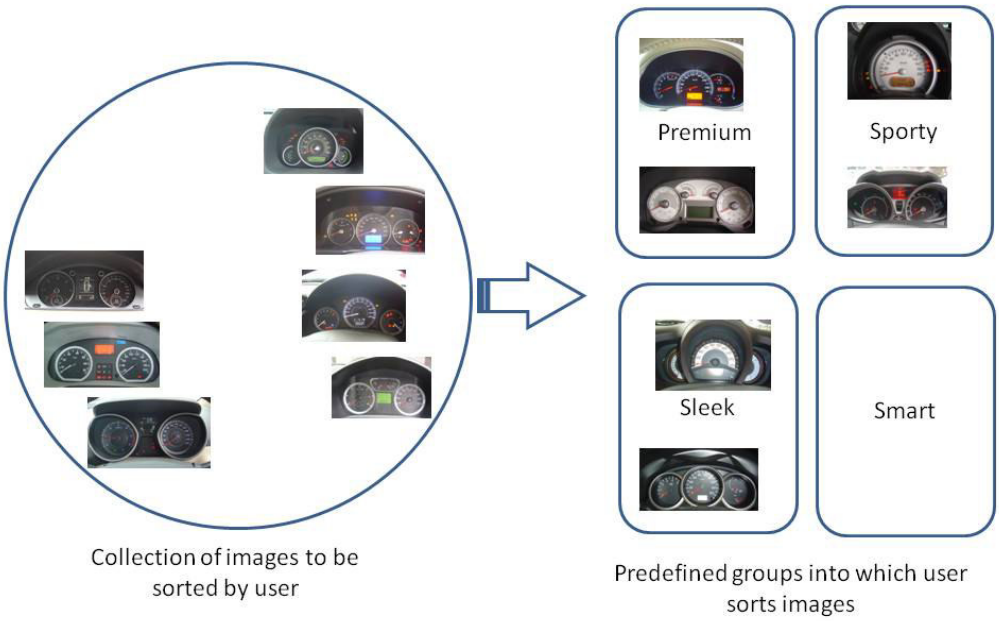


Figure 28: Example sorting into different predefined categories

The above method for understanding perceptions using card sorting can also be carried out using a set of random images to gain a general perspective of the user's tastes and preferences. When carried out without any predefined groups, the user can create their own categories (open card sort), which can provide insight into the user's mental model for evaluating products. Alternatively, a mixed card sort can be carried out where, in addition to predefined groups, the user is also allowed to create their own groups, leading to an interaction between designer and user.

Despite the lack of validation, this method of obtaining perceptions through card sorting should offer the following benefits to the designer. First, the method does not require any prior knowledge of statistics as the data obtained is very qualitative in nature. Second, the procedure is not dependent large number of users like the SDM technique, as just a few representative users could be sufficient to meet the designer's needs. Third, the same method can be used for a large number of users (scalable) to analyse the data through dendrograms (hierarchical cluster analysis), where the strength of relationships between various images/products/product attributes can be examined. Finally, and perhaps most importantly, the easy translation of the card method to online platforms (e.g., Optimal Workshop's optimal sort[11]) allows for the designer to use this method across cultures, even when they might not be able to make direct contact with the target users. Therefore, due to its simplicity and flexibility, the idea of understanding perceptions with the help of card sorting is seen to offer information that adds to the story of design development in a natural way, as recommended by Goodman et al. (2007). It is recommended that understanding perceptions with the help of the suggested card sorting method be further studied and validated to check its effectiveness and determine possible further improvements.

6.4 Summary

This chapter discussed the major results of all the studies conducted in this thesis. The results of the 1:1 design studies from Chapter 3 revealed a limited influence of the designers' own culture on the design process in terms of the major steps followed. However, it did reveal the influence of the target culture on the design process in terms of the strategies employed within particular steps. The final designs revealed an influence of the target culture on the design, as the designs for the unfamiliar received poorer CCF and usability scores than those for the familiar. The designer's own culture was also seen to influence the design through the general form and colour treatment.

As a result of the knowledge gained from the 1:1 design studies, a modified design process was suggested. The perception studies and the results of the validation of the modified design process were then discussed to show the positive impact of the process. Based on the feedback from the validation exercise, a further suggestion was made of using a card sorting technique to understand perceptions. The general idea was described, along with its potential to help understand perceptions. Finally, the advantages of the card sorting method were discussed, with regard to it being a less time consuming and less dependent on statistical methods than the Repertory Grid Technique and the Semantic Differential Method.

[11] http://www.optimalworkshop.com/optimalsort.htm Last accessed: 01.08.2014

7 Implications and Future Scope of Research

In this chapter the learning and implications of this research are dealt with from a methods perspective, followed by a discussion from the perspective of the thesis and research as a whole. The chapter concludes with suggestions for future research directions.

7.1 Methodological implications for future research

This section discusses the lessons learnt with respect to the methodology for examining the research questions. These discussions contribute to the body of knowledge for similar studies in future.

7.1.1 1:1 Design studies

1:1 intercultural design studies were carried out with design students from India and Germany to examine the influence of culture on designs and the design process. Students in their third semester (10 out of 14 students) or fifth semester (4 out of 14) of design education were chosen for the study, because by their third semester students are exposed to the design process in their coursework and will have employed the processes learnt in one or more of their assignments and projects. This was believed to be adequate experience for observing the cultural influences on design and the design process. However, it must be said that similar studies with professional designers might produce different results, based on Lawson (2005) who says that the decisions designers make are dependent upon their own knowledge, experience, education, and the impact of others upon them, including colleagues, clients, and end users.

In the light of the above, the 1:1 design activity with design students limits the applicability of the results of this study to general design practice. Therefore, similar studies with professional designers are recommended to make the results more generalizable. A further unforeseen limitation of the study is that the students came from a single design school in India and a single design school in Germany. This resulted in a strong similarity in the process followed by the students from each culture, which might have been different had the students been from different design schools. Therefore, future studies must accommodate participants from different design schools within a particular culture to discern the cultural influences on the design and design process.

Since the research involved a comparison of the design and design process, a common ground was necessary. This common ground for comparison was achieved by providing both sets of students with the same design briefs and personas. Although these measures enabled easy comparison, on reflection this “tight” design brief and the persona provided could have dictated certain steps of the process. Therefore, future research must find a balance between an “open” design brief which provides little common ground for comparison and a “tight” design brief and persona which has potential to influence the design process. It is further recommended to retain the strategy of choosing relatable and familiar products for the design brief instead of context-specific products, which would adversely influence studies of this nature.

An additional common ground for comparing the influence of culture was achieved by asking participants to design for both the familiar and the unfamiliar culture/persona. In this regard, the effects of the first activity on the second were considerably minimised by the design for the two different personas, randomising the order in which the activities were done, and by having a minimum of one day's gap between the two activities. On reflection, it is recommended the gap between the first and second activities be increased to a week to ten days in future studies. This increased gap would further minimise the possibility of the students being subconsciously influenced by the results of their first activity, as was observed qualitatively in this study. This suggestion would particularly work when the students are unaware of the brief in their second activity, therefore eliminating the possibility of them consciously or unconsciously preparing for the activity in advance.

For analysis, cultural dimensions were not used because both groups of students received the same design brief and persona. On the other hand, a comparatively "open" design brief such as the one used by Razzaghi (2007) would allow for a comparison using cultural dimensions. However, the use of the dimensions would be restricted to comparison and analysis of the design and not a comparison of the design process, which was one of the objectives of this thesis. Therefore, the think aloud protocol and the associated procedures and measures for analysis was adopted (see Christiaans (1992), Dorst (1997), Kruger & Cross (2006), Rahimian & Ibrahim (2011), Jagtap et al. (2013), etc.). Future research must therefore consider the objective of the comparison (i.e., only designs, only the design process or both designs and the design process) before choosing the appropriate analysis measures.

Data triangulation was used and is recommended for analysis. The use of data triangulation for the analysis provided two distinct advantages. First, referring to findings across different sources of data brings validity to the observations. Second, it helps in justifying the arguments made from the analysis. For example, for the Indian students, the lack of intimate knowledge of the target persona's culture led to more units of information from the persona document being considered, which in turn led to more time spent being on the mood board exercise.

7.1.2 Expert evaluation of the designs from the 1:1 design studies

An expert evaluation was carried out on the designs produced in the 1:1 design studies. The designs were evaluated to examine the influence of culture (the designers' own and the target culture/persona's) on design. Here, the experts evaluated the low fidelity design concept sketches proposed by the students during the 1:1 design study. As mentioned previously, the nature of the design brief and personas used in the 1:1 study meant difficulties in evaluating the designs along cultural dimensions. Therefore, the parameter categories culture-concept fit, usability and general Impressions along with their sub parameters were created so the overall quality of the design and its appropriateness to the target culture/persona could be evaluated. In this regard, it must be mentioned that these parameters were created for the purposes of this thesis only, and further research must be carried out to validate and develop a set of robust parameters to evaluate the suitability of any given design across cultures.

During the expert evaluation, the initial pilot rounds revealed the influence of the expert's own culture and perception during evaluation, resulting in varied opinions on the design concepts. The varied opinions from the experts created problems in thoroughly understanding the suitability of a given concept for the target culture/persona. In addition, the experts' evaluation of the sketches was also influenced by the quality of the sketch and presentation.

In order to overcome these difficulties, there was a thorough explanation and discussion of the personas and the personas' requirements to achieve a common understanding before evaluation. In addition, each of the concepts was fully explained by the researcher before the evaluation so as to minimise the influence of the quality and presentation of the sketch and to also give an opportunity for the concept to be imagined and understood in totality before evaluation. At the same time, the experts' intuitive impressions were also captured with the help of the pre-evaluation card sort activity and the evaluation according to the parameters in the general impressions category. The card sort activity provided qualitative insights into the typical aspects of design from Indian and German students, and typical aspects of design for a particular target culture. The disclosure of both the target culture/persona and the country of origin during the in-depth evaluation helped the experts comment further on the influence of the designers' own culture and the target cultures' influence on the design. This mixed approach of direct evaluation of the design concepts and the persona/culture based evaluation helped holistically answer the research questions. Despite the approach requiring the experts to constantly shift from personal opinion to evaluating from the perspective of the target culture/persona, this approach is recommended for future research that involves expert evaluation of concepts designed for different cultures.

Ideally, the concepts would have been evaluated by the users, but the number and type of sketches prevented user evaluation. However, it would be of interest for future studies to carry out evaluations with actual users to find the suitability of the concept for a particular culture. A user evaluation would additionally examine and provide insight into whether there are any differences between the opinions of experts and users.

7.1.3 Validation of the modified design process

The findings of the 1:1 design studies revealed that intimate knowledge of the target culture/persona led to better designs i.e., higher culture-concept fit and usability scores. A modified design process was suggested to help students design better for unfamiliar cultures through a call for students to understand the target user's/culture's perception of the product being designed. In order to validate the effectiveness of the modified design process, particularly the perception studies block, a validation exercise was carried out. The validation exercise was broken up into three phases: a pre-workshop design activity, a workshop that exposed the students to the modified design process and the perception studies, and finally a post-workshop design activity. The pre-workshop and post-workshop design activities were take home assignments of 2-3 weeks each, which enabled the students to go through their normal design process to design for the two personas. The take home assignments also meant

that the end deliverables were digital renders rather than the concept sketches seen in the 1:1 design studies. This procedure allowed for a direct comparison between the students' pre-workshop and post-workshop activities (i.e., post-workshop design activity without the modified process versus post-workshop design activity with the modified process). The effectiveness of the modified process was examined by comparing the results of the design activities (pre-workshop and post-workshop). These were once again evaluated by experts according to the parameters used in the 1:1 design studies. In addition to the expert evaluation, the subjective feedback of the students on using the modified design process and the perception studies was considered.

However, the methodology applied to the validation studies had limitations. Firstly, the sample size of 14 design students (of whom only four were from Germany) was rather small. A larger sample size across different cultures is needed to validate the modified design process suggested in this thesis.

Second, since the objective was only to validate the modified design process, the personas were directly provided to the participants. Although this met the purpose of the study, it did not provide the students an opportunity to carry out their own research to create the personas. Likewise, the results of the perception studies were also directly provided to the participants, without allowing the students to carry out their own perception studies. A thorough validation of the process is only possible via longitudinal studies where students carry out their own user research and perception studies. In addition, directly providing the results of both the perception studies to students precluded the possibility of determining which of the two methods is most useful for design. Therefore, further research must also look into examining the effectiveness of each of the methods used to study perceptions. Finally, future evaluation studies of this nature could use actual users instead of experts to evaluate the concepts generated. As mentioned in the previous section, evaluation with actual users would provide information on the differences between the opinions of experts and actual users. In this regard, it would also be of interest to perform a cross evaluation of the designs, e.g., German users evaluating concepts made for India and Indian users evaluating concepts made for Germany. Such an evaluation would provide insight into the transferable aspects of the design.

7.2 Tools to understand differences in perceptions

The limitations of the Repertory Grid Technique and Semantic Differential Method, combined with the researcher's own observations and the students' feedback, suggested that simpler tools need to be developed that enable students to directly understand the difference in perceptions. It is believed that the ease with which perception studies can be performed is a critical factor in sustained adaptation of the modified design process in design projects.

Therefore, it is suggested that a mixed card sorting activity be carried out with a group of target users where competing products or similar products from different domains would be sorted into predefined or user defined categories. This card sorting activity, when combined

with an exploratory interview, has the potential to provide extremely useful product-specific insight and guidance. Along similar lines, other tools and methods must be developed to offer easier means for students to understand differences in perception, which in turn will lead to better guidance while designing for different cultures.

7.3 Implications – exposing students to the modified design process to design for different cultures

The results of the 1:1 design studies indicated that the design process followed by the students in the two countries were quite similar. The evaluation of the designs, on the other hand, showed limited understanding and appreciation about culture and the role it plays in design, especially when designing for an unfamiliar culture. A cursory glance at the design curriculum in some of the design schools in India and Germany, particularly the schools in this thesis further reveals that the students are not adequately exposed to cultural aspects of design as approached in this thesis i.e., perceptions of everyday products in different cultures. Students are currently exposed to culture and design from the perspective of traditional art forms and their integration into design, rather than the specifics of designing for international, unfamiliar audiences. This further echoes the findings of Reese (2002) who talks about the lack of industrial designers' know how in cultural integration, stemming from a gap in their education.

The modified design process suggested in this thesis attempts to sensitise students to differences in culture through aesthetic perceptions which in turn guide their design for different audiences. The three phase methodology chosen to validate and introduce the students to the modified design process was found to be encouraging by the faculty and students of the design schools in which the studies were carried out. The effectiveness of the process and the method of instruction (a multiphase workshop activity with hands-on experience of the process) are further confirmed by the researcher receiving invitations to return to some of the design schools to conduct the same workshop for the next batch of students.

With the above encouraging feedback, the researcher envisions the modified design process along with the associated workshop being formally offered to design students. Pre-final year design students are the ideal targets, as they are sufficiently exposed to the necessary aspects of design and design processes but are still in the process of establishing their own philosophy and process for design. The workshop format would sensitise the students to culture, cultural differences from a theoretical perspective followed by practical implications of how cultural differences can impact design, and is seen as a possible way to promote awareness of this topic. Furthermore, the hands-on design activities with a formal introduction to the modified design process between the pre-workshop and post-workshop design activities would provide the students with a holistic perspective about designing for different cultures and audiences.

Once exposed to the influence of culture in design, the students can use this awareness in their other design projects to further experience and experiment with the modified design process. It is envisioned that this exposure to the influence of culture in design through the suggested workshop format would be carried forward to professional practice. Even though the modified

design process might not be directly used in professional practice, for various reasons, it is believed the sensitisation brought about by the process and the associated workshop would help in creating better designs. This suggested workshop format is believed to fit well in the context of the design schools and also adequately capture some of the essentials of the course proposed by Razzaghi & Ramirez (2010).

From a wider perspective, it is recommended that academics explore possibilities for increasing exposure and sensitisation of culture and its impact on design to students as viewed in this thesis, in addition to culture as viewed from the perspective of traditional art. This sort of sensitisation and exposure is particularly important, given that globalisation has resulted in multicultural design teams and designers often being asked to design for unfamiliar cultures.

7.4 Directions for future research

The course of this research saw in-depth studies to examine the influence of culture on designs and the design process, with the help of 1:1 design studies. The learning from the 1:1 design studies further resulted in the creation of the modified design process to better guide design for different cultures. The encouraging results from the studies carried out in this thesis have laid a foundation for future work in this area. In addition to the improvements suggested in the methodological perspective, the future scope of research will now be envisioned from both the student/designer's perspective and the research perspective.

From the student/designer's perspective, as previously mentioned there is strong need for the development of simple tools and methods to understand target users' perceptions of products across cultures and cultural engagement with products. The tool must be simple enough to encourage students/designers to employ perception studies as one of the critical parts of their design process. The suggestion of the mixed card sort activity made in Chapter 6 must be explored further.

From a research perspective, the influence of culture should be examined with different products and product categories across cultures so as to understand the level of cultural influence on the various products/product categories. In addition, formal parameters to evaluate the culture-concept fit must be developed to measure the cultural engagement of products. This would add value to the modified design process and thereby culture integration models for design. These developments would provide designers with an insight into the level of cultural consideration required when designing a product for a particular culture. For example, cultural considerations for a kitchen product would be a lot more than those for a smart phone. This echoes Razzaghi's (2007) suggestion of a theoretical categorisation system aimed at linking the level of cultural consideration needed and product types. Further, these developments could be incorporated into resources and systems like the MHIROR (McGinley, 2012) which would further contribute to the level of information and empathy available in the quest for people-centred design output.

Additional areas of future research from a research perspective include mapping popularly used cultural dimensions to product design, as seen in interaction and interface design (e.g., Isa, Noor, & Mehad, 2007). In the same way, design processes can be examined along cultural dimensions whose understanding would facilitate cross-cultural collaborations in design. Finally, since the studies in this research involved students, it is recommended that future research involve professional designers to examine whether the findings from this research continue persist in professional practice. If they do not persist, then the techniques used by professional designers to design for unfamiliar cultures must be documented, which in turn could help students going forward.

7.5 Summary

This chapter first discussed some of the methods used to answer the key research questions through the 1:1 design studies and expert evaluation that could be employed for future research. However, future studies are encouraged to improve upon some of the shortcomings in the methodology used here, such as finding a balanced design brief, including participants from multiple design schools within a particular culture, carrying out design studies with professional designers, and the evaluation of concepts by actual users to better understand the influence of culture on the design and design process.

In light of the findings of the 1:1 design studies and expert evaluation, a modified design process was suggested. The methodology adopted to validate the modified design process was seen to effective and could be adopted for future research. Suggestions for future research here include longitudinal studies, evaluation, and cross-evaluation of the concepts with actual users. Further suggestions were made with respect to the development of simpler tools for designers and students to directly understand the perceptions of their target users. The chapter went on to describe the vision of formally sensitising design students to aspects of culture and the design for unfamiliar cultures through a workshop module. Finally, the chapter concluded with the scope for future research from the student/designer's and research perspectives.

8 Summary of thesis and conclusions

Recent years have seen an increased demand for designers to be able to design for users in different and unfamiliar cultures. This demand has resulted in a recent research focus on culture and design. However, a state of the art review revealed limited focus thus far on the influence of designers' and users' cultures on both individual designs and the design process as a whole. The key research questions to examine the influence of the designers' and users' cultures on designs and the design process were addressed via 1:1 design studies with German and Indian design students, where the results of the design process (design concepts) were evaluated with the help of experts.

The 1:1 design studies indicated little difference in the steps in the design process followed between designers from the two cultures or when designing for different cultures, except for variations in strategy based on the target culture/persona. The expert evaluation of the designs showed clear influences of designers' culture on the design, along with the fact that intimate knowledge of target user/user's culture played an important role in the success of designing for the unfamiliar.

In order to help better design for unfamiliar cultures, a modified design process was suggested, with an explicit call to understand the difference in perceptions between the designer and the target user/culture. The suggested modified design process was validated through multiphase design activity with design students in Germany and India. The validation studies showed the modified design process and the perception studies had a positive impact on designing for both familiar and unfamiliar cultures. However, qualitative analysis and feedback revealed the need to develop a simpler tool to understand perceptions.

One envisioned consequence of this thesis is the formal sensitisation of students to aspects of culture and its influence on design, which in turn would help students be better prepared to design for different and unfamiliar users/cultures. Finally, the future scope of research based on this thesis could include the development of formal methods and parameters to measure cultural engagement of various products and product categories, and research into the mapping of popularly used cultural dimensions onto product design and design process.

From a larger perspective, this thesis makes an original contribution to research in the area of culture and design by addressing the identified gap in research through a study of the influence of culture (designers' and users') on both individual designs and the design process as a whole, thereby building on and complementing the work done by Razzaghi (2007). The methodology used to examine the identified research questions establishes an initial framework to compare designs and design processes across cultures. The suggestion of the modified design process along with the perception studies adds to the body of work in the area of methods and tools to design for different cultures. Furthermore, a preliminary idea about a mixed card sort method is made in response to one of the findings, in an attempt to develop simpler tools for designers to understand perceptions.

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10 Appendices

10.1 Design Brief for the Exercise – India

You are working for a Product Design Consultancy where your customers include a leading automotive part supplier. Your client wants to enter new and emerging markets such as India, and therefore wants new design concepts for the **automotive cluster instrument**.

Your design is for the "hatchback" segment of cars ("kleinwagen" in Germany, examples- VW Golf, VW Polo, BMW 1er, Suzuki Swift, etc.) for the **Indian market, targeting young working professionals**.

The customer has carried out extensive user research and come up with a user persona representing the target user population you need to design for (see Attachment 1).

Specifications and constraints

The following elements must be illustrated in the concept design

- Speedometer (maximum range – your choice)
- Tachometer (maximum range – your choice)
- Odometer (no. of kms the vehicle has travelled)
- Fuel
- Indicators (both ON condition)
- Engine/Engine coolant temperature
- Seatbelt Warning
- Door open indicator (optional)
- Outside temperature

Standard symbols are available from the researcher for reference. The internet can also be used for any additional references.

You are free to choose digital, analogue, or a combination to display the information.

Deliverable

Concept sketches and/or renders to best illustrate the concept/s with description of the colour treatment, material, and finish.

10.2 Design Brief for the Exercise – Germany

You are working for a Product Design Consultancy where your customers include a leading automotive part supplier. Your client wants to regain market share in the German automobile market and therefore wants new design concepts for the **automotive cluster instrument**.

Your design is for the "hatchback" segment of cars ("kleinwagen" in Germany, examples- VW Golf, VW Polo, BMW 1er, Suzuki Swift, etc.) for the **German market, targeting young working professionals**.

The customer has carried out extensive user research and come up with a user persona representing the target user population you need to design for (see Attachment 1).

Specifications and constraints

The following elements must be illustrated in the concept design

- Speedometer (maximum range – your choice)
- Tachometer (maximum range – your choice)
- Odometer (no. of kms the vehicle has travelled)
- Fuel
- Indicators (both ON condition)
- Engine/Engine coolant temperature
- Seatbelt Warning
- Door open indicator (optional)
- Outside temperature

Standard symbols are available from the researcher for reference. The internet can also be used for any additional references.

You are free to choose digital, analogue, or a combination to display the information.

Deliverable

Concept sketches and/or renders to best illustrate the concept/s with description of the colour treatment, material, and finish.

10.3 Persona documents used in the study – Germany

The Explorer

Max Kendler
28-30yr. old Male from Darmstadt
55000 - 65000 € per yr

Production line Engineer at XZY Gmbh, Rüsselsheim since 3yrs

Lives with his girl friend in Nauheim just outisde Rüsselsheim

Proud of his travels and recently completing a Scuba diving certification

Scuba-diving, Travel, Music and Hiking

"Life is a challenge, but there is nothing like doing it and having it all to show"

Determined | Open minded | Fun loving | Adventurous | Loyal

Max has a Masters degree in Process and Production Engineering from TU Darmstadt. He has been working since 3yrs as a Production line Engineer with an Automotive part supplier in Rüsselsheim. His primary responsibilities include planning, coordinating and controlling the process concerning to production. Max's 8 hr, 5 day week at work typically involves monitoring the production activity on the shop floor and also meet and coordinate with different departments and colleague to ensure smooth and consistent production. Max returns home at 7p.m after a 30min. drive from work with a list of tasks to do next day already waiting for him at work.

Max lives in a 2 bedroom rented house in Nauheim which is just outside Rüsselsheim with Carmen, his girl friend since 8yrs. Being an adventurous couple, they have had travels to many hiking trips to places like Thailand, Scotland, South Africa, etc. On a recent vacation in the Carribean islands,Max successfully completed a scuba-diving certification.

Scuba diving apart, Max tries to make it to the local Gym atleast 3 times a week to remain fit. Max has an active social life where he often meets his friends to watch football games of his favourite team BVB. Having learnt to play the guitar at school, Max also listens to a lot of music with bands such as Aerosmith, Guns n Roses, Led Zeppelin being his favourites.

Why does he want to buy a car?: Max has been driving around his fathers' old VW Polo since college and feels he now needs a bigger and a more respresentative car for his current status in life. The fact Max and Carmen going to get married only adds to his need to buy a bigger better car.

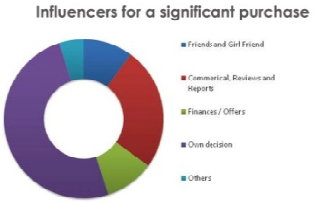
The Explorer

Fashion
Highly brand conscious dresser. With brands like Tommy Hilfiger, Jack Wolfskin, etc adorning his wardrobe. His attire heavily depends on the weather and season. At work he wears smart formals and changes into the required overalls if needs to visit the production line.

Seasonal shopper

Myers' Briggs Personality and Self Image								
Extrovert		■						Introvert
Sensing		■						Intuition
Thinking	■							Feeling
Judgement	■							Perception

"Any sort of significant spending involves alot of research and trials "



Aspirations for Usage of a General Product								
Low Cost				■				Extravagant
Fast						■		Precise
Simple					■			Powerful
Time saving		■						Savouring time
Privacy		■						Social connection

Asipiration for Product Characteristics															
General Product - Gadget									Cluster Instrument						
				■	■	■	Compact/Small	■	■						
					■	■	Premiumness	■	■	■					
		■	■	■	■	■	Price/Cost	■	■	■	■	■			
	■	■	■	■	■	■	Feature Rich	■	■	■	■	■	■	■	■
	■	■	■	■	■	■	Rugged	■	■						
					■	■	Customizable	■	■	■					
					■	■	Easy to share / show off	■	■						

"Feature Rich means that the prduct should be able to provide me with a lot of information and options for use.
Customizeable is not impo rtant as long as it does what it is supposed to properly.I do not want gimmicky customization like changing skins, etc
Premiumness means - a good material and finish which makes the product look simple yet sophisticated therefore, Premium"

10.4 Persona documents used in the study – India

The Aspirer

Vignesh K. Hegde
26-28yr. old Male, Single
B.E. and M.B.A

Manager Business Development and Operations at FACE, Bangalore

Lives alone in Bangalore. Visits parents and sister over the weekends

Proud of topping the college during M.B.A and securing a job off campus

Indian Movies, Cricket and Manga Comics

"Life is a challenge, but there is nothing like doing it and having it all to show"

Determined | Open minded | Humourous | Honest | Passionate

Vignesh has a degree in Management (M.B.A) and has been working with a Corporate training start up called FACE since the last year. His primary responsibilities include client development and coordination of the services offered i.e., trainer schedule coordination, travel, logistics, etc. Vignesh's 12-13hr a day often includes 50 - 70km of riding around the city meeting clients on his bike. He returns home late in the evening with always some work left over.

Vignesh lives alone in a 2 bedroom apartment in the suburbs of Bangalore. His parents and younger sister live in Shimoga which is about 6hrs by road from Bangalore. His parents, both bank employees live in Shimoga and plan to move in with Vignesh soon after retirement in a couple of years.

Club cricket, Bollywood and Regional movies with friends take up most of his free time. He also has been collecting Manga comics since the last few years which was he was introduced to by a friend.

Vignesh is very proud of securing highest marks and topping the college examinations. He is also proud of securing a job off campus.

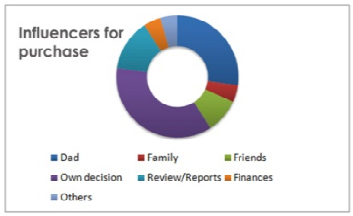
Why does he want to buy a car?: Constant travel on his bike on bad roads is taking a toll on his back. He also feels it will be representative when goes to meet clients. He also sees a car being useful to visit his parents over the weekend. Most importantly, it will be a matter of pride for him and his parents if he buys a car from his own money other than being one up on his peers.

The Aspirer

Fashion
Heavy dresser with Jackets and boots, big- steel watches, religious bands and bracelets. Tatoos of a Phoenix on left arm
Shops frequently for clothes and shoes (Branded stores)

Myers' Briggs Personality and Self Image								
Extrovert		■						Introvert
Sensing			■					Intuition
Thinking						■		Feeling
Judgement				■				Perception

"Any big purchases like a car or a bike generally involves a lot of consultation in particular with my father "



Aspirations for Usage of a General Product								
Low Cost							■	Extravagant
Fast			■					Precise
Simple							■	Powerful
Time saving						■		Savouring time
Privacy							■	Social connection

Asipiration for Product Characteristics															
General Product - Gadget									Cluster Instrument						
				■	■	■	■	Compact/Small	■	■					
			■	■	■	■	■	Premiumness	■	■	■	■	■	■	
				■	■	■	■	Price/Cost	■	■	■	■	■		
■	■	■	■	■	■	■	■	Feature Rich	■	■	■	■	■	■	
				■	■	■	■	Rugged	■	■	■	■			
■	■	■	■	■	■	■	■	Customizable	■	■	■	■	■	■	
	■	■	■	■	■	■	■	Easy to share / show off	■	■	■	■	■		

"Feature richness means I should be able to do many things with a single product. Premiumness for me means that using the product should give me a sense of being exclusive and one of a kind."

10.5 Example of Protocol Used in the Design Study

10.5.1 Informed Consent Form

This is a study about designing for different cultures. Our goal is to understand the influence of culture in design and design process. Your participation will help us achieve this goal.

In this session, you will be working on a short design activity where you will redesign the vehicle cluster instrument for a particular culture. We request you to perform the task just as you would undertake any other design task. Member(s) of the research team will sit in the same room, quietly observing and taking notes. The research team member will also help you if you are stuck or have questions during the design task. While performing your design task, you will be asked to "*think aloud*" so that the researcher better understands your thought process and ideas.

The session is divided into the following blocks: 1. Introduction and training 2. Design Activity 3. Discussion on design and design activity

All data and information collected (sketches, etc) in the session belongs to Institute and **will be used for research purposes only**. We will videotape and audiotape the session for further research. We may publish our results from this and other sessions in our reports, but all such reports will be **confidential** and **will not include your name. If in case we wish to use one of your designs as an example in our report, we shall explicitly ask your permission before doing so.**

A participant incentive (Amazon voucher / cash voucher of Rs. 1000/-) would be given as a token of our appreciation for participating in this research study.

Please remember we are not testing you or your design skills during this session.

You may take breaks as needed during the study at any time.

Statement of Informed Consent

I have read the description of the study and of my rights as a participant. I voluntarily agree to participate in the study.

Participants Name:

Semester and Branch:

Age:

Sex:

Email:

Signature:

Date:

10.5.2 **Think Aloud Protocol – Training – 15 mins**

Task 1: Water jug problem

You have two water jugs. One jug can hold 5 litres and the other 3 litres. The jugs have no marks and you cannot see how much water they contain. They can be filled from a water tap and emptied into a sink. You can also pour water from one jug in another.

We ask you to note the contents of the water jug on this sheet. Please make two columns, one for each jug. Initially, both jugs are empty, so we have 0 – 0. Also, during your task please "think aloud" so that we understand your thinking during the task.

Your task is to make 4 litres of water.

Task 2: Redesign the telephone to make it more suitable for older people

10.5.3 **Design brief for the activity – India**

You are working for a Product Design Consultancy where your customers include a leading automotive part supplier. Your client wants to enter new and emerging markets such as India, and therefore wants new design concepts for the **automotive cluster instrument**.

Your design is for the "hatchback" segment of cars ("kleinwagen" in Germany, examples- VW Golf, VW Polo, BMW 1er, Suzuki Swift, etc.) for the **Indian market, targeting young working professionals**.

The customer has carried out extensive user research and come up with a user persona representing the target user population you need to design for (see Attachment 1).

Specifications and constraints

The following elements must be illustrated in the concept design

- Speedometer (maximum range – your choice)
- Tachometer (maximum range – your choice)
- Odometer (no. of kms the vehicle has travelled)
- Fuel
- Indicators (both ON condition)
- Engine/Engine coolant temperature
- Seatbelt Warning
- Door open indicator (optional)
- Outside temperature

Standard symbols are available from the researcher for reference. The internet can also be used for any additional references.

You are free to choose digital, analogue, or a combination to display the information.

Deliverable

Concept sketches and/or renders to best illustrate the concept/s with description of the colour treatment, material, and finish.

The Aspirer

Vignesh K. Hegde
26-28yr. old Male, Single
B.E. and M.B.A

Manager Business Development and Operations at FACE, Bangalore

Lives alone in Bangalore. Visits parents and sister over the weekends

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The Aspirer

Fashion
Heavy dresser with Jackets and boots, big- steel watches, religious bands and bracelets. Tatoos of a Phoenix on left arm
Shops frequently for clothes and shoes (Branded stores)

Myers' Briggs Personality and Self Image								
Extrovert		■						Introvert
Sensing			■					Intuition
Thinking						■		Feeling
Judgement				■				Perception

"Any big purchases like a car or a bike generally involves a lot of consultation in particular with my father "

Aspirations for Usage of a General Product								
Low Cost						■		Extravagant
Fast		■						Precise
Simple						■		Powerful
Time saving					■			Savouring time
Privacy						■		Social connection

Asipiration for Product Characteristics														
General Product - Gadget									Cluster Instrument					
				■	■	■	Compact/Small	■	■					
		■	■	■	■	■	Premiumness	■	■	■	■	■	■	
			■	■	■	■	Price/Cost	■	■	■	■	■		
■	■	■		■	■	■	Feature Rich	■	■	■	■	■	■	
				■	■	■	Rugged	■	■	■	■			
■	■	■	■	■	■	■	Customizable	■	■	■	■	■	■	
	■	■	■	■	■	■	Easy to share / show off	■	■	■	■	■		

"Feature richness means I should be able to do many things with a single product. Premiumness for me means that using the product should give me a sense of being exclusive and one of a kind."

Questions and topics for during reflective interviews

1. Could you describe your typical design process?
2. How is the design process and approach you followed during the course of this activity different from your typical design process?
3. Do you feel your process and approach change when designing for the Indian persona, which is familiar, compared to when designing for the German persona, which is unfamiliar?
4. Did you make any assumptions during the course of the two activities?
5. Would your process or approach change if the order in which the activity was done was reversed i.e., you designed for the German persona first and then for the Indian persona?
6. Was there conscious knowledge/information transfer from the first activity to the second?
7. Other questions and clarifications from the design activity

Thank the participant for participation and end the interview.

10.6 Expert evaluation of the concepts

10.6.1 Card sorting and in-depth evaluation

Classify every concept presented before you into one of the following categories i.e. **Germany** German (design for **Germany** by German), **India** German, **Germany** Indian and **India** Indian.

Example:

Concept Number	**Germany** German	**India** German	**Germany** Indian	**India** Indian		**Comments**
Xx		**X**				

10.6.2 In-depth evaluation of the concepts

Step 1: A concept will be presented with the target culture it is intended for along with a short explanation of the concept.

Step 2: Rate each of the concepts according to the parameters explained below on a scale of 1 to 10 – 1 being the minimum and 10 the maximum.

Culture-concept Fit: How well does the concept meet the requirements of the target culture/persona (refer to personas previously given)? It is further divided into parameters of form, layout of elements, features, colour treatment and finish, and overall impressions of culture-concept fit

Usability: How usable is the concept for the given target culture/persona. Usability in this case is evaluated based on the parameters of visibility of system status, prioritisation of information/elements, consistency, and standards and overall usability of the concept

Clarity and Presentation: Overall clarity and presentation of the concept/idea

Overall Aesthetics and Design: The overall aesthetics and design of the concept

Expressiveness: The overall emotion the concept is conveying, i.e., is it an emotional design?

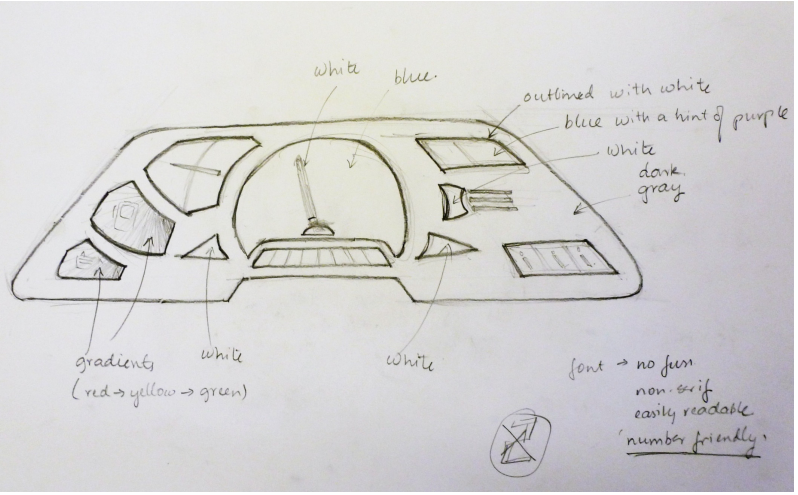
Completeness of the concept with respect to the design brief: Are the minimum elements required by the design brief presented in the concept?

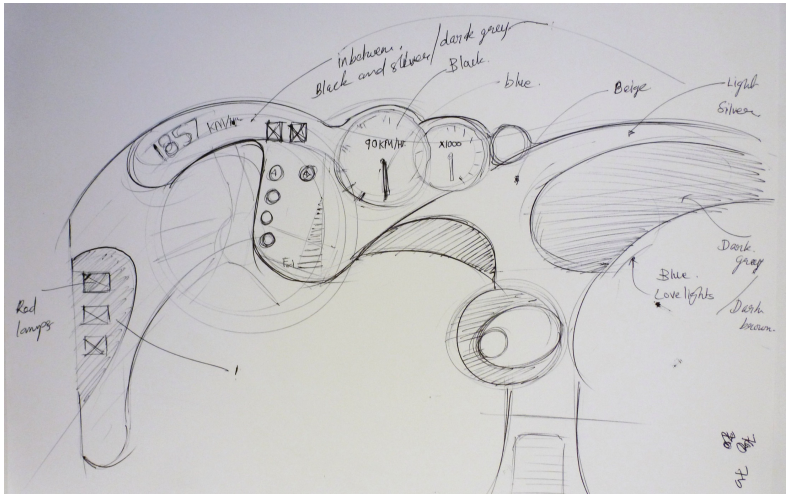
The table below shows a snapshot of the evaluation table used for in-depth evaluation of the concepts

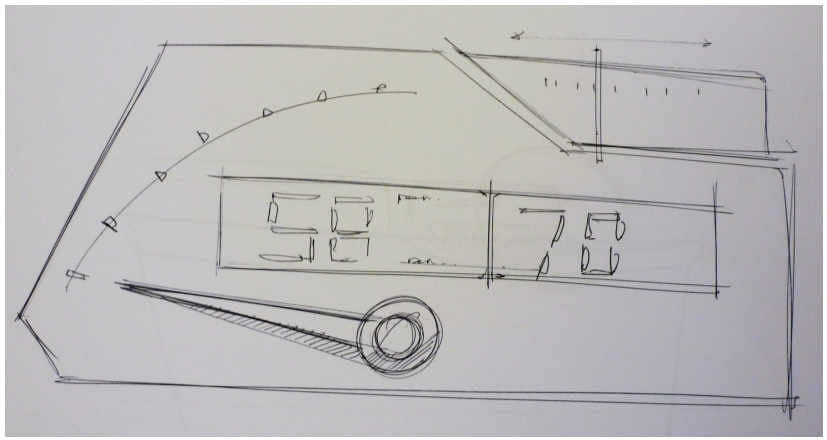
Concept Number		1a	1b	2a	2b	3a	3b	4a	4b	5a	5b	6a	6b	7a	7b
Culture - Concept Fit(max 30)	Form (5)														
	Layout of elements (5)														
	Features (5)														
	Color treatment and finish (5)														
	Overall impressions (10)														
Usability (max 30)	Visibility of system status (10)														
	Prioritisation of infos/elements (10)														
	Consistency and standards (5)														
	Overall usability of concept (5)														
Feasibility (max 10)															
Clarity and Presentation (max 10)															
Overall aesthetics and design (max 10)															
Completeness of Concept wrt brief (max 10)															

10.7 Concept sketches from the 1:1 design studies

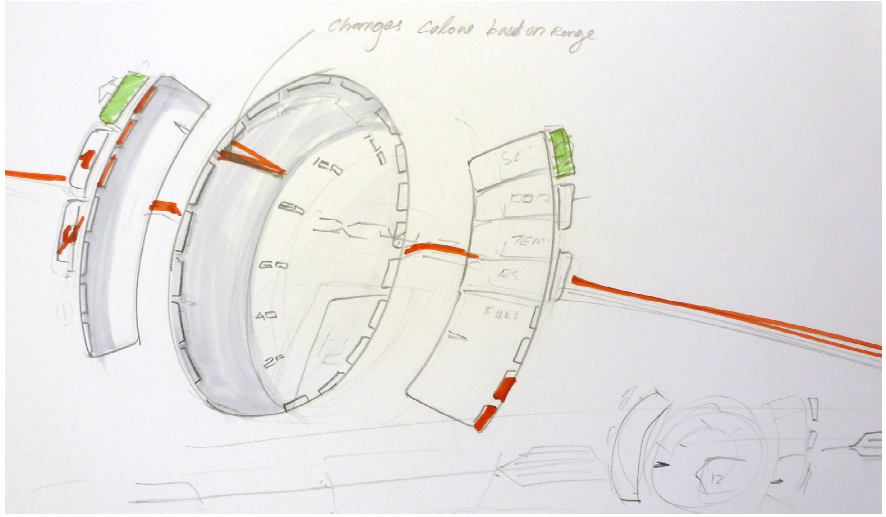
Example of some of the sketches the students produced during the 1:1 design studies**.** Concepts by Indian students for the German persona.

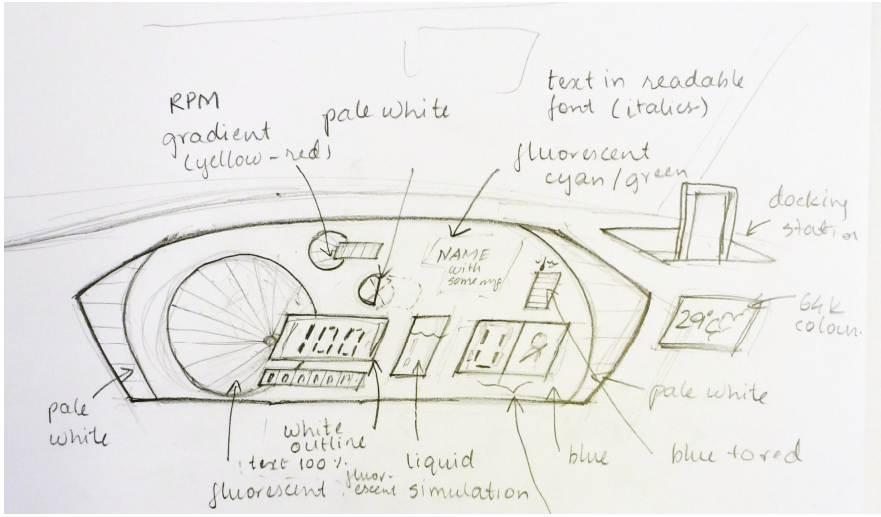


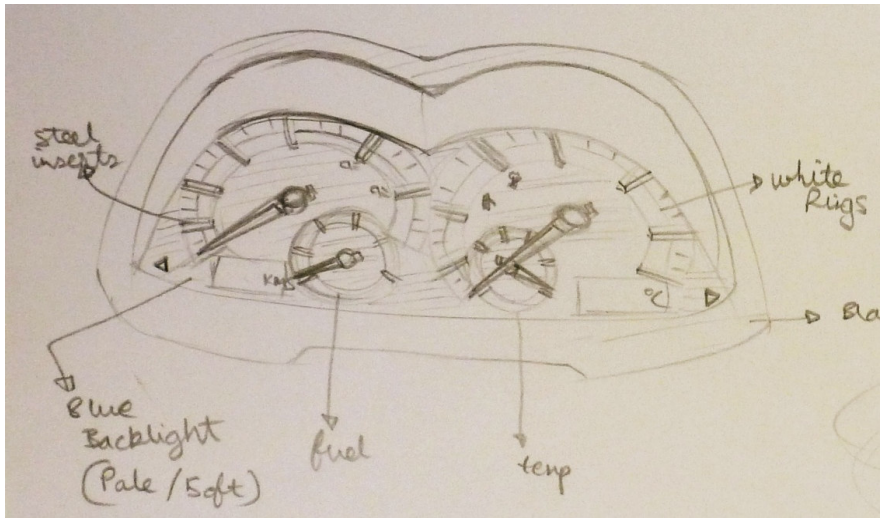




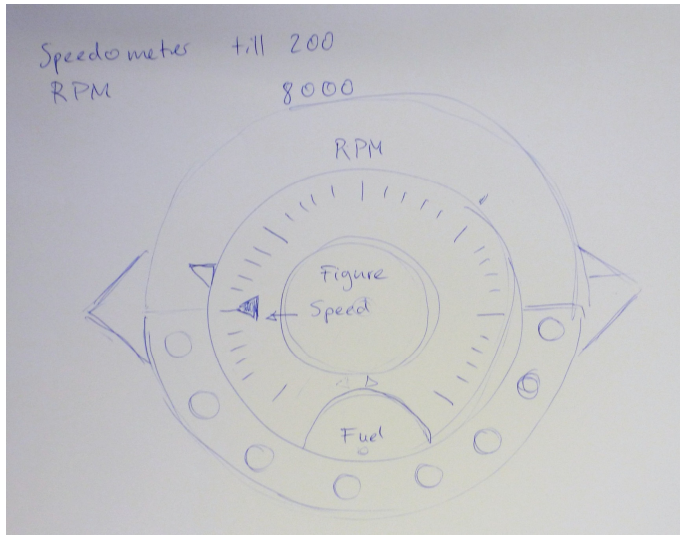
Concepts by Indian students for the Indian persona.

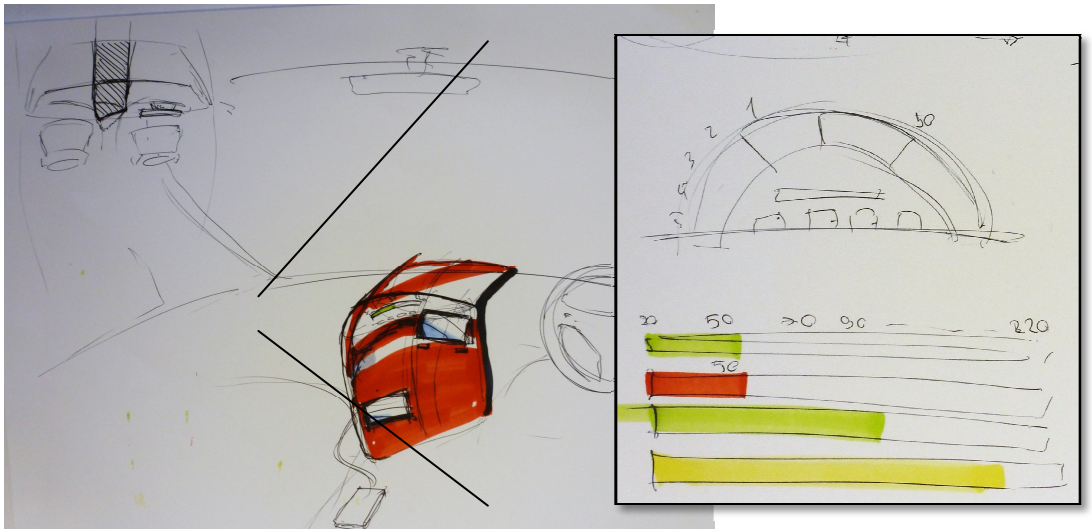


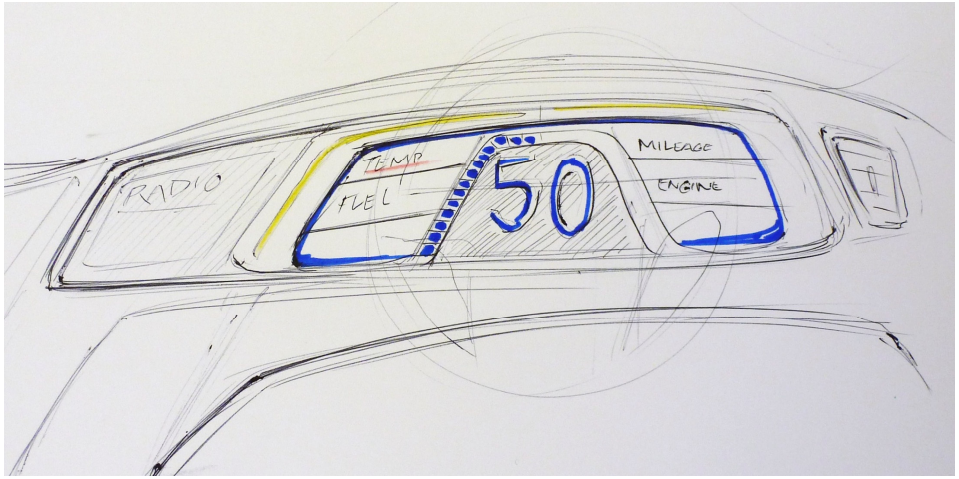




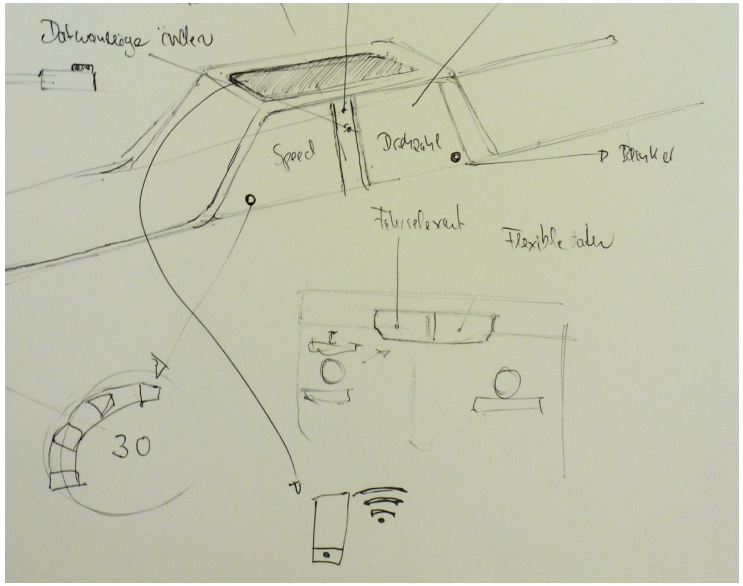
Concepts by German students for the Indian persona.

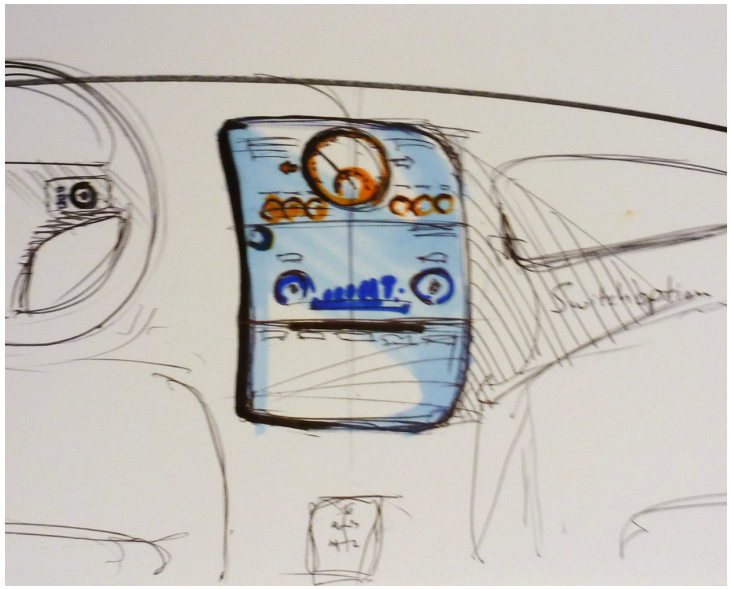


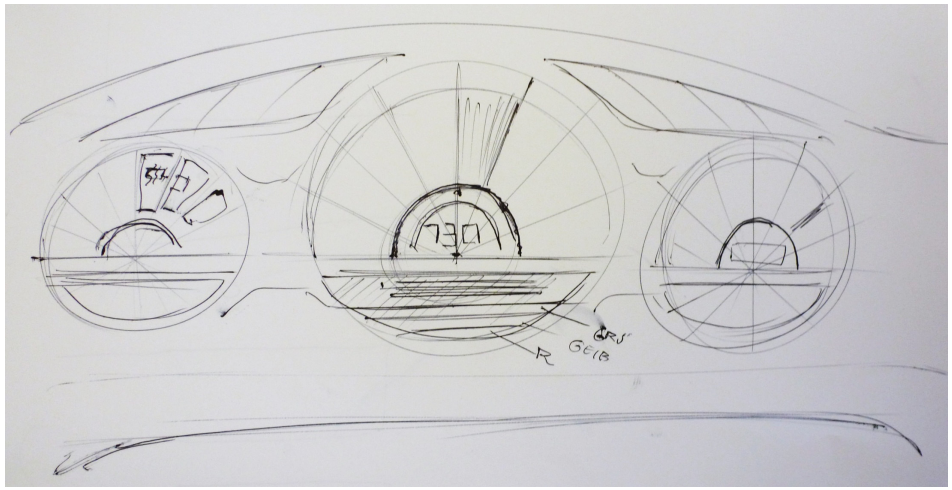




Concepts by German students for the German persona.







10.8 Breakdown of the expert evaluation scores

Scores for concepts by Indian and German students targeted at the Indian Persona.

Concept Number	Culture - Concept Fit(max 30)					Usability (max 30)				Feasibility (max 10)	Clarity and Pres-entation (max 10)	Overall aesthetics and design (max 10)	Completeness of Concept wrt brief (max 10)
1-7>> IND stu-dents 14-20>> GER	Form (5)	Layout of elements (5)	Features (5)	Color treatment and finish (5)	Overall impressions (10)	Visibility of system status (10)	Prioritisation of infos/elements (10)	Consistency and standards (5)	Overall usability of concept (5)				
1a	9.00	8.67	8.67	8.67	8.67	7.33	7.00	7.00	8.33	8.67	8.33	9.00	9.00
	1.00	1.15	1.15	1.15	1.15	1.15	1.00	1.00	1.53	1.15	1.53	1.00	1.00
	43.67					29.67							
2b	8.00	9.00	8.67	9.00	9.00	8.00	7.00	8.33	8.00	8.33	8.00	8.33	8.67
	1.73	1.00	1.15	1.00	1.00	0.00	1.00	1.53	1.73	1.53	2.00	1.53	1.15
	43.67					31.33							
3a	7.00	7.33	8.00	8.67	6.67	7.33	6.33	7.33	6.67	7.00	7.00	7.67	8.67
	1.00	0.58	1.73	1.15	0.58	1.15	0.58	0.58	0.58	0.00	1.00	0.58	1.15
	37.67					27.67							
4b	2.67	3.00	3.33	3.33	3.33	5.00	3.33	3.00	4.00	3.67	3.00	3.33	8.00
	1.15	1.00	0.58	0.58	0.58	1.00	0.58	1.00	0.00	0.58	1.00	0.58	2.00
	15.67					15.33							
5b	6.67	6.67	7.00	7.33	7.00	8.00	7.00	6.67	6.67	6.33	6.33	6.00	8.67
	1.53	1.53	1.00	1.15	1.73	1.73	1.00	0.58	0.58	2.89	2.89	2.65	1.15

	34.67					28.33							
6b	5.67	5.33	5.33	7.00	6.00	6.33	6.00	7.33	5.67	6.00	5.67	5.33	8.67
	0.58	1.15	1.15	1.00	1.00	0.58	0.00	1.15	0.58	0.00	0.58	0.58	1.15
	29.33					25.33							
7b	8.33	7.67	7.33	6.67	7.00	7.33	7.33	7.00	6.33	7.00	6.00	6.33	9.00
	0.58	0.58	1.15	1.15	1.00	1.15	1.15	1.00	0.58	1.00	2.65	2.89	1.00
	37.00					28.00							
14a	2.00	3.67	2.67	4.00	3.67	4.00	4.00	4.00	4.00	5.33	4.00	4.00	8.33
	1.00	1.15	0.58	1.00	0.58	1.00	1.00	1.00	1.00	2.08	1.73	1.00	1.53
	16.00					16.00							
15b	7.67	7.67	7.33	7.67	7.67	8.00	7.67	7.67	7.67	8.00	8.00	8.00	9.00
	0.58	0.58	0.58	0.58	0.58	0.00	0.58	0.58	0.58	0.00	0.00	0.00	1.00
	38.00					31.00							
16b	4.67	5.33	8.00	5.33	5.00	6.67	7.33	6.00	6.33	5.67	4.67	5.00	8.67
	1.53	2.08	0.00	2.08	1.73	0.58	1.15	0.00	0.58	2.31	1.53	1.73	1.15
	28.33					26.33							
17a	2.67	3.33	3.00	4.00	3.67	4.67	3.00	4.67	4.67	5.33	3.00	3.67	8.33
	0.58	1.53	1.00	1.00	1.15	1.53	0.00	1.53	1.53	2.08	2.00	0.58	1.53
	16.67					17.00							
18a	7.00	7.33	7.00	7.00	7.00	8.00	7.33	8.33	7.33	7.67	7.00	7.33	8.33
	1.73	1.53	1.73	1.73	1.73	1.00	1.53	1.15	1.53	1.15	2.00	1.53	0.58
	35.33					31.00							
19a	7.33	6.00	7.00	7.33	7.00	6.00	5.00	6.67	5.67	6.00	6.33	7.33	8.67
	1.15	0.00	1.00	1.15	1.00	0.00	1.00	1.15	0.58	2.65	2.89	1.15	1.15
	34.67					23.33							
20b	7.00	5.67	7.67	6.67	6.33	6.33	6.67	7.00	6.67	5.67	5.67	7.33	8.67
	1.00	1.53	1.53	1.15	0.58	0.58	0.58	1.00	0.58	2.31	2.31	1.15	1.15

	33.33					26.67							
TOTAL	6.12	6.19	6.50	6.62	6.29	6.64	6.07	6.50	6.29	6.48	5.93	6.33	8.62
	31.71					**25.50**				**6.48**	**5.93**	**6.33**	**8.62**
IND students	6.76	6.81	6.90	7.24	6.81	7.05	6.29	6.67	6.52	6.71	6.33	6.57	8.67
	34.52					**26.52**				**6.71**	**6.33**	**6.57**	**8.67**
GER students	5.48	5.57	6.10	6.00	5.76	6.24	5.86	6.33	6.05	6.24	5.52	6.10	8.57
	28.90					**24.48**				**6.24**	**5.52**	**6.10**	**8.57**

Scores for concepts by Indian and German students targeted at the German Persona.

Concept Number	Culture - Concept Fit(max 30)					Usability (max 30)				Feasibility (max 10)	Clarity and Pres-entation (max 10)	Overall aesthetics and design (max 10)	Completeness of Concept wrt brief (max 10)
1-7>> IND stu-dents 14-20>> GER	Form (5)	Layout of elements (5)	Features (5)	Color treatment and finish (5)	Overall impressions (10)	Visibility of system status (10)	Prioritisation of infos/elements (10)	Consistency and standards (5)	Overall usability of concept (5)				
1b	6.33	6.67	4.00	7.00	6.00	5.00	5.00	7.00	5.33	4.67	4.67	6.00	7.33
	0.58	1.15	1.73	1.00	1.00	1.00	1.00	1.00	1.15	0.58	1.53	0.00	2.31
	30.00					22.33							
2a	7.00	6.33	8.67	8.33	7.67	6.33	6.67	6.33	6.33	6.67	7.33	8.00	8.00
	1.73	1.53	1.15	1.53	0.58	1.15	0.58	0.58	1.15	1.15	0.58	1.00	1.73
	38.00					25.67							
3b	4.67	6.33	5.33	2.33	5.00	7.33	6.00	6.67	6.67	6.33	5.00	5.00	8.33
	1.15	0.58	1.53	0.58	1.00	1.15	0.00	0.58	0.58	0.58	1.00	1.00	1.53
	23.67					26.67							
4a	3.33	3.67	5.67	3.33	4.67	5.67	4.33	5.00	6.00	6.67	4.00	4.33	8.67
	0.58	0.58	0.58	0.58	0.58	1.53	1.15	1.00	1.73	0.58	1.00	1.53	1.15
	20.67					21.00							
5a	4.33	4.67	5.00	2.67	3.67	7.67	7.67	7.67	7.67	7.33	5.33	5.00	9.00
	1.15	1.53	1.00	0.58	1.15	0.58	0.58	0.58	0.58	2.08	2.08	1.73	1.00
	20.33					30.67							

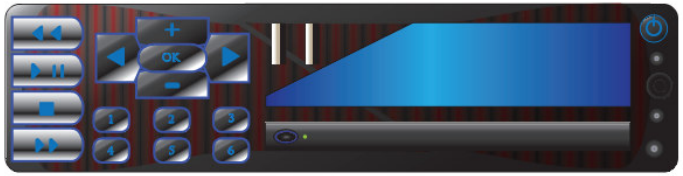
6a	4.33	5.00	4.00	4.00	4.67	6.67	4.67	7.67	5.33	5.33	5.33	6.33	8.67
	1.53	1.73	1.73	1.00	1.53	1.15	1.53	0.58	1.15	0.58	0.58	1.15	1.15
	22.00					24.33							
7b	3.00	3.33	5.67	4.33	4.00	4.33	4.33	5.33	3.67	6.33	5.00	5.67	9.00
	0.00	0.58	0.58	1.53	1.73	1.15	1.15	0.58	0.58	0.58	2.00	2.52	1.00
	20.33					17.67							
14a	7.33	7.33	7.00	6.33	6.33	7.33	7.33	7.33	7.33	6.33	6.00	6.00	9.00
	1.15	1.15	1.00	1.15	1.15	1.15	1.15	1.15	1.15	2.89	2.65	2.65	1.00
	34.33					29.33							
15a	9.00	9.00	9.33	9.00	9.33	9.00	9.00	9.33	9.00	9.00	9.33	9.00	9.00
	1.00	1.00	0.58	1.00	0.58	1.00	1.00	0.58	1.00	1.00	0.58	1.00	1.00
	45.67					36.33							
16a	3.33	4.67	6.33	2.33	4.33	4.67	4.00	5.67	4.00	4.33	3.00	2.33	8.67
	1.53	1.53	0.58	0.58	1.15	1.53	1.00	0.58	1.00	1.15	1.00	0.58	1.15
	21.00					18.33							
17b	6.33	7.67	5.00	7.00	6.67	7.33	7.00	7.33	8.67	7.00	5.67	4.67	8.67
	0.58	1.53	2.00	1.00	0.58	1.15	1.00	1.53	1.15	1.00	2.31	1.15	1.15
	32.67					30.33							
18b	5.33	4.33	3.67	5.33	5.33	6.00	7.00	8.00	7.67	6.33	5.00	4.00	8.67
	1.15	1.53	1.15	0.58	0.58	0.00	1.00	0.00	0.58	0.58	1.00	1.73	1.15
	24.00					28.67							
19b	5.67	5.33	5.33	7.00	6.00	6.00	6.33	6.00	7.33	5.67	6.00	5.67	5.33
	0.58	1.15	1.15	1.00	1.00	1.00	0.58	0.00	1.15	0.58	0.00	0.58	0.58
	38.00					26.00							
20a	7.33	6.67	7.33	7.00	7.33	6.33	5.67	7.00	6.00	6.33	6.33	5.33	9.00
	1.15	0.58	1.15	1.00	1.15	1.15	1.53	1.00	0.00	2.89	2.08	2.08	1.00
	35.67					25.00							
TOTAL	5.64	5.90	6.12	5.48	5.88	6.40	6.05	7.00	6.43	6.38	5.67	5.64	8.64

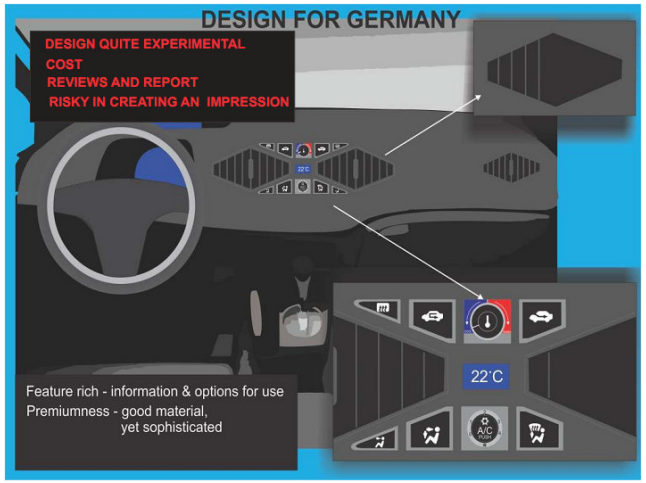
	29.02					**25.88**				**6.38**	**5.67**	**5.64**	**8.64**
IND students	4.71	5.14	5.48	4.57	5.10	6.14	5.52	6.52	5.86	6.19	5.24	5.76	8.43
	25.00					**24.05**				**6.19**	**5.24**	**5.76**	**8.43**
GER students	6.57	6.67	6.76	6.38	6.67	6.67	6.57	7.48	7.00	6.57	6.10	5.52	8.86
	33.05					**27.71**				**6.57**	**6.10**	**5.52**	**8.86**

10.9 Designs from the validation studies of the modified design process

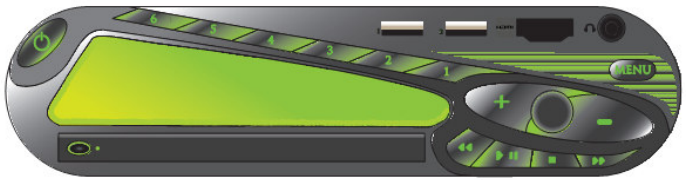
Examples of pre-workshop design concepts.

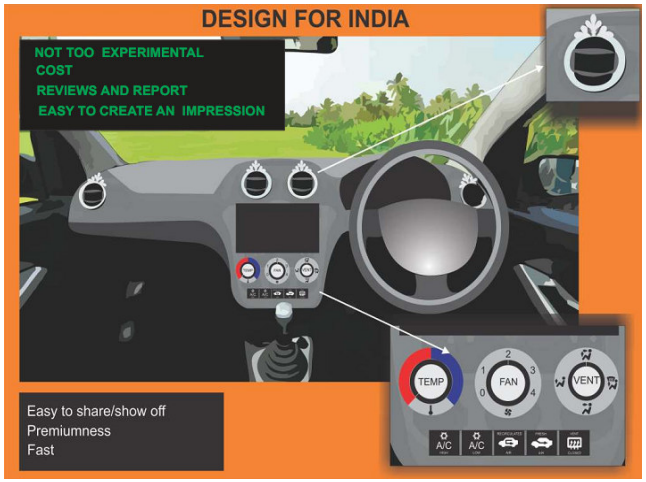
Target: German Persona





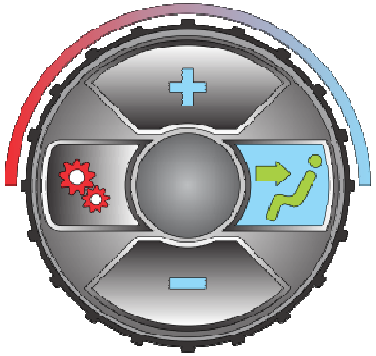
Target: Indian Persona

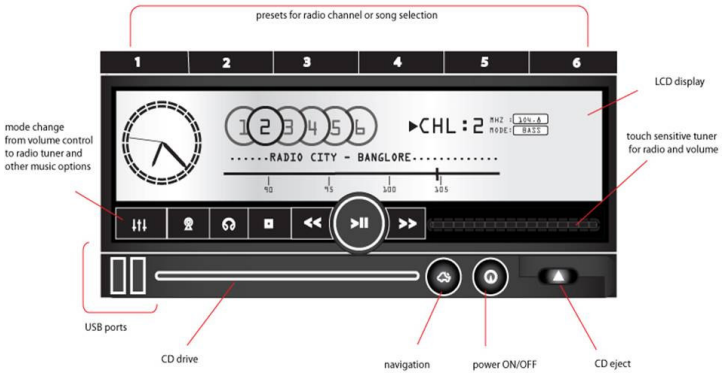




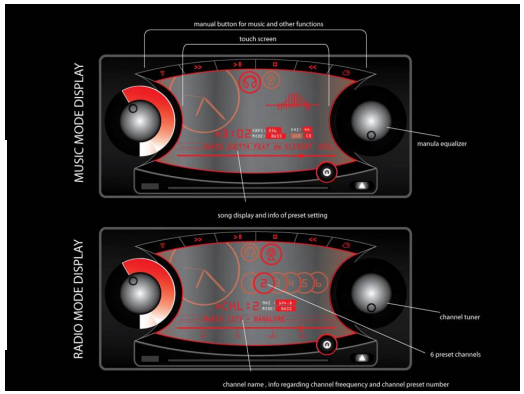
Examples of post-workshop design concepts – **without** modified design process

Target: German Persona





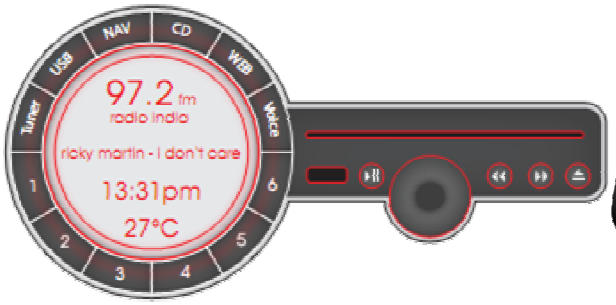
Target: Indian Persona



Examples of post-workshop design concepts – **with** modified design process

Target: German Persona

Target: Indian Persona



10.10 Evaluation of the concepts from the validation of the modified design process

	Culture - Concept Fit(max 30)					Usability (max 30)				Feasibility (max 10)	Clarity and Pres-entation (max 10)	Overall aesthetics and design (max 10)	Completeness of Concept wrt brief (max 10)
	Form (5)	Layout of elements (5)	Features (5)	Color treatment and finish (5)	Overall impressions (10)	Visibility of system status (10)	Prioritisation of infos/elements (10)	Consistency and standards (5)	Overall usability of concept (5)				
Pre work-shop	5.93	6.00	6.07	5.50	6.04	6.24	6.15	6.23	6.06	6.24	5.44	6.00	8.96
	1.17	0.92	1.18	1.55	1.09	0.73	0.87	0.98	0.71	0.89	1.20	0.91	0.15
	29.41					**24.65**				**6.24**	**5.44**	**6.00**	**8.96**
FAM (10)	6.03	6.20	6.03	6.03	6.23	6.33	6.07	6.35	6.17	6.03	5.43	6.00	8.93
	30.53					**24.92**				**6.03**	**5.43**	**6.00**	**8.93**
UNFAM (9)	5.79	5.75	6.13	4.83	5.79	6.13	6.25	6.08	5.92	6.50	5.46	6.00	9.00
	28.29					**24.38**				**6.50**	**5.46**	**6.00**	**9.00**

Post workshop (WITH)	7.00	7.14	6.81	6.56	6.69	7.17	7.14	7.25	6.89	6.92	6.64	6.83	8.83
	1.15	0.89	0.93	0.83	1.04	1.00	1.11	1.06	0.96	0.94	1.17	1.05	0.48
	34.19					**28.44**				**6.92**	**6.64**	**6.83**	**8.83**
FAM (6)	7.50	7.28	6.89	6.72	6.78	7.06	7.17	7.44	6.72	6.72	7.00	7.06	8.94
	35.17					**28.39**				**6.72**	**7.00**	**7.06**	**8.94**
UNFAM (6)	6.50	7.00	6.72	6.39	6.61	7.28	7.11	7.06	7.06	7.11	6.28	6.61	8.72
	33.22					**28.50**				**7.11**	**6.28**	**6.61**	**8.72**
Pre workshop (WITHOUT)	6.12	5.61	5.88	5.79	5.88	5.91	5.58	5.85	5.88	5.80	5.64	6.03	8.94
	1.45	1.32	1.37	1.40	1.29	0.94	1.69	1.34	1.36	0.72	0.57	0.69	0.00
	29.27					**23.20**				**5.80**	**5.64**	**6.03**	**8.94**
FAM (5)	6.07	5.67	6.00	5.93	5.87	5.60	5.73	5.87	5.93	5.50	5.13	5.73	9.00
	29.53					**23.13**				**5.50**	**5.13**	**5.73**	**9.00**
UNFAM (6)	6.17	5.56	5.78	5.67	5.89	6.17	5.44	5.83	5.83	6.06	6.06	6.28	8.89
	29.06					**23.28**				**6.06**	**6.06**	**6.28**	**8.89**