

Bijan Aryana

Exploring Design for Country-specific Customisation

Thesis for the degree of Philosophiae Doctor

Trondheim, May 2013

Norwegian University of Science and Technology
Faculty of Engineering Science and Technology
Department of Product Design



NTNU – Trondheim
Norwegian University of
Science and Technology

NTNU

Norwegian University of Science and Technology

Thesis for the degree of Philosophiae Doctor

Faculty of Engineering Science and Technology
Department of Product Design

© Bijan Aryana

ISBN 978-82-471-4368-1 (printed ver.)

ISBN 978-82-471-4369-8 (electronic ver.)

ISSN 1503-8181

Doctoral theses at NTNU, 2013:133

Printed by NTNU-trykk

Abstract

Characteristics of each country such as culture, socio-economic and laws can shape the way that users in that country interact with products such as mobile phones. Some of these country-specific differences may be the source of usability problems in such systems, as these systems are not usually customized based on the characteristics of the countries. The objective of this research is to explore possible ways for incorporating customization considerations in a design process aimed to solve country-specific usability problems. Based on this objective, the core research question was as follows:

How can existing design methods be incorporated into a customization process for solving country-specific usability problems?

To do this, it is necessary to have an understanding about the current knowledge in related fields, especially New Product Development (NPD) and Human Computer Interaction (HCI). In addition, it is essential to see if users face any country-specific usability problems when they use interactive systems. Therefore, the following sub questions were also developed:

What is the state of the art in research that may provide relevant background for addressing country-specific differences and design?

How do first-time users in Iran and Turkey interact with smart phones' standard applications?

The literature review phase of this study showed that in many research studies, cultural models, especially Hofstede's model, have been used as the basis of the study. In these models, culture is usually broken down into a number of dimensions. In addition, there is a concentration on the so-called "attribute-based" approach for providing solutions for culture-oriented design or culture-oriented NPD, in which the system and the cultural specifications are broken down into a number of attributes.

However, an experiment with an attribute-based method in Iran showed that users' evaluations towards the mobile phones' individual attributes did not reflect their final total evaluation of the devices; their total impression was different than the sum of how different individual attributes were experienced. That was why another, empirical approach was considered for the rest of the study. This approach is based on user research and observing user-system interaction in actual settings rather than modelling the users and the systems by their attributes.

Using this approach, two case studies were designed and the scope of the research was limited to the smart phones. Two emerging markets of Turkey and Iran were selected for the case studies, as emerging markets similar to the ones in these countries were not studied much before.

The case studies were started by interviews with local marketing teams of an Original Equipment Manufacturer (OEM). These interviews revealed the importance of innovative users in the

diffusion and marketing of new products, as these users usually adapt to new technologies faster than do other members of society.

The case studies in Iran and Turkey continued with focus group studies with innovative users accessed by the OEM, in order to identify areas in which country-specific usability problems may exist. Results of the focus group studies identified that Iranian users may have usability problems in using SMS and music player applications. In Turkey, the contacts and music player applications were identified as the most critical applications. In each country, two tasks were designed according to the identified areas in the focus groups for usability tests.

The usability tests exhibited a number of usability problems related to these areas, along with a number of general usability problems. The cases studied were completed with requirement gathering sessions, in which innovative users generated a number of solutions for country-specific usability problems. A content analysis showed that the participants focused on similar activities in each country.

The analysis approach of this research was based on a constructive grounded theory. In this approach, the researcher is allowed to explore the influence of contextual factors on the research process and the interpretations of the researcher plays an important role in the analysis.

In general, case studies demonstrated that users in both countries faced a number of country-specific usability problems. Moreover, users who participated in requirements gathering sessions were focused on specific interaction activities in each country. The case studies also showed how local innovative users can participate in country-specific customization and how existing marketing facilities can be used for user research and country-specific customization. In addition, the case studies suggest that existing Human Centred Design methods can be adjusted for country-specific customization. As a recommendation, the results were generalized in the form of a conceptual solution for country-specific customization, and the evolutionary framework of NPD and Human Centred Design process suggested by the International Organization for Standardization was used for structuring this conceptual solution.

Acknowledgments

I would like to express my sincere gratitude to the following people, each of whom made a significant contribution in helping me to complete the research:

My main supervisor, Professor Casper Boks, for his great support, flexibility and contribution to the quality of research.

My co supervisor, Professor Torkil Clemmensen, for his guidance and significant help, especially in the final phases of the project.

Dr. Seyyed Javad Zafarmand for his help in developing the research plan.

Associate Professor Andre Liem for his creative ideas and cooperation during the study.

Faculty members at the Department of Product Design, Norwegian University of Science and Technology, especially Ida Nilstad Pettersen, Marikken Høiseth, Brita Fladvad Nielsen, Martha Rice Skogen, Johannes Ludvig Daae Zachrisson, Shahrman Zainal Abidin, Associate Professor Johannes Sigurjonsson, Associate Professor Trond Are Øritsland, and Associate Professor Jon Herman Rismoen, for all helpful insights, discussions, and support.

Staff at the Department of Product Design, Norwegian University of Science and Technology, especially Kari Qvam and Morten Kvamme, for their time, consideration, and assistance.

Fazin Shariati, Babak Amjadi, and Jenia Baghdanian at the LG Electronics office in Tehran, and Rami Kim at the LG Electronics office in Istanbul, for their help in conducting the case studies in Iran and Turkey.

Dr. Vahid Choopankareh , Dr. Alireza Ajdari and Jamshid Emami at the Department of Industrial Design, University of Tehran, and Professor Özlem Er at the Department of Industrial Product Design, Istanbul Technical University, for their assistance in conducting the case studies in Iran and Turkey.

Azadeh Navabi for her assistance in conducting the case study in Iran and analysing the usability tests' results.

Mahdi Rahnama and Mahideh Arabpour, students at Department of Industrial Design, University of Tehran, for their assistance in conducting the case study in Iran.

Elham Ghazi, Sara Rakei, Koray Gelmez, and Ezgi Elvan, students at the Department of Industrial Product Design, Istanbul Technical University, for their assistance in conducting the case study in Turkey.

Finally, many thanks to my family for their incredible support and understanding.

Contents

Abstract	iii
Acknowledgments	v
List of Acronyms	xi
Part I: Main Report	1
1. Introduction	3
1.1. Focus	5
1.1.1. Definition of concepts.....	5
1.1.2. Devices and features	8
1.1.3. Countries.....	9
1.2. Research questions.....	12
1.2.1. Research question one, the core research question.....	13
1.2.2. Research question two, a sub research question.....	14
1.2.3. Research question three, a sub research question.....	14
1.3. Outline of the Thesis	15
2. Background	19
2.1. Directions of research on country-specific differences in use of technology	19
2.1.1. Business advantage.....	19
2.1.2. Usability.....	20
2.1.3. Understanding social impacts.....	21
2.1.4. Social sustainability	21
2.2. Similarities between NPD and HCI perspectives	22
2.3. Customization.....	24
2.4. Summary.....	25
3. Research Methods.....	27
3. 1. Literature review method	32
3.1.1. Mobile HCI and culture	32
3.1.2. NPD and consumer culture	33
3.2. The attribute-based method	34

3.2.1. Hofstede’s cultural dimensions.....	35
3.2.2. Culture-oriented design of human-machine systems.....	36
3.2.3. Product model.....	37
3.2.4. Experiment design.....	37
3.3. Methods used in the case studies.....	40
3.3.1. Countries’ profiles.....	43
3.3.2. Semi-structured Interviews with the OEM’s Mobile Marketing Teams.....	44
3.3.3. Focus group studies.....	45
3.3.4. Usability evaluation.....	48
3.3.5. Requirements gathering.....	50
3.4. Analysis method.....	51
3.4.1. Constructive Grounded Theory.....	52
3.4.2. Qualitative analysis.....	53
3.5. Summary.....	54
4. Results.....	57
4.1. Literature review results.....	57
4.1.1. Mobile HCI and culture.....	57
4.1.2. NPD and culture.....	58
4.1.3. Summary.....	60
4.2. The attribute-based method experiment.....	60
4.3. Case studies.....	61
4.3.1. Semi-structured Interviews with the OEM’s Mobile Marketing Teams.....	61
4.3.2. Focus group studies.....	62
4.3.3. Usability tests.....	64
4.3.4. Requirements gathering.....	68
4.4. Summary.....	70
5. Discussion.....	73
5.1 Comparison between the current study and previous related studies.....	73
5.2. Highlights of case studies’ results.....	75
5.3. A conceptual solution for country-specific customization.....	76
5.4. Research limitations.....	78
6. Conclusion.....	81

6.1. Overview	81
6.2. Research question two, a sub research question	82
6.3. Research question three, a sub research question	84
6.4. Research question one, the core research question	86
6.4.1. Finding methods for identifying country-specific usability problems	87
6.4.2. Finding solutions for modifying the system according to the identified country-specific usability problems	90
6.5. Summary of answers to the research questions	92
6.6. Recommendations for further research studies	93
7. Summary of papers	97
7.1. Paper 1	98
7.2. Paper 2	100
7.3. Paper 3	102
7.4. Paper 4	104
7.5. Paper 5	106
7.6. Paper 6	108
7.7. Paper 7	110
7.8. Other papers	112
References	115
Part II: Papers	127
Errata	129
Co-authors' collaboration agreement	131

Paper 1.

Aryana B. & Øritsland, T.A. (2010) *Culture and Mobile HCI: A Review*. Proceedings of the 8th International NordDesign Conference 2010, 217-226.

Paper 2.

Aryana B. & Boks C. (2012) *New Product Development and Consumer Culture, a Review*. International Journal of Product Development, 16(1), 45-62.

Paper 3.

Aryana B. & Boks C. (2010) *Cultural Customization of Mobile Communication Devices' Components*. Proceedings of the 11th International Design Conference DESIGN 2010, 137-146.

Paper 4.

Aryana B., Boks C. & Navabi A. (2011) *Possibilities for Cultural Customization of Mobile Communication Devices: The Case of Iranian Mobile Users*. Lecture Notes in Computer Science, Human Centred Design, 6776/2011, 177-186.

Paper 5.

Aryana B. & Clemmensen T. (2013) *Mobile Usability, Experiences from Iran and Turkey*. International Journal of Human Computer Interaction, 29(4), 220-242.

Paper 6.

Aryana B. & Clemmensen T. & Boks C. *Users' Participation in Requirements Gathering for Country-specific Customization of Smart phones in Emerging Markets*. Submitted to Universal Access in the Information Society.

Paper 7.

Aryana B. & Boks C. (2012) *Country-specific Customization of Smart phones for Emerging Markets; Insights from Case Studies in Iran and Turkey*. International Journal of Logistics Economics and Globalization, 4 (3), 179-196.

List of Acronyms

ACM	Association for Computing Machinery
CSC	Country-Specific Customization
HCI	Human Computer Interaction
IBM	International Business Machines Corporation
ICT	Information and Communication Technologies
ISI	Institute for Scientific Information
ISO	ISO International Organization for Standardization
MIT	Massachusetts Institute of Technology
NPD	New Product Development
OEM	Original Equipments Manufacturer
SMS	Short Message Service

Part I: Main Report

1. Introduction

Answering to users' needs and desires has been one of the main principles of product design career from its beginning (Bürdek, 2005). However, dealing with the complexity of users has always been a challenge for designers, as there are large numbers of contextual factors that can shape each user's behaviour, tendencies, experience and needs. For example, culture is among the influential factors that can affect the way that a user uses a technology (Shena et al., 2006).

When designers want to design interactive systems, considering users' cultural background can be one of their challenging tasks, as users' interaction with such systems usually covers users' personal aspects of everyday life, which are sometimes hard to investigate, and culture clearly can affect these aspects.

United States and Western Europe are the main origins of fields such as industrial design, interaction design and Human Computer Interaction (HCI); therefore, a considerable part of design heritage belongs to the West. However, there are examples that show technologies are not being used in a similar way around the world (Leidner, & Kayworth, 2006). At the same time, the birth of emerging economies and markets initiates new approaches in design, production and use of products that are not similar to the Western approaches.

Globalization accelerates the diffusion of technologies around the world (Mann & Kirkegaard, 2006; Kellner, 2002). Today design, manufacturing and use of a product can occur in three different continents. Country-specific characteristics can be important when products are being designed and used on a global scale. Such products usually need to be manufactured in large quantities for international markets. This means that in many cases a similar design is going to be used by different users around the world. However, providing a similar design does not necessarily mean that all users have similar needs and use the technology in similar ways.

Mobile phones are among the interesting products that can show different aspects of relationships between country-specific characteristics and design. The market of these ICT (Information and Communication Technologies) products are dominated by few global OEMs (Original Equipments Manufacturers) that usually present a similar range of products around the world. It is interesting that these devices can be used in quite different ways in each country. For instance, in some developing countries, the penetration rate of the internet is smaller than that of

mobile phones. Therefore, mobile services in these countries are more common than internet services. As an example, mobile banking services are more successful than internet banking services with similar features (Chigona et al., 2009). Another example of the different use of technologies can be seen in some Asian countries such as Japan and South Korea. Users in these countries sometimes tend to give a cute personality to their mobile phones. This task is being done by physical attachments such as small dolls or labels that illustrate cute characters (Hjorth, 2005).

This study investigates the use of smart phones in two emerging markets of Iran and Turkey. In these two emerging markets, many mobile users are shifting from ordinary mobile phones to smart phones. Smart phones have strong computational and communicational features at the same time and their operating systems enable users to install and update a wide range of applications. Because of these new features, first-time users in countries such as Iran and Turkey may have usability problems when they begin to use smart phones. Similar to many other products and information systems, in many cases, these usability problems have country-specific roots (Clemmensen, 2012; Douglas, 2007; Baumann, 2001; Nielsen, 1993). National culture (Hofstede, 2001), regulations, market structure and many other contextual factors in each country may cause specific patterns in users' interaction with smart phones. That is why some features of smart phones might need to be customized according to users' characteristics in each country. This process is called "country-specific customization" in this research.

For the first-time users of smart phones, customization of standard applications is more important than other features, as these applications are pre-installed on smart phones by the OEM and are the first applications with which the users are confronted when they begin to use these devices.

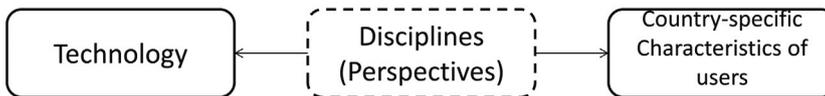
Because of the multidisciplinary nature of the study, the subject has been viewed from different perspectives. The primary perspectives used are Human Computer Interaction (HCI) and New Product Development (NPD). The HCI perspective is helpful in understanding the users, especially from the usability point of view. The NPD process is the process of bringing a new product to the market (Annacchino, 2003) and the NPD perspective in this research addresses the entire process of design and development of a new product. This perspective is useful in

understanding how country-specific customization can be feasible considering the current conditions of OEMs.

The study has been divided into two main phases: a literature review phase and an empirical phase consisting of two case studies.

Before defining clear research questions, it is necessary to specify certain focus points for both phases of the study. Figure 1 shows that relationships between technology and country-specific characteristics of users can be viewed from perspectives of different disciplines. As can be seen, the current study is narrowed to some focus points that are going to be described here.

General outlook:



Focus of current study:

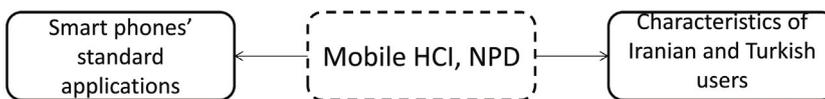


Figure 1. Relationships between technology and country-specific characteristics of users, general and focused outlook

1.1. Focus

Before posing the research questions, it is necessary to define some focus points. These focus points include a number of main concepts which shaped the research, such as design for country-specific customization along with some other items such as devices, features, and the countries selected for the empirical phase of the study. The next subsections will introduce these focus points and reasons for selecting them.

1.1.1. Definition of concepts

A number of concepts have been used frequently in this study. It is necessary to fix clear definitions for these concepts in the beginning, as some of these concepts have different definitions in literature. First, the concept of country in this research will be explained. This

explanation will then be used to define the concept of country-specific customization. Finally, the concept of OEM (Original Equipment Manufacturer) will be elaborated, as OEM represents the business and industry side of country-specific customization in the current study, especially in the empirical phase.

Country

Country can have quite different definitions, from sub-urban areas to a political state (Scruton, 2007; Simpson et al., 1997). In this study, a country is a territory, under the role of a recognized and independent sovereign state, identified with internationally recognized borders. Therefore, country is not only equal to a political state, or a nation. The Palgrave Macmillan dictionary of political thought (Scruton, 2007) presents four different definitions for the concept of a country. One of these concepts is quite similar to the definition of country in this research (pp 148-149):

A 'country' may also be an independent sovereign state, identified, however, not in terms of its political features, but in terms of its territory and jurisdiction. The frequency of this usage emphasizes the important role that territorial conceptions play in identifying and explaining political entities. It also illustrates an area of potential confusion in political thought, since the relation between state and country seems not to be determinate. Thus Russia is the same country now as in the novels of Tolstoy; but is it the same state? Could A be the same state as B but a completely different country? (Suppose a given set of political institutions is simply transported, together with language and customs, from one part of the world to another: cf. the founding of Israel, which some believe did not occur in the twentieth century.) The problems here are not unlike those that arise in trying to describe the relation between a human person and his body.

Country-specific Customization

According to this definition, people who live within the borders of a country may have a range of different languages, religions and cultures. At the same time, the political state may apply some rules and regulations that can affect the socio-economics of people inside the territories of the country. Finally, the country usually has an identity, which can be defined by characteristics like national culture (Hofstede, 2001) official language(s), or official religion(s). All of these characteristics can shape the conditions in a country such as social relationships, economy, standards and even physical infrastructures.

According to the Ivanovic and Collin dictionary of marketing (2003), customization is “*the process of making changes to products or services that enable them to satisfy the particular needs of individual customers*”.

Based on this definition, when a product or service is going to be customized for a country, there will be a range of attributes that can be customized. Here are examples of country-specific customization:

- Consumer electronics can be designed by a modular design, in a way that their components can be changed according to the conditions of a country in which they are going to be used. For example, as different countries have different standards for electricity outlets and voltage, a printer can have a country-specific external power supply that enables users to plug it in when they are setting up the printer (Feitzinger and Lee, 1997).
- Companies may customize their strategies for entering the markets of different countries according to each country’s regulations, market conditions and business potential (Burgel and Murray, 2000).
- When a brand is going to be introduced in a country through a website, country-specific characteristics such as national identity, individualism, and rule of law can affect the perceived value of the website (Steenkamp and Geyskens, 2006).

The above examples show that country-specific customization can be applied by different methods such as modular design of a product, different marketing strategies, and website design. In other words, based on the type of the product or service that is going to be customized for a country, there are different solutions for country-specific customization. In this thesis, country-specific customization is limited to customized interaction designs for standard applications of smart phones. Therefore, customization is not applied by modular design or marketing strategies. It should be noted that “Standard applications” are introduced in the next subsection (devices and features).

Original Equipment Manufacturer (OEM)

Interactive devices such as smart phones are being manufactured by using various hardware and software components. The term Original Equipment Manufacturer (OEM) is used for a company

that buys these components from other manufacturers in order to make its own products (Yadin, 2001) in the form of interactive devices, which are smart phones in this case.

1.1.2. Devices and features

Smart phones are the main device used for the empirical phase of the study. The early definitions introduce smart phones as a combination of Personal Digital Assistants and ordinary mobile phones (Ilyas and Ahson, 2006); however, the more recent definitions picture them as mobile phones capable of running a licensed operating system and different applications. This capability enables them to process and operate documents similar to personal computers. In addition, smart phones are considered as wireless terminal devices, able to send and receive data through technologies such as the internet, Bluetooth, and Global Positioning System (Liu et al., 2011). According to the definition by Liu et al. (2011), smart phones have a range of characteristics that make them a suitable case for studying relationships between country-specific characteristics of users and technology. These characteristics are itemized here:

- As smart phones cover both mobile computing and mobile communicating features, users have a high level of interaction with them in everyday life. This means that cultural and country-specific differences have an important role in the use of smart phones.
- These devices are being used by a wide range of users around the world, and this means that they might be used in different ways in different countries. Therefore, it is meaningful to select them as a case for country-specific customization research.
- As we will see later, the literature review shows that there is little attention towards smart phones in similar studies, and most of these studies targeted ordinary mobile phones. Therefore, a study on country-specific differences in use of smart phones can be considered a less explored topic.
- The OEM that participated in this study was more interested in concentrating on smart phones in its marketing strategies. As a reason, the emerging markets selected for the study have relatively high penetration rates of mobile phones. This meant that, while the market of ordinary mobile phones is matured, there are potential users who are shifting from ordinary phones to smart phones, which are called “first-time users” in this study.

As the definition of smart phones by Liu et al. (2011) shows, these devices are complex interactive systems that carry different design elements such as the hardware (industrial) design,

the interaction design of operating system, the user interface design of standard applications (which are installed locally on the device by the OEM), and the user interface design from imported applications which can be installed by the user.

The focus of this study was the customization of smart phones' standard applications. In this research, the term "standard applications" is used for the applications that are installed by the OEM on the device. The reasons behind focusing on standard applications are as follows:

- There are a number of operating systems for smart phones such as Windows Mobile, Android, and Apple iOS. Each OEM usually uses one or two of these operating systems on its smart phones. As a result, in many cases, the operating system is not designed by the OEM of the smart phone. In addition, users are able to install different applications on their smart phones after the purchase of the smart phones. Therefore, in considering software features such as the operating system and non-standard applications, there was a need for considering several stakeholders such as developers of operating systems and non-standard applications. However, as standard applications are usually developed or ordered by the OEM, studying these applications only requires communication with the OEM.
- As will be explained in the next chapters, the interviews with OEM marketing teams and focus group studies show that the OEM marketing team and users suggested software features for country-specific customization. That is why the hardware (industrial design) aspects of customization were not studied.

1.1.3. Countries

The term "country" in this research is used for regions defined by internationally recognised political borders. The concept of country is preferred as the main basis of customization for other concepts such as "culture" and "market". A culture or a market could cover regions from different countries, therefore, defining an exact border for a culture (Jackson et al., 1996; Barnett, 2001) or a market (Deligonul, 2009) is not always possible, but countries could be specified clearly by their political borders. Governmental regulations usually define the way that OEMs work; therefore, OEMs mostly consider the political borders when they define national markets (Schmitz, 2004; Deligonul, 2009). In addition to defining national markets, political systems also affect the socio-economics of countries, which create differences between countries

in the same geographic regions. These differences can shape the users' interaction with products in each country.

A large number of mobile users are living in countries that are not the origins of mobile technology. Among these countries, many are classified as emerging markets and at the same time as developing countries (Kalba, 2008). A large number of studies about the role of cultural differences in use of mobile phones are about comparison between East Asian countries, such as South Korea and Japan, and Western countries. China and India are also mentioned frequently in the literature, as these are large scale markets encompassing relatively low income customers who are going to obtain their first mobile phones in the next few years (Aryana and Øritsland, 2010; Aryana and Boks, 2012a). These users are sometimes called the "next billion users" and are considered the main target group for OEMs of mobile phones (Kenny and Keremane, 2007; Jensen et al., 2012). They also belong to a specific socioeconomic group that is called the Base of the Pyramid.

Unlike East Asian countries, China and India, the emerging markets selected for this research were not studied much before. While Iran and Turkey are considered as emerging markets, and at the same time, as countries with non-Western cultures, they are not as large as China and India, and at the same time are not placed in East Asia. Penetration rates of mobile phones are going to cover the entire population in both countries in the next few years, so users in these countries cannot be classified as the next billion users. In contrast, there are potential first-time users of smart phones in these markets who experienced ordinary mobile phones before. Unlike China and India, the Base of the Pyramid does not cover a large number of users in Iran and Turkey.

Both Iran and Turkey are placed in the same geographic area and are among the influential countries in the Middle East region. There are similarities in terms of population, penetration rate of mobile phones and average income (OCED, 2012; BIM, 2012).

In summary, Iran and Turkey were suitable candidates for conducting the research because of the following characteristics:

- These were not explored before in similar studies, and were not similar to the countries that were frequently studied in similar studies (East Asian countries and large emerging markets, mainly China and India).
- These two markets were suitable for research on smart phones because of a relatively high penetration rate of mobile phones and average incomes, which allowed a number of users to purchase smart phones.
- While Base of the Pyramid users were the focus point of some similar studies, users with higher-than-average incomes in emerging markets were not studied frequently. Iran and Turkey were good candidates for studying these less-studied users.

Along with above similarities, there are some important differences between Iran and Turkey. The economic and political systems are quite different as Iran is an Islamic (religious) Republic (Curtis & Hooglund, 2008), while Turkey is a Parliamentary republic similar to most Western countries (Metz, 2008) with quite higher economic growth. The political system in Iran caused some restrictions in the use of communication technology, for example, by filtering websites and limiting the internet speed for home users. In contrast, Turkey is more connected to the West and there are fewer political limitations in the use of technology in comparison with Iran. Finally, Turkey is faster in developing the infrastructures that are needed for new generation of mobile telecommunications (OCED, 2012; BIM, 2012).

While both countries are sometimes categorized as a part of so-called Islamic world, it should be noted that Iran is mainly a Shia Muslim country, while most citizens of Turkey and other countries in the Middle East are Sunni Muslims. The common language in most Middle Eastern countries is Arabic; however, the majority of people in Iran and Turkey do not speak Arabic. Persian, which is being spoken by most Iranians, is an Indo-European language and the Turkish language is classified as an Altaic language. Therefore, the three languages of Arabic, Persian and Turkish are basically different (Nydell, 2012). Table 1 provides a summary of the two countries' profiles.

Table 1. Summary of countries' profiles

	Iran	Turkey
Politics	Islamic republic	Parliamentary republic
Limitations in use of information technology	Yes (mainly in use of internet and related technologies such as some 3G features)	No
Most common religion	Shia Islam	Sunni Islam
Language	Persian (an Indo-European language)	Turkish (an Altaic language)
Population	74,798,599 (World Bank, 2013)	73,639,596 (World Bank, 2013)
Gross domestic product	\$331.01 Billion US dollars at current prices (World Bank, 2013)	\$773.09 Billion US dollars at current prices (World Bank, 2013)
Gross domestic product growth rate	1.8% annual change (World Bank, 2013)	8.5% annual change (World Bank, 2013)

1.2. Research questions

The core research question in this study addresses country-specific differences between users in the way they use smart phones and possibilities for considering these differences in a design process. To be able to accomplish this research, an understanding about current knowledge in a number of related fields is essential. In addition, it is important to know how users in selected countries interact with smart phones and if they face any country-specific problem during their use of smart phones. That is why two other research questions are added as sub-questions to the main research question.

In this way, research question one is the core research question of this study and addresses the country-specific customization and its integration with the design process. Accordingly, the research question two as a sub-question focuses on current knowledge in the related fields. Finally, the research question three investigates different aspects of users' interaction with smart phones in the selected countries.

Therefore, as Figure 2 shows, the sub-questions two and three were answered before the research question one during the study.

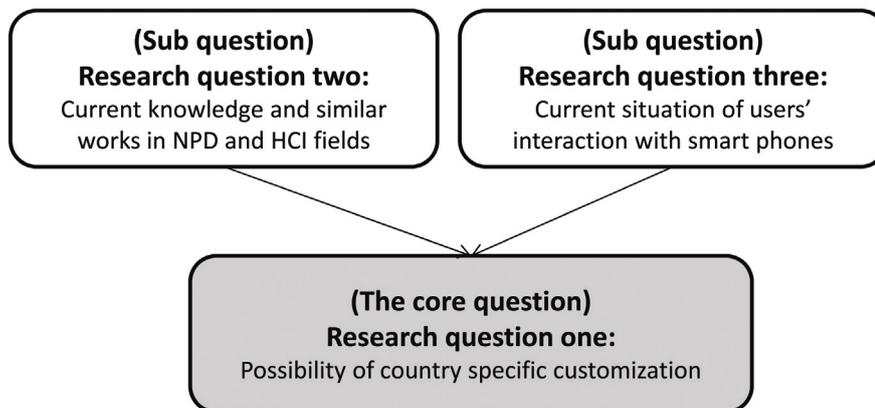


Figure 2. The research questions and their relationships

Research questions one, two and three will be presented and explained in more detail in the next subsections.

1.2.1. Research question one, the core research question

The research question one is developed as follows:

How can existing design methods be incorporated into a customization process for solving country-specific usability problems?

In order to clarify this research question, it should be added that this research question addresses country-specific customization in two main areas:

- Finding (a) method(s) for identifying country-specific usability problems.
- Finding (a) solution(s) for modifying the system (in this research: smart phones) according to the identified country-specific usability problems.

In addition, this research question can be answered on two different levels:

- The case-specific level: the method(s) and solution(s) that were used for the empirical phase of the research.
- The general level: suggesting methods and solutions that can be used in similar country-specific customization processes in the future.

1.2.2. Research question two, a sub research question

This research question has been addressed by the literature review phase of the study, and addresses the basic knowledge that is necessary for answering the core research question (research question one). Research question two is:

What is the state of the art in research that may provide relevant background for addressing country-specific differences and design?

The most important issues addressed by this research question are as follows:

- The common research approaches about country-specific differences within mobile HCI and NPD fields.
- The methods used in these studies.
- The most important results and findings of these studies.
- The less developed or problematic areas that can be explored more in further studies.

Appended papers 1 and 2 are developed for answering this question. In addition, paper 3 shows an experiment with one of the common approaches in the current literature, which is called an attribute-based approach. As paper 3 shows, this approach has some limitations. Therefore, paper 3 can partially answer research question two by focusing on “the less developed or problematic areas that can be explored more in further studies”.

1.2.3. Research question three, a sub research question

Research question three is defined in order to clarify current state of Iranian and Turkish users’ interaction with smart phones’ applications as another essential prerequisite for answering research question one:

How do first-time users in Iran and Turkey interact with smart phones’ standard applications?

Answering this question not only shows the quality of users’ interaction, but also can highlight potential problems resulting from country-specific characteristics. The existence of such problems is one of the reasons for considering country-specific customization. The most important issues addressed by this research question include:

- The usability problems that users face during their first interaction with smart phones.

- Possible country-specific reasons for such problems.

Research question three guides the research to the next step, which is the final objective of the study: exploring possible ways of country-specific customization reflected by research question one. By highlighting the country-specific usability issues, this research question addresses the importance of country-specific customization, which is going to be discussed in the context of research question one. Answers to this research question can be found in papers 4, 5 and 7.

1.3. Outline of the Thesis

The thesis includes two main parts. Part I, which includes 7 chapters, shows an overview of the study, scope, research questions, methods, results, and a discussion of final conclusions. Part II contains more detailed information about each step of the study in the form of seven research papers. The literature review and empirical phases of research are explained in chapters 2 through 6. Figure 3 shows how information gathered in these two phases are covered by these chapters. Components of literature review and empirical phase that are shown in Figure 3 will be explained gradually in the next chapters.

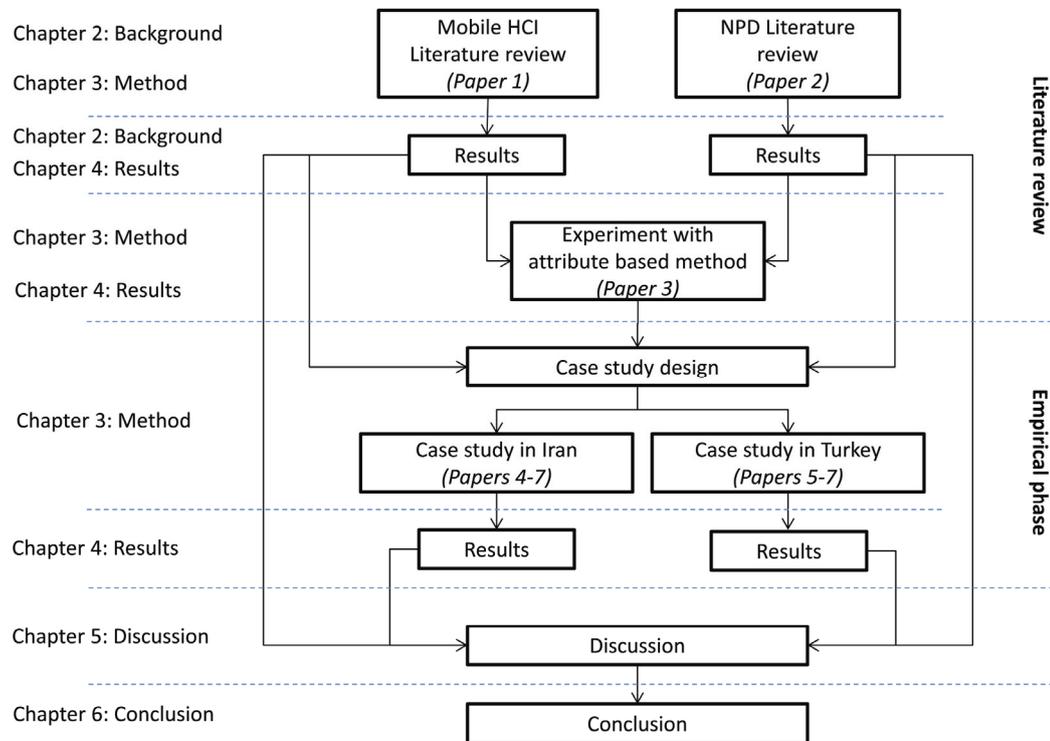


Figure 3. Phases of the study and their coverage by papers and chapters

According to the phases of the study as presented in Figure 3, the balance of Part I is outlined as follows:

- *Chapter 2, Background*

A brief overview of related works is described in this chapter. The first two papers in Part II presents more extended literature reviews. In addition, the other papers include their own background sections that discuss the related works more specifically according to the scope of each paper. Therefore, Chapter 2 only reflects on the most important points of the literature and their connections.

- *Chapter 3, Method*

The procedure of the research project including the steps of the literature review and empirical phases is explained in Chapter 3. In addition, this chapter exhibits a summary of all techniques and approaches used in the study.

- *Chapter 4, Results*

The results of the study in different phases are summarized in this chapter.

- *Chapter 5, Discussion*

In this chapter, the results of the empirical phase are discussed. An important part of this discussion compares the results of current study with similar works in the literature. In addition, some interesting findings that came out of the empirical phase, but which are not directly related to the research questions, are presented in Chapter 5.

- *Chapter 6, Conclusion*

Answers to the research questions, recommendations for further research, possible implications, and research limitations comprise this section.

- *Chapter 7, Summary of the papers*

Summaries of the papers in Part II are presented in this chapter.

Part II of the research includes the following papers:

1. Aryana B. & Øritsland T.A. (2010) **Culture and Mobile HCI: A Review**. Proceedings of the 8th International NordDesign Conference 2010, 217-226.
2. Aryana B. & Boks C. (2012) **New Product Development and Consumer Culture, a Review**. International Journal of Product Development, 16(1), 45-62.
3. Aryana B. & Boks C. (2010) **Cultural Customization of Mobile Communication Devices' Components**. Proceedings of the 11th International Design Conference DESIGN 2010, 137-146.
4. Aryana B., Boks C. & Navabi A. (2011) **Possibilities for Cultural Customization of Mobile Communication Devices: The Case of Iranian Mobile Users**. Lecture Notes in Computer Science, Human Centred Design, 6776/2011, 177-186.
5. Aryana B. & Clemmensen T. (2013) **Mobile Usability, Experiences from Iran and Turkey**. International Journal of Human Computer Interaction, 29 (4), 220-242.
6. Aryana B., Clemmensen T. & Boks C. **Users' Participation in Requirements Gathering for Country-specific Customization of Smart phones in Emerging Markets**. Submitted to Universal Access in the Information Society.

7. Aryana B. & Boks C. (2012) **Country-specific Customization of Smart phones for Emerging Markets; Insights from Case Studies in Iran and Turkey.** International Journal of Logistics Economics and Globalization, 4 (3), 179-196.

2. Background

This chapter provides an overview of research about country-specific differences in the use of interactive technologies, especially mobile phones. Systematic literature reviews in the fields of New Product Development (NPD) and Mobile HCI have been accomplished in the first phase of the study to exhibit both user-oriented and business-oriented perspectives. Although these two disciplines are different in terms of their perspectives on users, they are similar in terms of defining design as an important attribute. Design is a vital part of the development of a new product and an influential factor in HCI.

To this end, in the first step the directions of studies about country-specific differences in use of technology will be explained. After introducing these objectives, similarities between the reviewed studies will be discussed. The literature review phase of the study, which will be presented in chapters 3 and 4, only covers mobile HCI and NPD fields. In addition, a brief background of customization will be presented.

2.1. Directions of research on country-specific differences in use of technology

This subsection briefly explains why there is a need for research on country-specific differences. Papers 1 and 2 represent a number of studies about relationships between country-specific characteristics (especially national cultures) and use of technology. The direction of these research studies are summarized below in five main categories.

2.1.1. Business advantage

Gaining a business advantage is one of the objectives for considering cultural, regional and country-specific differences in design and development of products and technologies. In fact, understanding differences between customers and accordingly specific needs of each socio-cultural group is not a new trend in the field of marketing. However, methods for considering such differences have changed over time. The conventional market segmentation approaches usually classify customers according to their demographic characteristics, such as gender, age, country, region, culture and income (Weinstein, 1987). The more recent approaches are more focused on relationships between customers and the provided service or product. This means that sometimes customers with different demographic specifications may have similar relationships

(for example similar needs, or similar feelings) with a product or service that put them in one segment (Liu et al., 2012).

In comparison with marketing, terms such as culture-oriented design or country-specific design (similar to what is studied in this research) are relatively new terms within the design discipline and similarly in the HCI field (Hinds and Lyon, 2011). A close look at HCI and interaction design disciplines shows that they have mainly been developed in the West. Therefore, these were Western users who shaped the scholars' understanding of users when these fields were emerging (Myers, 1998; Bürdek, 2005). In the 1990s, the global market of the software industry was extended and some major companies, especially in the United States, felt the need for understanding users in other countries especially in Asia (Tan, 1998; Raman and Watson, 1994). Global scale diffusion of information technology by-products and services such as internet and mobile phones created another wave in the studies about cultural and country-specific design (Fortunati, 2001; Benson, 1998). In the case of mobile phones, country-specific differences play an important role in emerging markets of developing countries. Many companies see the future of mobile industry in these markets, which are not yet matured. However, users in these markets might be different from Western users, so understanding their cultural and country-specific characteristics is vital for gaining a business advantage. Among these user groups, the so-called next billion users are more studied (Björhov and Weidman, 2007; Vertovec, 2009). These are usually users from large population and low-income socio-cultural groups, which did not use mobile phones before. Countries such as China and India are among the main focus points of these studies (Tongia, 2007; SadreGhazi and Duysters, 2008).

2.1.2. Usability

Providing universal usability is among the reasons for research into cultural, country-specific and regional differences of users in academia and industry. Differences among users have always been a concern in disciplines such as human factors and ergonomics. Research studies on topics such as anthropometry in the 20th century showed that there are differences among different countries in terms of physical specifications, which should be considered in the ergonomic design of products and workstations (Brookhuis, 2008). With more advancement in these scientific fields, new research directions emerged that were more focused on the cognitive and psychological aspects of human-system interactions (Kaplan, 2004). Experiences in using human

machine systems around the world showed that users may have different perceptions about directions, colours, signs and symbols (Chapanis, 1974; Horton, 1993; Alvares-Torres and Mishra, 2001) and in many cases these perceptions are influenced by cultural background and language (Stephanidis and Savidis, 2001; Moray, 2004). The emergence of more advanced systems and products, especially interactive systems, made the subjective aspects of these differences more important. Now, designers of interactive systems contend with complex human activities such as communication and intuitive interaction. In many of these activities, users' cultural backgrounds have a clear influence on the way users interact with a system (Nam et al., 2009; Blackler et al., 2007). That is why providing universal usability is among the reasons for research into cultural, country-specific and regional differences of users.

2.1.3. Understanding social impacts

When the aim of studies about country-specific differences is to increase the business advantage or to improve the usability of a technology, results are usually focused on the technology, and possible ways for improving or changing the technology. However, unlike scientists in design, HCI, and human factors disciplines, social science scholars are more interested in understanding the impacts of technologies on the society, and not necessarily always care about changing the technology itself (Bauer, 1990; Bijker and Law, 1992). In other words, when objectives of a research study are improving the usability or gaining the business advantage, the results usually address some changes in the system. However, when understanding the social impact is the main objective, the results do not necessarily address changes or improvements in the system; they are more about understanding and interpreting the social impacts of the system. Of course, looking at these types of research studies could be quite useful for experts in other fields such as HCI and design, as they can provide a detailed, qualitative, and deep view of social impacts of information technology. An important outcome of these studies is that similar technologies can be used in different ways around the world (Hjorth, 2004).

2.1.4. Social sustainability

Environmental concerns are usually the core areas of research within the sustainability research. However, sustainability is a broad concept, and can be extended to systems such as societies (Dillard et al., 2009). According to McKenzie (2004), social sustainability is “*a life-enhancing condition within communities, and a process within communities that can achieve that*

condition.” According to this definition, equity of access to key services such as health, education, transport, housing and recreation is among the indicators of social sustainability.

A direction in social sustainability is considering low-income people who need certain types of technologies to improve their living conditions. This group is not usually interesting for companies that provide those technologies because of their low purchase power. Therefore, the design and development teams in the business environments usually do not create products for this group of users (Kirchgeorg and Winn, 2006). That is why a number of organizations and research centres are trying to deliver technological solutions to these socio-cultural groups, to maintain social sustainability.

Another major direction in social sustainability is inequality in the use of technology between developed and developing countries. As disciplines such as product design and ergonomics that transform technologies into usable products are primarily developed in the West, users in developing countries may not be able to use technology with equal satisfaction (Scott, 2008). Therefore, there is a need to review the knowledge in these disciplines to gain a fair distribution of opportunities that technologies may provide to people around the world.

Finally, studying possible negative effects of technology on societies is also a direction in social sustainability studies. For example, the unlimited technological and economical development in different parts of the world may cause more use of worlds’ natural resources, which can be a threat to the future of human beings (Mills and Emmi, 2006).

The direction of this thesis can be classified under the usability category, because usability evaluation was a core component of the empirical phase of the study. This will be explained in the next chapters.

2.2. Similarities between NPD and HCI perspectives

Because HCI and NPD are two different disciplines, they have different perspectives towards users. While NPD is mainly influenced by the business perspective and is more “customer” oriented, the HCI perspective can be considered more “user” oriented. Despite the differences in the natures of these two fields, the literature review suggests that both HCI and NPD have similarities in the way that they look at country-specific differences in the use of technology. Understanding these commonalities may be useful for planning the empirical phase of this study.

The common methods for studying culture that are found in HCI and NPD fields can be used again for planning the empirical phase of this study. In addition, common shortcomings in both fields could be good points for investigation in the current study.

As motivated in the previous section, country-specific differences in the use of interactive technologies can be an interesting topic for a wide range of disciplines. In addition, research on this topic can have quite different directions ranging from gaining business advantages to providing social sustainability. As explained above, NPD and HCI were two main areas that are selected to shape the perspectives of this research. In both HCI and NPD fields, an approach that is called “attribute based approach” has been used frequently for studying culture and its influence on the use of technology. In this approach, both systems and culture (as one of the most important country-specific characteristics) are broken down into various attributes, which are connected or evaluated in order to provide an abstract image of the culture-system relationships (Srinivasan et al., 1997). In such approaches, the relationships between culture and the system are usually modelled and predicted without testing the system in real settings. Conventional approaches in HCI usually rely on modelling both users and systems in order to understand the interaction (Clemmensen, 2004). Culture could be viewed as the most important aspect of country-specific differences (Leidner and Kayworth, 2006). The results of the literature reviews presented in papers 1 and 2 suggest that the modelling approach influenced the way that scholars in the HCI field looked at the relationships between culture and HCI, even in some recent research studies. While there are different ways for modelling interactive systems such as using Object Oriented thinking (Binder, 2000), there are relatively few cultural models. It is interesting that in the NPD and marketing fields, a similar approach is used. Even some existing tools such as conjoint analysis or quality function deployment were modified for use in the culture-oriented NPD (Srinivasan et al., 1997). These tools are usually attribute-based tools that are designed for modelling products or services, and users’ needs by showing and scoring their attributes.

Though the attribute-based approach is dominant in NPD and HCI, a prototyping approach is also used to study the concept of cultural usability (Clemmensen, 2011). In this approach, user research in real settings is the basis of the research method. User centred design has an important influence on these groups of studies especially in the HCI field, because in a typical user-centred

design process, users are engaged in testing the design prototypes from the early phases of the design (Righi and James, 2007). The design team in a user-centred design process usually does not predict or model the users, but tries to develop low fidelity prototypes to capture the users' reaction in real settings. Some studies in the NPD field also include recommendations for using consumer ready prototypes or design concepts in the initial phase of an NPD process (Viswanathan and Sridharan , 2012; Vallaster and Hasenöhr, 2006).

In most NPD and HCI studies that used a modelling approach, quantitative methods are used for the analysis (Aryana and Boks, 2012 a; Aryana and Øritsland, 2010). In contrast, the studies relied on an empirical approach usually comprise of qualitative methods and in-depth studies on a small number of users.

2.3. Customization

The concept of customization of products is often associated with what is called “mass” customization. As an example, Kodzi and Gazo (2007) defined mass customization as (p 83):

The fulfilment of customer specific orders for defined segments of mass markets, at costs and lead times that communicate value rather than an associated penalty for personalization or order size.

This definition and similar definitions usually illustrate a production system quite adaptable to customers' orders, and as efficient and economical as in mass manufacturing systems. Therefore, in many research studies, the term customization usually addresses production lines integrated with configuration systems that are able to transform consumers' orders to combinations of previously mass produced modules (Hvam et al., 2008).

However, customization has a wider meaning than modular configurations of hard products. As an example, service customization can be a quite different concept and usually is performed by managerial techniques (Gwinner et al., 2005) or by using information technology (Cao et al., 2006). Customization can also be illustrated as a spectrum (Rautenstrauch et al., 2002). This means that, on one end of the spectrum, there are modular customization techniques that are based on building products based on modules according to the consumers' orders, and on the other end, there are opportunities for products that are customizable during the use. Of course, there are different solutions between these two sides of spectrum, which are called hard and soft

customization (Sugumaran et al., 2006). Hard customization is a type of customization that is done by the manufacturing process. The soft customization on products is usually done by the customers or by the retailers, which products are flexible for customization after production (Blecker et al., 2004, pp. 16-18). As we will see, the type of customization mentioned in the current study is closer to the soft side of the spectrum because it has the following characteristics:

1. The proposed country-specific customization is defined for standard applications of smart phones, so it cannot be categorized as a hard customization.
2. It is proposed for a point after production of the basic hardware (the device) and the software (the operating system) platforms, and before use. Therefore, country-specific customization could be done by local representatives of the OEM in each country, or by the operators that provide the device along with a mobile line subscription.
3. Since the first-time users and the standard applications are the focus of the study, the proposed customization is not applicable during the use. However, smart phone users are usually able to apply higher levels of customization by installing other applications. This will be discussed more in the research limitations section.

2.4. Summary

In both the HCI and NPD fields, there are multiple objectives for doing research about country-specific characteristics of users. Gaining business advantage, usability enhancement, understanding social impacts of technology and finally empowering social sustainability and equality on use of technology are among these objectives. Most existing research studies have relied on a conventional “attribute-based” approach. This approach sometimes fails when the system is to be tested in real settings because models cannot predict all aspects of users’ interaction with the systems. However, some studies used an empirical approach similar to the user-centred design concept. These studies are based on observation of users-systems interaction rather than predicting such interactions by models.

In the current study, the main focus is on country-specific customization of smart phones’ standard applications. However, since in general customization can be applied in many different forms, paper 7 in part II explains the concept of customization more extensively.

3. Research Methods

Based on the research questions posed in the beginning of the thesis, the main method of the study was qualitative research. However, a mixture of different techniques was used in this study. The research questions suggest using a qualitative approach as they express the study's design as an open, emerging and developing research (Creswell, 2009). In other words, in each step of the study, findings from the previous steps were among the factors that have been considered for selecting the proper method for conducting the study in that step. Moreover, the research questions start with the words "what" and "how", similar to what is common in most qualitative research studies (Creswell, 2009). As can be understood from these research questions, the objective of research is not searching for cause-effects relationships, but the main concentration is on the quality and texture of the experience, and this is another important characteristic of the qualitative research approach (Willig, 2008). As an example, the study is not built on objectives such as identifying relationships between some predefined variables (such as economic parameters, population or education) and country-specific usability problems, or identifying the efficiency of a certain design method in country-specific customization. Instead of such objectives, quality of users' interaction in each country, or experiences of using different design methods for country-specific customization are among the focus points. That is why the qualitative approach is dominant, while a combination of different methods and techniques are used.

Although the dominant language of the current study is multidisciplinary and the contributions of research have been published in diverse fields such as design, product development, and HCI, the design perspective played an important role in developing the research plan.

Design research can be characterised as having gone through three overlapping periods in its history as a research discipline (Blessing and Chakrabarti, 2009). In the first period, referred to as the experimental period, design research usually reflected the reports of design projects. After some years, design research became more mature; logical and theoretical discussions about design shaped the second period, which is referred to as the intellectual period. Finally, the most recent period is referred to as the empirical period, in which research studies usually concentrate on the way that design processes are conducted, the influence of design processes on resulting designs, and the impacts of designs on users or society. The approach of the current study has

mostly similarities with the empirical approach, and accordingly the case studies are the main components of the thesis. In the case studies, different methods for problem identification, usability evaluation, and problem solving (requirements gathering) were used and the results of applying each method were analyzed. At the same time, participants' interaction with an interactive system showed the impact of an existing design on users. Therefore, case studies (as the main components of this qualitative research) exhibit an approach similar to the empirical approach of design research.

However, the literature review phase, being the first phase of the project, was conducted in a systematic way to ensure the understanding of current knowledge. This understanding is necessary for a proper research design, suitable selection of scopes and methods, and novelty of research contribution. That is why two of the seven papers that are presented in Part II are review papers.

As stated before, the literature review was conducted in two areas of mobile HCI and NPD, and from user-oriented and business-oriented perspectives. Papers 1 and 2 represent these two reviews.

The conclusions from the reviews of both the NPD and mobile HCI fields show some similarities. An important similarity between both domains was the frequent use of attribute-based methods for culture-oriented design and development. That was why an experiment using an attribute-based method similar to what was seen in the literature was planned. In this experiment, a limited number of Iranian mobile users participated in an evaluation of different attributes of mobile phones. In this evaluation, female users defined the extent of femininity or masculinity of each attribute of mobile phones. For example, they were asked to express their ideas about a variety of mobile phones' form factors, and according to the results, most female users believed that a slide form factor is more feminine, while a bar type form factor is masculine. The results of the experiment revealed an important problem with the attribute-based approaches towards culture-oriented design. Users' ideas towards the attributes when they were presented to them separately were not similar to their ideas about those attributes when they were presented together in the form of products (mobile phones). This means that similar to what the Gestalt theory expresses, the whole is different from the sum of its parts (Plotnik, 2002). In other words, an evaluation of a mobile phone's attributes by users cannot provide a complete image of

their idea about the whole product. This experiment, which is presented in the paper 3, was helpful for selecting an empirical approach for the rest of the study. Therefore, instead of trying to model the smart phones and cultures by their attributes, observing users from certain countries during interaction with their smart phones was tried.

As the research questions were focused on customization, the micro-scope (individuals' interactions with smart phones) was superior to the macro-scope (social and organizational impacts of smart phones). However, after completion of the literature review phase, some explorations about the social aspects of mobile phones were completed, which are reflected in two papers focusing on social sustainability (Aryana and Boks, 2010a) and cultural value creation (Liem and Aryana, 2011) topics. Although these papers are not presented in part II, as they were not within the research questions area, a summary is included in Chapter 7. The outcomes of literature review, along with results of paper 3 about the attribute-based methods, were helpful in the research design for the empirical phase of the study.

In the empirical phase, it has been decided that the case studies were to be designed in a business context, as the companies' business circumstances were not considered a great deal in the HCI literature. Therefore, in the first case study in Iran, a number of global OEMs of smart phones were asked to participate in the project. Ultimately, one of these OEMs accepted this request, and the case study was started by group interviews with the OEM's local marketing team in Iran. The interviews were the basis for selecting the device for usability study, selecting a specific user group and accessing the users for the study. The interviews were continued with a focus group study, usability tests, and requirements gathering sessions. The focus group study was planned for identifying areas where country-specific problems might exist. The usability tests were designed based on the results of focus group studies, and their results revealed a number of usability problems. Finally, participants of the focus group provided solutions for the found usability problems in the requirements gathering sessions.

Paper 4 was developed during the case study in Iran. This paper shows the conditions of this case study, interviews with marketing team, focus group and usability tests, and finally initial insights and conclusions. As can be seen in the title of this paper, at this point, similar to what happened in the literature review phase; the prefix "cultural" was used in the text and the titles of publications. However, after careful analysis of the results, especially the usability tests results, it

has been decided that the term country-specific be used instead of cultural, as not all of the local usability problems were directly related to what is defined as national or ethnic culture. There were also some other contextual factors such as governments' regulations or telecommunication infrastructure. The case study in Turkey had similar steps to the case study in Iran. However, the empirical phase was based on a multiple case research design; which means that the conditions of the case studies in Iran and Turkey were not exactly similar while they were following similar research questions. The reasons behind this strategy are explained in the next section. All steps of both case studies are explained extensively in the appended papers:

- Paper 5 shows the focus group studies in Iran and Turkey along with the results of the usability tests in both countries.
- Paper 6 exhibits the requirements gathering phase in which some solutions are posed by participants in Iran and Turkey for customization in each country according to the results of the usability tests.
- Paper 7 was added to the publications to cover all aspects of the cases studies. This paper includes a general overview of both case studies, and also clarifies the connection between the steps taken (problem identification, usability evaluation, requirements gathering) and what is called "country-specific customization" in this research.

Table 2 presents a summary of the research procedure in 12 steps. There are brief explanations of each step's outcomes and the sequence of writing publications. In addition, it can be seen how steps 1 and 2 affect the later steps:

- Literature review (step 1) showed that attribute-based methods are common in both NPD and mobile HCI literature. Therefore, before the case studies, this technique was used in an experiment (step 2).
- The importance of business context, lack of user research (findings of step 1) and imperfection of an attribute-based method (as a finding of step 2) were considered in planning the case studies in Iran and Turkey (step 3).
- In both case studies, interviews with the marketing team (steps 4 and 8) were held before conducting the user research, as the literature review suggested more attention to the business context (step 1).

Table 2. Steps of the study and sequence of publications

Step	Outcome	Papers sequence*	Previous influential steps	
1. Literature review, constraints on NPD and mobile HCI domains	1. An understanding of the importance of new products' diffusion processes and their connections with culture 2. Relatively few user research studies exist, most studies preferred to predict users by using cultural models 3. Lack of attention on the business context in HCI studies 4. Attribute-based methods are dominant in both NPD and mobile HCI articles	Papers 1 and 2		Literature review
2. The experiment with an attribute-based method in Iran	An attribute-based approach is not suitable for predicting users' attitude towards the product: The whole is different from the sum of its parts. The empirical approach is chosen instead for the rest of study.	Paper 3	Step 1	
3. Developing a plan for the case studies			Steps 1 and 2	Empirical Phase
4. Semi structured interviews with the marketing team of an Original Equipment Manufacturer (OEM) of smart phones in Iran	1. Focusing on innovative users 2. Selecting a suitable device for the study 3. Accessing users by the OEM's marketing network		Step 1	
5. Focus group studies combined with the diary study in Iran	Identifying a number of applications and tasks that might be the sources of country-specific usability problems			
6. Usability tests in Iran (recorded on videos)	Identifying country-specific usability problems in Iran			
7. Requirements gathering sessions in Iran	Ideas for country-specific customization of applications	Paper 4		
8. Semi structured interviews with marketing team of an Original Equipment Manufacturer (OEM) of smart phones in Turkey	1. Focusing on innovative users 2. Selecting a suitable device for the study 3. Accessing users by the OEM's marketing network		Step 1	
9. Focus group studies combined with the diary study in Turkey	Identifying a number of applications and tasks that might be the sources of country-specific usability problems			
10. Usability tests in Turkey (recorded on videos)	Identifying country-specific usability problems in Turkey			
11. Requirements gathering sessions in Turkey	Ideas for country-specific customization of applications	Papers 5 and 6		
12. Summarizing	Connecting results to the research questions	Paper 7		

* Table note: The sequence of publications shows when each paper is developed. Therefore, it does not show the steps that each paper covers by its contents. For example, paper 7 is developed after the case studies in step 12, but covers steps 2 to 12. There will be more information about the papers' contents in chapter 7.

As can be understood from Table 2, methods used in the study are diverse. In order to provide an overview of these methods, these methods will be explained in the following order in the rest of this chapter:

- Literature review method
- The attribute-based method (used in the experiment in Iran, before the main case studies)
- Methods used in the case studies
- Analysis method

3. 1. Literature review method

The literature review phase in this study was arranged to elicit core ideas, concepts, methodologies, tools used in empirical studies and resulted findings (Hart, 2005). Therefore, a concept-centric approach (Webster and Watson, 2002) was applied, in which the literature was searched, classified and reviewed based on specific concepts.

3.1.1. Mobile HCI and culture

The review process of mobile HCI literature had three parts: identifying the relevant literature, definition of culture as search criteria, and structuring the review:

- *Identifying the relevant literature:* In order to guarantee the scientific quality of the articles, it was necessary to define specific databases for the review. The journals of Institute for Scientific Information (ISI) list, and Association for Computing Machinery (ACM) digital library were selected as the primary databases. The ISI database was selected because of a high level of scientific quality, and the ACM database was used for its wide coverage of HCI related journals, conferences and workshops around the world.
- *Definition of culture as search criteria:* Culture has a qualitative nature and therefore is hard to define. It was essential to select a certain definition for culture before the review to avoid confusion. A definition by Van Biljon (2007) was among the few existing definitions of culture in the context of HCI: “*The patterns of thinking, feeling and acting that influence the way in which people communicate among themselves and use mobile devices*”. This definition was compatible with the perspective of this research, which looks at culture as a characteristic of users. Therefore, articles were only reviewed in which the term “culture” had a similar meaning. Other definitions, such as

“organizational culture” or “professions’ culture” were omitted from the review, as they did not focus on users’ culture as the scope of this study.

- *Structuring the review:* A method called the concept – matrix method (Webster and Watson, 2002) was used for structuring the review. Using this method, each article was categorized based on the concepts presented in it. The concepts for classification were developed in a way that covered all aspects of the research, from the approaches that shaped their research objectives to the final results reflected in their conclusions. These major concepts were approaches, tools and methods, and results and findings.

3.1.2. NPD and consumer culture

The overall approach towards the review of the NPD research studies was similar to the review in the mobile HCI field. However, as NPD covers a wide range of multidisciplinary areas of the study, specific theories within the NPD were considered as the search criteria. The NPD’s evolutionary framework is one of the available frameworks of NPD that provides a systematic, simple and general overview of the NPD. This framework compares the NPD process with natural evolution (Loch and Kavadias, 2007) and tries to clarify the process by classifying the activities into three simple phases that can be repeated in a cyclical pattern:

- *Variety generation:* This is the creative process in which ideas and concepts for a new product are identified.
- *Selection:* The process of evaluation and selection of the best ideas and concepts.
- *Inheritance:* The process of converting the selected ideas into the real products. Each product can create new needs or new problems that may be the starting points of the next generation of that product or the creation of other new products.

By considering the evolutionary framework as the primary perspective for looking at the NPD literature, the review was conducted in three parts:

- *Identifying the relevant literature:* A number of journals from the ISI, list such as International Marketing Review, Journal of Consumer Research, Journal of Economic Psychology, MIT Sloan Management Review, Journal of Marketing Research, International Journal of Research in Marketing and Journal of International Management

were used as the source of the review. No date limitation was applied; however, the oldest references stem from the mid-1990s.

- *Certain theories within the evolutionary framework of NPD, as search criteria:* The NPD framework includes certain theories, and some of these theories are directly related to the relationships between consumers (users) and products. Focusing on these theories was helpful for limiting the scope of the search. In addition, similar to the mobile HCI, the meaning of the term culture was only specified to the user (consumer) culture.
- *Structuring the review:* Similar to the mobile HCI review, the concept – matrix method (Webster and Watson, 2002) was used for structuring the review. The major concepts for classification were approaches, tools and methods, and results and findings.

The literature review phase was followed by an experiment about an attribute-based method, as similar attribute-based methods were mentioned frequently in both NPD and mobile HCI studies.

3.2. The attribute-based method

Because of the complexity of culture and uncertainty about its definition, many scholars preferred to use some of the existing cultural models for understanding culture, instead of relying on a certain definition. In these models, instead of defining culture, culture is broken down into some specific attributes or dimensions. In some models, these attributes and dimensions are scored, and therefore, culture is presented in a quantitative way. In most of these models, culture is usually equal to the “national culture”, which represents the culture of people who live inside specific political borders. As cultural models have attributes or dimensions, and can be quantified, it is possible to map them on attributes of other systems. Among these cultural models, Hofstede’s model was the most common model used in the research studies in both the NPD and mobile HCI literature studied. Other common models are those from Hall (1976) and Trompenaars (1993).

At the same time, there are similar approaches in modelling products by their attributes. When both culture and product could be modelled by their attributes, it is then possible to connect these attributes together and see which cultural attribute is compatible with the existing attribute of a product. It is also possible to see how attributes of a product can be changed to be more compatible with existing cultural attributes. This is the core concept of the so-called attribute-

based method used in an experiment in this study presented in paper 3. As Figure 4 exhibits, the attribute-based method used in this experiment included the following parts:

1. A cultural model: Hofstede's model (Hofstede, 2001) was used in this experiment. Hofstede's dimensions were free to access and simple to understand and use.
2. A model for linking culture attributes to the product attributes: Culture-oriented design of human machine systems (Röse, 2004) was selected for connecting these attributes. This model is one of only a few existing culture-oriented design models. In addition, this model was developed in a way that could be used for all human-machine systems.
3. A product model: An object-oriented product model similar to what is used in mass customization systems illustrated all attributes of a typical mobile phone. Simplicity, modularity and possibility of showing attributes in different classes (which were not limited to the physical components but also exhibited attributes such as colour) were among the main reasons for using this model.

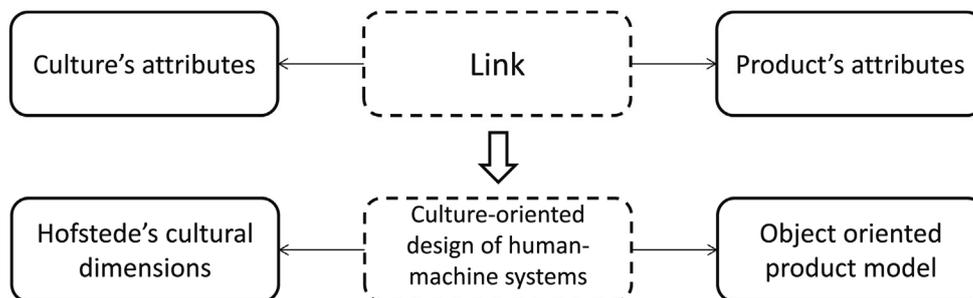


Figure 4. The attribute-based method and its main parts

The next subsections will explain these three parts: Hofstede's cultural dimensions, culture-oriented design of human machine systems, and object oriented product model. Finally, the last subsection will show how an experiment was designed based on the attribute-based method.

3.2.1. Hofstede's cultural dimensions

Geert Hofstede's cultural model is a result from a study supported by IBM in about 70 countries, between 1967 and 1973. The scope of this study was organizational culture and the findings have been updated since then (Hofstede, 2001). The simplicity and the free access database of

Hofstede model (Hofstede, n.d.), made it easy to use and popular even in studies that are not looking at culture from the organizational point of view. Hofstede's model included five dimensions, which are scored for each country:

1. Power distance index shows the extent that the less powerful members of the community accept and expect that power be distributed unequally.
2. Individualism (versus "collectivism") is the degree that individuals are integrated into groups.
3. Masculinity (versus "femininity") presents the distribution of roles between the genders.
4. Uncertainty avoidance index shows the society's tolerance for uncertainty and ambiguity.
5. Long-term orientation (versus "short term orientation") deals with "virtue" regardless of "truth". In other words, the long-term orientation values are thrift and perseverance while Short Term Orientation values are respect for tradition, fulfilling social obligations, and protecting one's 'face'.

3.2.2. Culture-oriented design of human-machine systems

Aaron Marcus (2002) used Hofstede's model in developing a solution for culture-oriented design of websites. In his solution, websites' user interfaces are broken down into a number of components: metaphors, mental models, navigation, interaction and appearance. Then, according to the scores of Hofstede's dimensions for each culture, some suggestions are made for each user interface component. For example, for cultures with high power distance navigation patterns such as restricted access, choices, authentication, passwords, and prescribed routes are suggested. Alternatively, navigation patterns such as open access, multiple options, and sharable paths are recommended for cultures with low power distance. Röse (2004) developed this approach further and proposed a comprehensive solution for culture-oriented design and development of all human machine systems. In addition to considering cultural dimensions, she also added a phase for looking at intercultural variables such as direct variables (information presentation, language, etc.), indirect variables (general machine design, functionality) and frame variables (the educational or political system, technical standards). Hofstede's model is also the basis of understanding culture in both solutions. In the current study, mobile phones were the scope of the research. Because of the importance of the attribute-based approach, it was decided that this

approach be examined. However, it was not clear how mobile phones could be broken down into components. That is why a product model was used.

3.2.3. Product model

Product models are able to show the components of a product and their classifications. Therefore, product models could be used for modular productions, which allow manufacturers to provide a relative variety of products based on a limited number of modules. If this simple solution is combined with a configuration system that is able to transfer customers' choices to the manufacturing process dynamically; manufacturers will be able to provide customized products by using available modules. An object-oriented paradigm is among the main perspectives for creating product models, which define the product as a system structured by objects and classes (Hvam et al., 2008). Since object-oriented product models are able to show a map of the products' real and virtual components and their classifications, they could be used in an attribute-based approach.

3.2.4. Experiment design

By using Hofstede's model, culture-oriented design of human-machine systems, and the object oriented product model, an experiment was designed to show the cons and pros of the attribute-based approach in a specific case of culture-oriented customization of mobile phones. The experiment consisted of the following steps:

Step 1: Creating a model of the product

At the first step, a model was created to show the structure and components of a typical mobile phone as a system. In other words, the model represented all possible modules of a mobile phone as objects that belong to certain classes. Figure 5 shows a part of the product model diagram.

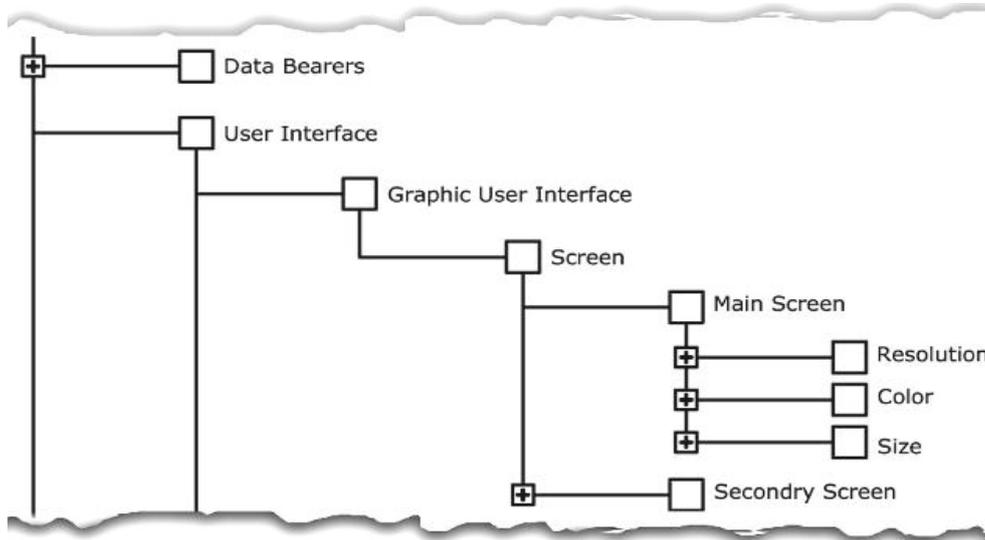


Figure 5. A part of a product model diagram

Step 2: Mapping the cultural model to the components

Since the number of components was relatively high, considering all cultural dimensions was not feasible in a single experiment. Therefore, relationships between one of Hofstede’s cultural dimensions and all components of the product model were studied. A group of 20 female Iranian mobile phone users participated in the study. These female users were between 25-30 years of age with minimum education at a bachelor level, and living in Tehran, Iran. Iran has a medium score of masculinity in Hofstede’s model that is 43. The highest score is 110 for Slovakia, and the lowest is for Sweden at five. The participants were asked to identify the level of femininity or masculinity of each mobile phone component. Of course, only those components were evaluated that were in direct contact with the users. For example, internal hardware components were not among the evaluated components. Users were able to assign one of following levels of femininity and masculinity to each component. Each of these levels had a score:

- F3: High Femininity, Score = 2
- F2: Medium Femininity, Score = 1.5
- F1: Low Femininity, Score = 1
- Neutral, Score = 0

- M1: Low Masculinity, Score = -1
- M2: Medium Masculinity, Score = -1.5
- M3: High Masculinity, Score = -2

According to the sum of all the scores that the users assigned to each component, it was possible to see a final score for each component. Negative scores showed that a component is evaluated as a masculine component by most users and positive scores indicated that most users thought that the component was a feminine component. Figures 6 and 7 show a part of a tables used for calculating these scores by the users.

	Users										
	1	2	3	4	5	6	7	8	9	10	11
Color Brightness	F1	-	F3	F1	-	F2	F2	F3	F3	F3	F1
Color temperature	F2	F3	F3	F2	-	F3	F1	F2	F2	F1	F1
Bar formfactor	-	-	M3	-	-	M3	M1	M3	-	F3	M1
Swivel Form Factor	F1	F3	F3	-	-	F3	-	-	-	M2	F2
Slide Form Factor	-	F3	F3	F1	-	F3	F1	F3	F2	M2	-
Flip up	-	-	F3	-	-	F3	F1	-	-	F2	-
Flip down	-	-	M3	-	-	F2	F1	-	M1	M2	-
Fold out	-	M3	F3	-	-	F2	F1	-	F1	M3	-

Figure 6. Scores made by participants for each component.

	M3 -2	M2 -1.5	M1 -1	F1 1	F2 1.5	F3 2	Scores
Color Brightness				4	4	8	26
Color temperature				4	5	7	25.5
Monochromatic Color	4	3	5				-17.5
Bar formfactor	5	1	4			1	-13.5
Swivel Form Factor	2	1		3	2	4	8.5
Slide Form Factor		2		4	2	6	16

Figure 7. Calculation of scores

Step 3: Evaluating a range of products

After identifying femininity-masculinity scores for all components, a set of products from a specific OEM were selected for the next step of the study. All of these products were similar in terms of price, but had different designs, most likely in order to target a wider range of user groups by the OEM. An overall score was calculated for each product considering its components. This score was the sum of the products' components scores. The same products were then evaluated by the same group of users, to see how they think about the femininity or masculinity level of each product.

Now, it was possible to compare the results, and answer these questions: Is it right to evaluate a product based on its components in this specific cultural context? Do the components define the femininity or masculinity level of the device in the users' eyes?

3.3. Methods used in the case studies

Considering the limitations in the attributed-based method, an empirical approach was selected for the rest of the study. In the "culture-oriented design of human-machine systems", models play an important role (Röse, 2004), but in the empirical approach, predictions are avoided, and actual relationships between users and systems are the source of conclusions for design or

customization of a system for a specific culture or country. In order to have a higher feasibility for generalization of results, the empirical phase was designed as a comparative study. This means that the interactive system (in this case the smart phone) was studied in two different contexts focusing on cultural or country-specific differences in using the technology (Vatrapu, 2011). However, planning and conducting user research is always influenced by environmental and contextual conditions (Kuniavsky, 2003). Therefore, a comparative experiment in which the conditions in both cases should be the same was not feasible. In contrast, holistic multiple case designs (Yin, 1994) were preferred for the current study. In this type of case study design, the objective of study in multiple contexts is similar; however, in each context, a specific case is designed according to the situation (Figure 8).

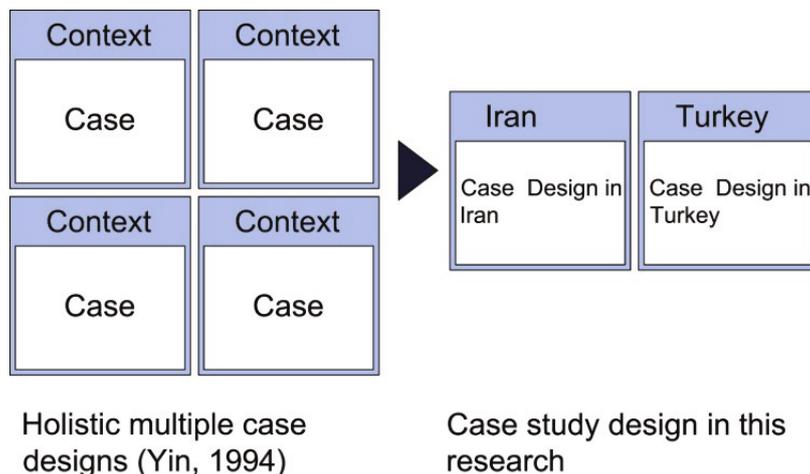


Figure 8. Holistic multiple case designs in Iran and Turkey

According to Eisenhardt (1989), a research strategy using multiple cases is common for analysis when each case is a stand-alone entity. Therefore, this approach was selected because cases that were studied were users in two different countries without much influence on each other. In addition, there were contextual differences such as market conditions and communication infrastructure between two countries that made conducting similar experiments infeasible.

Another reason for applying multiple case research design was due to the connections between different steps of case studies, as results of each step were influential in planning the next step.

As an example, participants of the focus groups in each country addressed different applications in focus group studies; therefore, two different sets of tasks were tested in Iran and Turkey.

According to the definition of case studies (Yin, 1994), experimental controls or manipulation should not be applied in conducting case studies. Therefore, the validity of comparison between two cases by using multiple cases may seem doubtful, as multiple case research design could not be quite similar. However, applying multiple case research design is suggested frequently when the objective of research is to provide a description, building or testing a theory, or generating general research results (Bonoma, 1985; Benbasat et al., 1987; Yin, 1994). The case studies in Iran and Turkey were developed to answer research questions one and three in this study.

Research question one addressed the concept of country-specific customization, which can be classified as a “general” research result. Research question three is focused on “description” of users’ interaction with smart phones’ applications. Therefore, the nature of this study is compatible with using a multiple case research design while other alternatives may fail.

One of these alternatives was to use an attribute-based or modelling approach. Using a modelling approach (predicting users and systems by models before testing the system) may not always predict all aspects of the users’ interaction in real settings (Aryana and Boks, 2010; Liem and Aryana, 2011). The experiment with an attribute-based method showed some limitations of this approach.

The other alternative was a single case design. Focusing on one country would not be enough for making conclusions about the concept of country-specific customization on a general level.

Therefore, at least two countries should be studied. However, differences in characteristics of the countries did not allow similar experimental settings in both countries. Although the two case studies had differences in how they were designed, there were also enough similarities to allow for a partial comparison; both case studies included the following steps:

- *Interviews with regional marketing teams*: This part was planned to identify the contextual parameters from the OEM’s perspective, such as product and market segmentation, users’ groups, and market conditions. Another objective was facilitating the user research, especially in terms of accessing participants.

- *Focus group studies:* These studies were conducted to identify potential areas in which country-specific usability problems may exist. This was an essential part for designing tasks for usability tests.
- *Usability tests:* The outcome of the tests was finding usability problems including a number of country-specific usability problems.
- *Requirements gathering sessions:* The same focus group members in each country participated in requirements gathering sessions in order to propose ideas for solving the existing problems.

The case study designs show that a variety of techniques was used. These techniques will be explained in detail in the next subsections.

3.3.1. Countries' profiles

Country profiles for Iran and Turkey were presented in Chapter 1, including similarities and differences, along with information about language, population, religion and economy:

- These two countries are neighbouring countries, with similar population and penetration rates of mobile phones. Both countries are considered as Islamic countries.
- From a political point of view, Turkey is more similar to Western countries, while religion plays an important role in Iran's political system. That is why there are some laws in Iran that restrict the use of technology. For example, online social networks such as Facebook are banned in Iran.
- Turkey has a much higher economic growth than Iran. This country is also faster in developing the 3rd generation of mobile telecommunications technology.
- The majority of people in Turkey are Sunni Muslims similar to most Islamic countries, but most Iranians are Shia Muslims.
- While Arabic is the dominant language in the Middle East region, the majority of people in Turkey speak Turkish, which is an Altaic language. Most Iranians speak Persian, which is an Indo-European language.

These two markets can be classified as middle-income emerging markets with relatively high penetration rates of mobile phones. Such markets were not studied much before in similar studies. In Chapter 1, it was also explained why these two countries were suitable for this study about country-specific customization:

- Review of the literature suggests that many related studies focused on comparing Western countries and East Asian countries. Study on other non-Western countries such as Iran and Turkey can bring some novel insights into this area of research.
- In studies about mobile phones, there is also a focus on India and China as large emerging markets. There are many low-income customers in these markets who are potentially able to become first-time users of mobile phones. From this perspective, Iran and Turkey are not similar to China and India, while they can be considered as emerging markets. Therefore, a study on Iran and Turkey will show new insights about average or high income emerging markets which were not explored much before.

3.3.2. Semi-structured Interviews with the OEM's Mobile Marketing Teams

The OEM that participated in the case studies has representative offices in both countries, which are responsible for marketing, after sales services, and support. The interviews in Iran and Turkey were done under similar conditions and were planned in two sessions. The duration of each session was two hours. A plan including discussion topics and a specified time for each topic was written and provided to the interviewees one week before the sessions commenced. The interviews were in the form of group interviews, and started with an introduction about the project, continued with discussions about the topics and ended with decisions about facilities for accessing users. Two facilitators managed the sessions. One of them was responsible for posing the topics and inviting the interviewees to participate in the discussions. The other had the responsibility of timing and recording the conversations. The topics of the interview sessions in Iran and Turkey were:

- Current experiences of country-specific customization, and possible evidence for necessity of this issue
- Market segments and user groups
- Available products in the market

- Recommendations for country-specific customization, products and/or features that appeared to be more suitable for customization

3.3.3. Focus group studies

As interactive systems, smart phones cover a wide range of users' activities. Therefore, identifying specific scopes was necessary for conducting the user research. Focus groups are among the qualitative techniques that are suggested for obtaining early insights about a topic (Kidd & Parshall, 2000). Therefore, this technique was a suitable candidate for identifying the areas in which potential usability problems existed, before conducting usability evaluations. Focus groups are not usually conceived as a stand-alone method (Berg, 2001), so they were combined with a diary study in Iran and a free-listing exercise in Turkey. Facilities and available times for accessing participants were different in two counties, therefore, in considering the multiple case study research design, two different techniques (diary study and free listing) were used.

Both free listing and diary studies techniques can be used for qualitative research on users of interactive systems, such as mobile devices, in order to identify and understand areas of usability problems (Proctor and Vu, 2005; Sinha and Boutelle, 2004). Conducting diary studies takes more time compared with free-listing exercise, and therefore, participants of diary studies may provide more detailed information, especially for mobile devices that can be used at any time and any location. However, the researcher usually has better control over the entire process in a free-listing session.

The participants in the focus groups were accessed by the OEM among a group of users who usually adapts a new technology faster than other users in a community. This group of users are called "innovators" or innovative users and new products that are accepted by them usually have a higher chance for success among other user groups (Rogers, 2005). These users were also first-time users of smart phones. These two characteristics (being an "innovative" and "first-time" user at the same time) were suggested by the OEM during the interviews.

Since participants were first-time users without any experience with smart phones, focus group discussions were followed by concentrating on some existing digital devices that cover similar tasks. This approach is called a scenario-based approach, in which past use of existing systems or

future use of potential systems are used for understanding and interpreting the tasks (Rosson and Carroll, 2002).

Focus group and diary study in Iran

At the time of the interviews in Iran, the OEM was performing a “word of mouth” program in order to promote smart phones among Iranian users. In this program, a number of innovative users were provided with free smart phones and invited to participate in a set of social activities for promoting these devices. This word of mouth program was a good basis for accessing innovating users. A group of 15 users in this program was accessed by the OEM in order to participate in the study. These users had the following specifications:

- 20 to 30 years old
- Potential first-time users of smart phones
- Students or graduates of design or engineering fields
- Interested in consumer electronics and digital products
- Highly active in online social networks: This activity was identified by characteristics such as number of connections and their daily hours of activity in social networking websites

The focus group sessions began with an introduction to the research and continued with a diary study. Participants were asked to write their daily observations about the use of smart phones in an Iranian context. The core question for writing the diaries was: “Which features of smart phones need customization in Iran? Give examples from your own reports.” Since the participants were potential first-time users without prior experience with using smart phones, they were asked to use one of the following methods for collecting diaries:

- Daily observations of smart phone users at work or public spaces
- Trial use of smart phones in show rooms of electronic stores
- Daily observation and idea sharing with one of their friends or family members who use a smart phone

After collection of the diaries, a summary of all reports was composed. Then, another session was held with the participants. In this session, the summary of diaries was discussed and two

themes that could potentially cover areas of country-specific usability problems were defined. These two themes were the basis for the task designs and the usability tests. Addressing more themes was considered; however, focusing on two of the most important themes was preferred because users who participated in the usability tests were accessible for only a limited time. As participants were accessed by the OEM, there were some limitations in terms of the number of users who could participate in the tests and the time that they were accessible for the study. Therefore, it was not possible to arrange several usability tests sessions with each participant.

Focus group and free-listing in Turkey

There was not a similar word of mouth program in Turkey; however, similar to Iran, the focus group members were selected from innovative, first-time users with the following specifications:

- 20 to 25 years old
- Potential first-time users of smart phones
- Students of design
- Interested in consumer electronics and digital products
- Highly active in social networks

A group of 10 users participated in the study and the first focus group study session was started with an introduction, similar to what was done in Iran. However, since participants were able to follow up the study in a shorter period in comparison with Iran, a free-listing exercise was combined with the focus group study instead of the diary study. Applying a scenario-based approach, participants were asked to think about their interaction with mobile phones, portable music players and personal computers in a typical day, and then list all of their activities. Given that all participants did not use smart phones before, a combination of the above devices was selected in order to cover a range of tasks similar to what users could do with a smart phone. After finalizing the free-listing study, a number of common tasks among all lists were identified. These common tasks, along with remaining specific and unique tasks, were summarized and presented in the focus group session. In this way, the focus group members were able to see typical daily scenarios of using digital devices. Finally, the participants defined a number of themes that could potentially cover areas of country-specific usability problems in Turkey. Among these themes, the two most important ones were selected to develop task designs for usability evaluation.

3.3.4. Usability evaluation

In both countries, themes suggested by the focus groups were the basis of task designs for usability tests. The themes were transformed into task designs by passing the following steps:

1. Each theme addressed a specific application on the smart phone. Each application was explored by the author, and a list of all features that could be related to the theme was written.
2. For each theme, a scenario was defined that could cover all of the features in the list prepared before. In other words, a user should interact with all listed features during the scenario.
3. The scenario was written in the form of a task including clear, separate steps that could be read by a facilitator during each usability test.
4. The task design was tried by the author, possible problems resolved and unclear instructions modified.
5. The task was pretested on a user and video-recorded. Again, the task was modified if there was any problem in performing or understanding.

As an example, one of the themes in Iran was: “Iranian users have usability problems with the current SMS applications when they want to perform tasks that are related to their SMS social networking behaviour.” The so-called “SMS social networking behaviour” was a common practice among Iranian users in which they used SMS as a tool for sharing interesting contents in groups, and not just for communication between pairs.

According to this theme, a suitable scenario for the test was a scenario that could cover all features related to SMS social networking behaviour including sharing tools, expressing emotions, managing received messages, and searching among contacts. This scenario was translated into the following tasks:

1. Find the SMS application.
2. Select a predefined contact and send her a short message containing two words and one smiley. (The combination of text and smiley was considered due to the tendency of users for using emotions in the social networking.)
3. Return to the main page of the SMS application.

4. Search for a predefined text among the sent messages. (Users usually like to share interesting message with others, so the search function could be important for finding and sharing contents.)
5. Forward the found message to two predefined contacts. (Forward is the main function for sharing contents.)
6. Delete the found message. (In SMS social networking, users usually send and receive many messages; therefore, they need to delete some of them.)

Because of the multiple case research design, there were differences in the way that usability tests were carried out in Iran and Turkey.

Usability tests in Iran

The specifications of the usability tests in Iran can be summarized as follows:

- Selected device: The OEM suggested a smart phone with a reasonable price, which was positioned for the first-time users who are shifting from ordinary mobile phones to smart phones. This device was also used in the word of mouth program that was mentioned before. At the time of the tests, this device was not available in the market.
- Participants: The OEM concentrated on innovative users, and therefore the same group of 15 users who participated in the focus group study were tested.
- Facilitators: Two facilitators carried out the tests. One facilitator was responsible for guiding the participants through the task steps. The other facilitator had the responsibility of video recording the tests. All facilitators were native Persian speakers and were educated as industrial designers. They also attended a short course about the user research method before conducting the tests.

Usability tests in Turkey

The usability tests in Turkey had the following specifications:

- Selected device: The same device was proposed by the OEM for usability tests in Turkey.
- Participants: Unlike Iran, operators were active in providing smart phones to the users in Turkey, usually with prices lower than the free market. Therefore, innovator users were able to access new devices from operators. Because of this condition, the OEM suggested

focusing on users in the free market. Based on this suggestion, 25 subjects were selected by a convenience sampling in an electronics store in the centre of Istanbul.

- Facilitators: Three facilitators carried out the tests in Turkey. Two facilitators had responsibilities similar to those in Iran, and the other one was responsible for protecting and taking care that the test participant could do the test undisturbed by other people. All facilitators were native Turkish speakers and were educated as industrial designers. They also attended a short course about the user research method before conducting the tests.

The results of the usability tests were then analyzed and a number of usability problems were found under each theme. This was the basis for the requirements gathering sessions.

3.3.5. Requirements gathering

The final designs resulting from conventional design processes were often a rational solution to balance between requirements and system delivery. As a result, these solutions were able to answer functional needs. However, when it came to satisfaction, they were not necessarily the best answers. That is why some approaches such as participatory design and human-centred design solutions were gradually considered as requirements gathering solutions (Cherry, C. & Macredie, 1999). Because of the users' presence in such solutions, techniques that require specific technical knowledge could not be inclusively used for all user groups. That is why techniques such as brainstorming and sketching, which could be considered as free and simple ways for expressing ideas, are being used widely. Moreover, these techniques are also used for communicating between users and designers in a human-centred design process (Love, 2005).

The process of requirements gathering in the current study included two techniques of brainstorming and requirements gathering, and produced both textual and visual contents. These contents presented ideas for customizing current applications as an answer to the country-specific usability problems.

Regardless of ideas generated by the participants, an important aspect of having a requirements gathering component in case study designs was a better understanding of the way users think about solving the problems, and the points about which they are more sensitive. This will be discussed further in the results section. In addition, the analysis method subsection will address how these solutions are being translated.

Brain storming sessions

Brainstorming is a technique for creating a large number of solutions with relatively low sensitivity about the quality of ideas. Usually, after the sessions, a solution refinement process is done by identifying major categories of solutions and prioritizing them based on factors such as feasibility (Paulus and Nijstad, 2003).

A similar procedure was applied in brainstorming sessions in Iran and Turkey. Each session was started by watching sample videos of usability tests and presenting common usability problems, followed by generating solutions for each problem. The duration of the sessions was three hours, divided into two equal parts, and in each part participants generated ideas for one application. One facilitator had the responsibility of avoiding criticizing ideas and too much concentration on each design idea. Meanwhile, a second facilitator was writing the solutions on a white board. After the idea generation, the participants were asked to classify the solutions. Then it was time for ranking ideas according to their feasibility and relevance to the objective of the activity, which was country-specific customization.

Sketching sessions

Sketching is also a way for generating solutions; however, while its visual essence may give it higher power for communication, it may not generate a large number of ideas similar to brainstorming (Love, 2005; Stone, 2005). Sketching sessions were similar to brainstorming sessions in terms of timing. Each participant drew at least one sketch for each application. The technique was similar to a “brain drawing” or “visual brainstorming” technique, which means creating and modifying sketches to generate ideas quickly (van der Lugt, 2000).

3.4. Analysis method

As it can be understood from the case study techniques, and although a small number of participants in both countries were studied, diverse types of data were gathered and multiple techniques were used during the case studies. This diversity of data and techniques produced a high volume of data in forms of recorded sounds (interviews), videos (usability tests), text (diary study, free-listing exercise, and brainstorming sessions) and sketches (sketching sessions). In addition, research questions two and three, which addressed the empirical phase of this study, primarily were “how” questions: “*How do users in Iran and Turkey interact with smart phones’ standard applications?*” and “*How is it possible to customize the design of smart phones’*

standard applications for each country within the current situation". Considering the type of research questions, number of participants, and type and diversity of gathered data, a qualitative analysis was selected and applied as the main analysis approach in the research.

The qualitative analysis was an ongoing process during the case studies, as results of each step affected the next step. Therefore, framework and results of each step were built based on the previous steps. In addition, the role of the researcher during the research was not only to present the results, but the researcher also had the responsibility of adding his own interpretations about the results and possible connections among them. Because of these two characteristics (ongoing process of analysis and applying researcher interpretation in the analysis), this research obeyed constructive grounded approach.

Because of the importance of the researcher's interpretations, some of his competences are listed below:

- *Language*: The researcher is a native Persian speaker, which made the process of user research easy in Iran, as most people in Iran speak Persian. He also speaks English fluently. In Turkey, English was used in the interviews with the OEM marketing team and also for communicating with Turkish facilitators, who were also fluent English speakers.
- *Relation to facilitators*: The researcher is educated as an industrial designer, similar to the Iranian and Turkish facilitators.
- *Experience*: In addition to his academic experiences in applying different user research methods, the researcher has two years of professional experience in applying methods such as interviews, observation and user-centred design.

3.4.1. Constructive Grounded Theory

Systematic discovery of theory from data was a basis for analysis in the case studies. For example, as will be described in Table 3 and the next subsection, existence of country-specific usability problems was discovered from a three step qualitative analysis, which used videos as the initial input. That is why the grounded theory concept was the major approach of analysis (Glaser and Strauss, 2008). The influence of contextual factors (such as culture and socio economics) was important in the analysis. In addition, as we will see, the researcher's

interpretation was influential in shaping the conclusions. These were the main results for selecting the “constructive” version of the grounded theory (Charmaz, 2011) as the analysis approach for all parts of the case study. While the constructive grounded theory allows for the researcher’s interpretation and consideration of the contextual factors (which are not always predictable), the alternative “objective” version of grounded theory focuses on representing the data without the researcher’s interpretation and setting the influential factors before the research (Marvasti, 2003). Therefore, the objective approach was more suitable for an experiment setting, rather than the multiple designs cases applied in current study.

3.4.2. Qualitative analysis

The qualitative analysis followed a simple three-step qualitative analysis approach (Huberman and Miles, 1994) that includes the main steps of reducing the data, displaying the data and drawing conclusions. In order to clarify how these three steps were applied, table 3 shows what these steps mean for each part of the case studies. In the analysis of brainstorming and sketching results, a sub-analysis was also done for reducing the data.

Summative content analysis

Summative content analysis is a qualitative analysis method used for analysing the data from requirements gathering sessions. As brainstorming and sketching techniques produced two types of data (textual and visual), it was necessary to find a method able to analyze both types similarly. Content analysis was a good candidate, but in order to be more specific, a version of content analysis called summative content analysis was selected as the sub-analysis method (Ball and Smith, 1992). The classification in this method is done by a set of keywords that are identified before and during the data analysis. The analysis usually starts with identifying contents in the data in order to understand the contextual use of that content. In addition, the summative data includes the researchers’ own interpretation of the content, which is compatible with constructive grounded approach, as the main approach of analysis in the current study. Given that the focus of the usability evaluation was users’ interaction with smart phones, a conceptual model from Sharp et al. (2007) was used as the basis of classification. This model identified four main interactive activities including instructing, conversing, manipulating - navigating, and exploring - browsing. These activities were searched in each textual or visual

idea generated by the users. Of course, identifying these activities was a result of the researcher's own interpretation and that is why the summative content analysis was applied here.

Table 3. Steps of qualitative analysis for each part of the case studies

	Reducing the data	Displaying the data	Drawing the conclusions
Interviews	Recorded voices were reduced to written items. Contents not related to the main topics of tables, discussions about facilitating the rest of study, and repeated issues were omitted.	Items related to each topic were classified under the titles of those topics. Data was displayed by a classified shortlist.	Conclusions directly made for shaping the next phases of the study, including defining conditions of focus group studies and usability tests.
Diary study, and free-listing	Diaries and free lists were transformed into lists of features and their associated usability problems that were highlighted by the users.	A limited number of themes displayed the data. Each theme was a phrase that covers a feature and its related activities.	The final conclusion was designing a number of tasks for usability tests.
Usability tests	Videos of tests were translated into a set of information for each participant including task completion time, number of errors and type of errors.	A table was developed for each theme, which displayed all error types and participants who made those errors.	Common error types among users in each country were identified.
Brainstorming and sketching	Each sketch or idea was translated into a number of "activities" by summative content analysis.	A table was developed for solutions related to each theme, which displayed activities and a number of ideas that addressed that activity.	The conclusion described how users in each country addressed specific activities in their ideas.

3.5. Summary

In summary, the main method followed in this thesis was qualitative research. The most important component of the research was case studies with multiple designs, which is a common research design in qualitative methods (Merriam, 2009). However, there were also other components such as concept centric literature review and the attribute-based method that affected the overall research design.

The techniques presented in this section were quite diverse. In addition, not all details were presented here. Tables 4 and 5 represent a summary of all of these techniques and approaches, along with the publication that explained them in more detail.

Table 4 . Summary of techniques used in the study

Technique	Participants	Other details	Papers in which the technique is mentioned
Concept-centric literature review	Not applicable	ISI database for mobile HCI and NPD literature review. ACM database for mobile HCI review.	Papers 1 and 2
Attribute-based method	20 female Iranian users	Attributes of a product model were evaluated by participants based on masculinity – femininity dimension of Hofstede’s cultural model.	Paper 3
Semi structured interviews	Members of the OEM’s marketing team in each country	<ul style="list-style-type: none"> • Two sessions, at two hours duration for each. • These sessions included an introduction, four main questions, and a final part for planning facilities such as accessibility to users and providing devices. 	Papers 4 and 7
Focus group	Innovative users, 15 participants in Iran and 10 participants in Turkey	<ul style="list-style-type: none"> • Combined with a two weeks diary study in Iran and a free-listing exercise in Iran. 	Paper 5 <i>Also mentioned briefly in papers 4 and 7</i>
Usability tests	15 innovative users in Iran and 25 users selected by convenience sampling in Turkey	<ul style="list-style-type: none"> • Music and SMS applications were tested in Iran. • Music and Contacts applications were tested in Turkey. 	Paper 5 <i>Also mentioned briefly in papers 4 and 7</i>
Requirements gathering	Same participants as focus groups	Including brainstorming and sketching sessions in each country.	Paper 6 <i>Also mentioned briefly in papers 4 and 7</i>

Table 5. Summary of techniques used in the study

Approach	Where used	Publications addressed this approach
Constructive Grounded Theory	The main analysis for the data resulted from case studies.	Paper 5
Scenario based approach	Focus group studies, diary and free-listing techniques.	Paper 5 <i>Also mentioned briefly in papers 6 and 7.</i>
summative content analysis	Analysis of data resulted from requirements gathering sessions including brainstorming and sketching techniques.	Paper 6

4. Results

Corresponding with the research methods described in the previous chapter, this chapter includes a summary of results from all steps of the study. More detailed results can be found in the papers presented part II. Therefore, the main focus of this chapter is on the final and most relevant outcomes rather than presenting all details. Results are presented in three sections: literature review, the attribute-based method experiment, and case studies.

4.1. Literature review results

As was briefly noted in the background section, although NPD and mobile HCI have different natures, studies in these fields that are related topics such as users' culture, and country-specific characteristics have interesting similarities, especially in terms of approach and methods used. The next two subsections show an overview of the literature review results in each field.

4.1.1. Mobile HCI and culture

Three types of classifications were used for the literature review in mobile HCI and culture including, approaches, results and findings, and tools and methods. Table 6 shows the found directions in the reviewed literature under each classification.

Table 6. Three type of classifying the reviewed mobile HCI literature.

Approaches	Results and findings	Tools and methods
<ul style="list-style-type: none">• Discussions about the importance of culture on a general level.• Proposing solutions for culture-oriented design.• Case studies about cultural differences with focus on users.• Case studies about cultural differences with focus on effect of designers' culture on their designs.• Culture oriented designs.	<ul style="list-style-type: none">• Designs• Cultural dimensions and factors• Models processes• General guidelines	<ul style="list-style-type: none">• Cultural models• Contextual research• User research

Of course, in all classifications there were some directions that were addressed more, while some directions were relatively unexplored.

Looking at the approaches of the studies, the results showed that an important group of articles were concentrated toward proving the importance of considering the culture in HCI and mobile

HCI, rather than going a step further and providing solutions. In contrast, there are only a few research studies that addressed solutions for culture-oriented design. The same pattern could be seen in the results. Although many articles suggested general guidelines such as remembering the importance of culture in development of human machine systems, more solid results such as culture-oriented design processes are not common. However, there are some studies that exhibited actual design projects.

Using attribute-based methods based on cultural models, and especially Hofstede’s model, is a common way for understanding and evaluating users’ culture and connecting them to human machine systems. Other methods for evaluating culture such as Cultural Consensus Theory (Garro, 2000), which is a quantitative method for measuring beliefs in culture, were not used in the reviewed articles. Some other research studies tried to use some contextual factors similar to language and architecture for having insights from different cultures.

Finally, conducting user research is not a common way among the reviewed literature for doing studies about culture and mobile HCI. Most research studies relied on general social sciences methods such as observations, scalar questionnaires and interviews. Methods that are more common and in HCI and ethnographic research such as verbal protocols, cognitive walk through, and heuristics are rarely used. Another important limitation is that in most existing case study designs there is no attention to the business context in which products are delivered to the users.

4.1.2. NPD and culture

Classifying the NPD literature was done similar to the mobile HCI literature. Table 6 shows the main directions in each classification.

Table 7. Three type of classifying the reviewed NPD literature

Approaches	Results and findings	Tools and methods
<ul style="list-style-type: none"> • Product diffusion theory • Consumer psychology • Consumer need identification • Typology of markets 	<ul style="list-style-type: none"> • Managerial recommendations • Tools and techniques • Highlighting relationships between culture and NPD 	<ul style="list-style-type: none"> • Quantitative analysis based on secondary data • Cultural models • Interviews and questionnaires as a source of the primary data • User research • NPD case studies

Among the primary research approach, product diffusion theory was the most dominant direction. A large number of papers showed that culture could affect the diffusion of a new product or technology in markets. There were different topics within the diffusion theory that are connected to the culture in these references, for example, the growth stage of product life cycle, adoption of innovation, consumer innovativeness and market acceptance. A major finding within all topics is that the speed of diffusion of a product or a new technology can be influenced by specific cultural or country-specific characteristics. In most of these case studies, the basis of the research is the secondary data about the penetration of different technologies in certain countries. This data is usually compared with scores of Hofstede's cultural dimensions by mathematical models. Therefore, in summary, these studies are based on quantitative methods and secondary data.

In contrast, the methodologies used for studies about consumer psychology are more qualitative and resulted from social sciences. Some of topics within the consumer psychology are "word of mouth" (Mooradian and Swan, 2006), consumer resistance (Kleijnen et al., 2009), and brand personality (Sung and Tinkham, 2005; Monga and Roedder, 2007).

In studies that addressed consumer need identification, there are examples of using attribute-based methods for culture oriented NPD. In these studies, some existing tools such as conjoint analysis and Quality Function Deployment (Srinivasan et al., 1997) are modified for culture oriented NPD. In contrast, there are studies that used an empirical method, which is called concept testing for identifying consumer needs.

Most studies that addressed typology of markets are somehow similar to the "product diffusion" studies, as they classified markets based on their level of innovativeness and influence on the diffusion process of technologies on a global scale. However, some other studies in this category provided information about developing countries and their so-called emerging markets.

Similar to what mobile HCI literature suggests; there are only a few recommendations for culture-oriented solutions for NPD presented in the reviewed literature. However, unlike mobile HCI, there are some case specific managerial recommendations. The remaining studies usually highlight relationships between culture and NPD.

If we look at the tools and methods, we can see that as diffusion process is a core topic within the culture and NPD, there is much attention on quantitative methods and also Hofstede's cultural models. The data used for these studies are usually extracted from secondary data.

In all approaches, interviews and questionnaires are the main source of primary data. Similar to the mobile HCI area, user (consumer) research is not a common method. However, there are more case studies in real settings and in collaboration with an industry compared to mobile HCI.

4.1.3. Summary

It was found that the Hofstede model and attribute-based methods are the most dominant tools for understanding relationships between culture and technology, and in particular culture and mobile phones (Aryana and Øritsland, 2010). This means that in most studies, using predefined models was the only way for understanding users' cultural specifications and that conducting user research is not explored much in both NPD and mobile HCI disciplines. These two alternative approaches were tested in the next steps of the study, and as we will see, the less explored empirical approach was selected as the main approach.

NPD and culture research studies showed that culture could also influence the technology on a macro level and can define how a new technology is being diffused among users in different markets. Such business realities are not considered as an important contextual factor in the mobile HCI field. A possible reason for this situation is the user-centric nature of HCI. However, as technologies are usually presented to users by marketing networks, considering marketing activities can be an added value and bring more validity to the HCI studies. That is why the case studies in the current research started with interviews with the marketing team of an OEM.

4.2. The attribute-based method experiment

The results of the attribute-based experiment showed that users' evaluation about the attributes of a product can not necessarily show their final evaluation about the product as a combination of those attributes. The Iranian female users' ideas about masculinity and femininity of mobile phone components showed that they obeyed some stereotypes, when they wanted to score attributes of mobile phones. Attributes such as slide form factor, light and warm colours had the highest femininity scores. In contrast, attributes such as bar form factor, dark and cold colours, and having computation features (for example document processing applications) received the

highest masculinity scores. However, when the female users were asked to evaluate the mobile phones (as a whole, or as a combination of all components), results were quite different. The devices with stereotypical feminine attributes did not necessarily seem feminine. The first preference of female users were devices with some masculine attributes such dark colour and form factor, as many of them thought that these devices looked better. The results showed that making conclusions based on the attribute-based methods is challenging, as not all contextual factors can be predicted by cultural and product models. Therefore, observing users' interaction with systems in real settings was preferred to a modelling approach. This decision was the starting point for planning the case studies in Iran and Turkey.

4.3. Case studies

As explained before, results of the literature review and the attribute-based method experiment shaped the case study designs. In general, case studies in Iran and Turkey exhibited that country-specific conditions in two countries caused a number of usability problems in the use of smart phones for first-time users of these devices. From this point, the term "country-specific" was preferred to "cultural", as the reasons behind usability problems were related to a set of regional and contextual parameters that were not necessarily related to national or ethnic culture. In addition, users in each country showed their own ways of solving these problems. Summaries of results in each step of case studies are presented in this section.

4.3.1. Semi-structured Interviews with the OEM's Mobile Marketing Teams

In both countries, the OEM did not have any prior experience in country-specific customization. Because of penetration rates of ordinary mobile phones in Iran and Turkey, the market of ordinary mobile phones was already matured in both countries and the OEM preferred to focus on smart phones rather than ordinary mobile phones. A large group of user who were shifting from ordinary mobile phones to smart phones were the focus point of the OEM's marketing team. These users are called first-time users of smart phones in this research.

The marketing teams believed that basic communication applications are already well developed and common for users and, therefore, customization would be more relevant for other applications such as entertainment and multimedia applications. However, the focus group results showed that users still have usability problems when using these basic applications.

Innovative users were seen as influential users who could promote new technologies and products, and show the path that other user groups will go to in future. That was why these users were the main participants of the focus group studies and requirements gathering. In Iran, the usability tests were also done with these users, while in Turkey, a convenience sampling was proposed by the OEM. The reason behind this difference was the role of operators in the mobile phones' market in Turkey. Unlike Iran, Turkish innovative users were able to access new smart phones through operators, with reasonable prices. Therefore, the OEM was more interested in learning about other segments of users in the free market.

A type of smart phone with a price similar to ordinary mobile phones was suggested for the usability tests. The OEM positioned this device for first-time users who want to purchase a smart phone for the first time. At the time of the usability tests in Iran, this device was not introduced into the market. However, as usability tests in Turkey were done about six months later, this product was available in the Turkish market when the case study was ongoing.

4.3.2. Focus group studies

Based on the results of interviews, the OEM facilitated access to a number of innovative users in each country. The results of the focus group studies in Iran and Turkey revealed a number of country-specific usability issues in each country. Conducting usability tests for all addressed usability issues in each country was not possible in the allocated time in which users were accessible for the tests. Therefore, two most important usability themes in each country were selected by the users.

Focus group study in Iran

In Iran, diary studies highlighted a number of mobile applications. Users pointed out specific situations or tasks in which current mobile applications might need country-specific customization. The applications in the list were Short Message Service (SMS), music player, and maps. In addition, there were some hints about security features. In further focus group discussions, two applications, SMS and music player, were selected.

According to diaries and focus group discussions, Iranian users were interested in sharing interesting contents to a network of friends by sending SMS. In the current study, this behaviour is called "SMS social networking". Although Iranian users were not using SMS only as a tool for

communication in pairs, most current SMS features on mobile phones are designed for pair communication. A theme was defined according to these insights from the focus group study in Iran:

Theme 1: Iranian users have usability problems with the current SMS applications when they want to perform tasks that are related to their SMS social networking behaviour.

The focus group also revealed another theme about using the music applications. In the most recent music applications, users access songs by media tags such as artist name, song name, album, or genre. However, many Iranian users preferred to do the same task by conventional file and folder browsing, as they usually use sound files that do not carry media tag information. They often access these files from unofficial sources. This was the core concept of the second theme in Iran:

Theme 2: Iranian users have usability problems in sorting and finding songs by the current music application.

Focus group study in Turkey

The results of free-listing exercise were discussed in the focus group session, and similar to what was done in Iran, specific situations or tasks in which current mobile applications might need country-specific customization were identified in these sessions. The shortlisted applications included music player, contact list and games. Finally, two applications, music player and contact list, were selected.

Turkish participants talked about their alternative way of sorting and finding songs on their digital devices. According to focus group members, they classified songs based on the “mood” of songs (for example sad, happy, energetic, etc.) and not according to the media tag information. Similar to what was observed in Iran; the media tag information was not the participants’ first choice for sorting and accessing songs. Unlike Iran, the possible country-specific reason behind this behaviour was not clear; however, as this behaviour was suggested by the focus group, it was the basis for a theme that was defined in this way:

Theme 3: Turkish users have usability problems in sorting and finding songs by the current music application.

Another frequently mentioned topic in the free list was classifying contacts based on their relationships. Most participants had frequent daily conversations with their parents, and they believed that communication with close family members and updating them about their activities is an important part of their mobile communication. Therefore, they believed that they should be able to create a type of hierarchy for their contacts in which close family members can be placed on the top level. Therefore, the second theme in Turkey was developed as below:

Theme 4: Turkish users have usability problems with the contacts application, when they want to create and classify contacts according to their preferred hierarchy.

4.3.3. Usability tests

Developed themes were translated to a number of task designs for conducting the usability tests. The results of usability tests showed a number of usability problems, which were common among most participants in the tests. Users faced some of these problems when they were doing activities mentioned in the themes. Some other usability problems were general usability problems of the applications, which could be found even if usability tests were performed with users in other countries. Task designs and most important usability problems are presented in separate subsections for each country.

Task designs and usability tests results in Iran

According to theme 1, the following task was designed for the SMS application in a way that could cover all of the activities related to this theme:

1. Find the SMS application.
2. Select a predefined contact and send her a short message containing two words and one smiley. (The combination of text and smiley was considered due to the tendency of users for using emotions in the social networking.)
3. Return to the main page of the SMS application.
4. Search for a predefined text among the sent messages. (Users usually like to share interesting message with others, so the search function could be important for finding and sharing contents.)
5. Forward the found message to two predefined contacts. (Forward is the main function for sharing contents.)

6. Delete the found message. (In SMS social networking, users usually send and receive many messages; therefore, they need to delete some of them.)

The results showed a number of errors related to the theme, addressing the social networking behaviour. Errors were classified as theme-related when they occurred exactly during the activities addressed by each theme:

- Not all participants were able to find out how to forward a message while working with the SMS application. Forwarding a SMS was a basic activity for sharing contents. Sharing contents is a core activity in SMS social networking behaviour.
- Nine participants (out of 15) were not able to insert a smiley in a SMS. Smiley was the only function for expressing emotions in social networking behaviour.
- Eight participants (out of 15) had problems in identifying the search results in the archive. SMS social networking requires dealing with a higher number of messages in comparison with communication in pairs. Therefore, users usually need to search and manage messages.

In addition, another task was designed based on the theme 2, including following step:

1. Find the music application.
2. Type and search for a predefined song name.
3. Add this song to a predefined play list without playing the song.
4. Play the song.
5. Try again to add the song to the play list.
6. Return to the main page of the music player.
7. Search for the songs of a predefined artist.
8. Play all songs of that artist.
9. Return to the main page (home).

Similar to what was observed for theme 1; a number of theme-related errors were identified after usability tests:

- After searching among the songs, no one was able to play the search results. In other words, they were not able to fulfil the final step of the search activity.

- All participants had problems in finding and adding songs to the playlists.
- Not all participants were able to sort and play all songs by an artist.

Another type of data gathered in usability tests was performance metrics that included task completion time and number of errors per participant. Participants with a relatively short task completion time and few errors were considered high performance participants. Results showed that both high performance and low performance participants had the same common usability problems. Although factors such as education or participants' experience with similar devices may influence their performance, in both tests it was not possible to find relationships between participants' performances and type of usability problems that they had.

Task designs and usability tests results in Turkey

Base on the theme 3, the following task was designed for the music application in a way that could cover all of the activities related to this theme:

1. Find the music application.
2. Decide the "mood" of music that is going to be listened.
3. Find a song in that mood (members of focus group collected songs from 30 most popular Turkish singers in pop, traditional, rock, and rap genres in order to cover a wide range of tastes).
4. Add the found song to a predefined play list without playing the song.
5. Play the song.
6. Try again to add the song to the play list.
7. Return to the main page (home).

All of the theme-related errors occurred when Turkish participants tried to add a song to a playlist:

- Twenty-four participants (out of 25) were not able to add a song to a playlist without playing it.
- Twenty-four participants (out of 25) had at least two errors in adding songs during their tests.

Another common usability problem was a problem in identify the meanings behind the graphic symbols assigned for the “Shuffle” and “Repeat” play modes. Ten participants had this type of error while performing tasks.

Although usability tests proved that Turkish participants had problems in sorting and finding songs, short interviews before the tests showed that only six participants used to sort and find songs by applying the “mood” on their digital devices, including portable music players, personal computers, and conventional mobile phones. Accordingly, videos showed that most participants selected a random song quickly when they were asked to select a mood and then select a song. It can be concluded that the “mood” way of selecting songs suggested by the focus group was not a common behaviour of all the participants in the usability tests. However, it should be noted that the theme addressed the general issue of sorting and finding songs, and not only the “mood” way of selecting songs.

Finally, theme 4 was translated into the following task design for contact list application:

1. Find the contacts application.
2. Create a new contact with a predefined name.
3. Add the above contact to the contact list.
4. Return to the main page of application.
5. Find the same contact again.
6. Add the contact to the favourites.

After usability tests, a number of theme-related errors, which occurred during creating and classifying contacts, were found in four categories:

- Seven types of errors were found when users tried to create a contact. Twenty-one out of 25 participants had at least one error in this category.
- Three types of errors were found when users tried to search for a contact. Twelve out of 25 participants had at least one error in this category.
- Five types of errors were found when users tried to mark a contact as a favourite. Thirteen out of 25 participants had at least one error in this.

Similar to what was seen in the previous test, some participants could not identify the meaning behind graphic symbols. For example, 11 participants (out of 25) were not able to identify the star icon as a symbol of favourite contacts.

Similar to the previous tests in Iran, participants with different performances faced similar usability problems. For instance, identifying graphic symbols was one of these problems which were common between users with quite different performance metrics.

Summary of usability tests' findings in Iran and Turkey

Although the multiple case research design does not allow for a precise comparison between two countries, there are still some interesting connections between the findings in Iran and Turkey that should be noted:

1. In both countries, users had usability problems related to predefined themes.
2. Contextual parameters had an influence on these usability problems. For example in Iran, restrictions in the use of social networking applications such as Facebook might cause Iranian users to use SMS as a social networking tool.
3. Users' experiences with other digital devices were also among other contextual factors. The users' interaction with the new smart phone showed that sometimes they obeyed habits that they gained from a previous use of similar devices. For example, usability tests showed that Iranian users had problems in scrolling the application menu in the right direction, because before they had used mobile phones with a different scrolling direction.
4. No connection between cultural stereotypes (such as religion or differences between genders) and country-specific usability problems was found.
5. The music application was the most important non-communication application mentioned by first-time users in both countries. The current feature for sorting and finding songs by media tags was not common for Turkish and Iranian users.
6. Unlike Iranian users, Turkish users had problems in identifying graphic symbols.

4.3.4. Requirements gathering

As explained in the methods section, Iranian and Turkish participants proposed customization ideas in both textual and visual formats, and these ideas were analyzed based on the activities

each idea addressed. According to Sharp et al. (2007), these activities included instructing, conversing, manipulating - navigating, and exploring - browsing.

Instructing activities ranked the first among activities mentioned by Iranian users for customization of music application. Iranian users primarily proposed ideas for mental models of the application, rather than for its user interface, and that is a reason behind their concentration on instructing activities. In contrast, manipulating and navigating activities are not mentioned much in their ideas. A similar pattern of focusing on instructing activities and changing mental models instead of user interfaces could be seen for the SMS application. As an example, some Iranian participants proposed that a new tab be added to the music application to provide file and folder browsing. Although this solution could change the mental model when a user wanted to find a song, it did not require a radical change in the application's user interface (Figure 9).

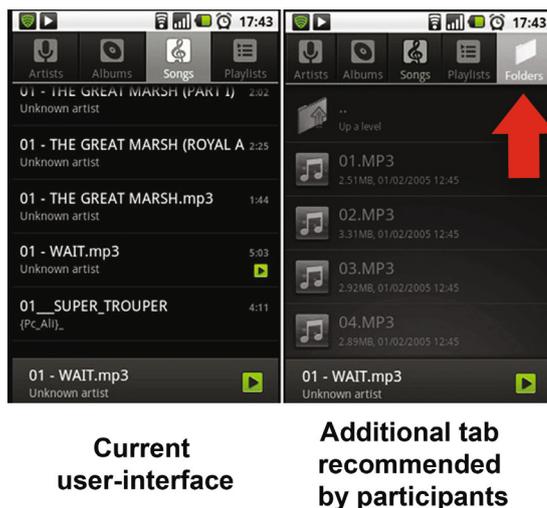


Figure 9. Iranian participants' solution for adding a new tab to the music application user interface

Unlike Iran, manipulating and navigating activities were the core activities that shaped the customization ideas in Turkey, and most of their ideas required radical changes in user interfaces. This pattern can be seen for both music and contact list applications.

As an example, an idea by a Turkish participant in figure 10 exhibits a new user interface for the contact list application. In this user interface, each group of contacts can be opened as a scrollable list by touching its name. To access contacts, touching and scrolling is needed and therefore, this solution covers manipulating and navigating, and exploring and browsing activities. It should be added that, even for music application, which was tested in both countries, Iranian and Turkish users had different customization approaches.

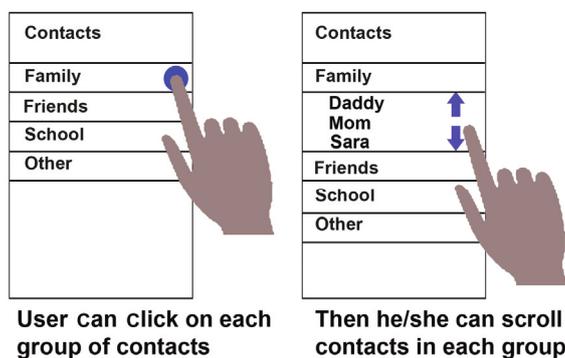


Figure 10. A solution for the contacts list application by Turkish participants

It can be concluded that in each country, participants focused on specific activities. It is interesting that a comparison between results of usability tests and requirements gathering showed that in most cases, the solutions and related usability problems were focused on the same activities.

4.4. Summary

Because of the diversity of results, first an overall image of what was done in the project is provided. Figure 11 shows a summary of the project along with the findings of each part of the research. For example, findings from the literature reviews are shown in four main categories, and each category of finding had effects on planning the next steps. This image will be helpful in understanding the connections between results before the discussion.

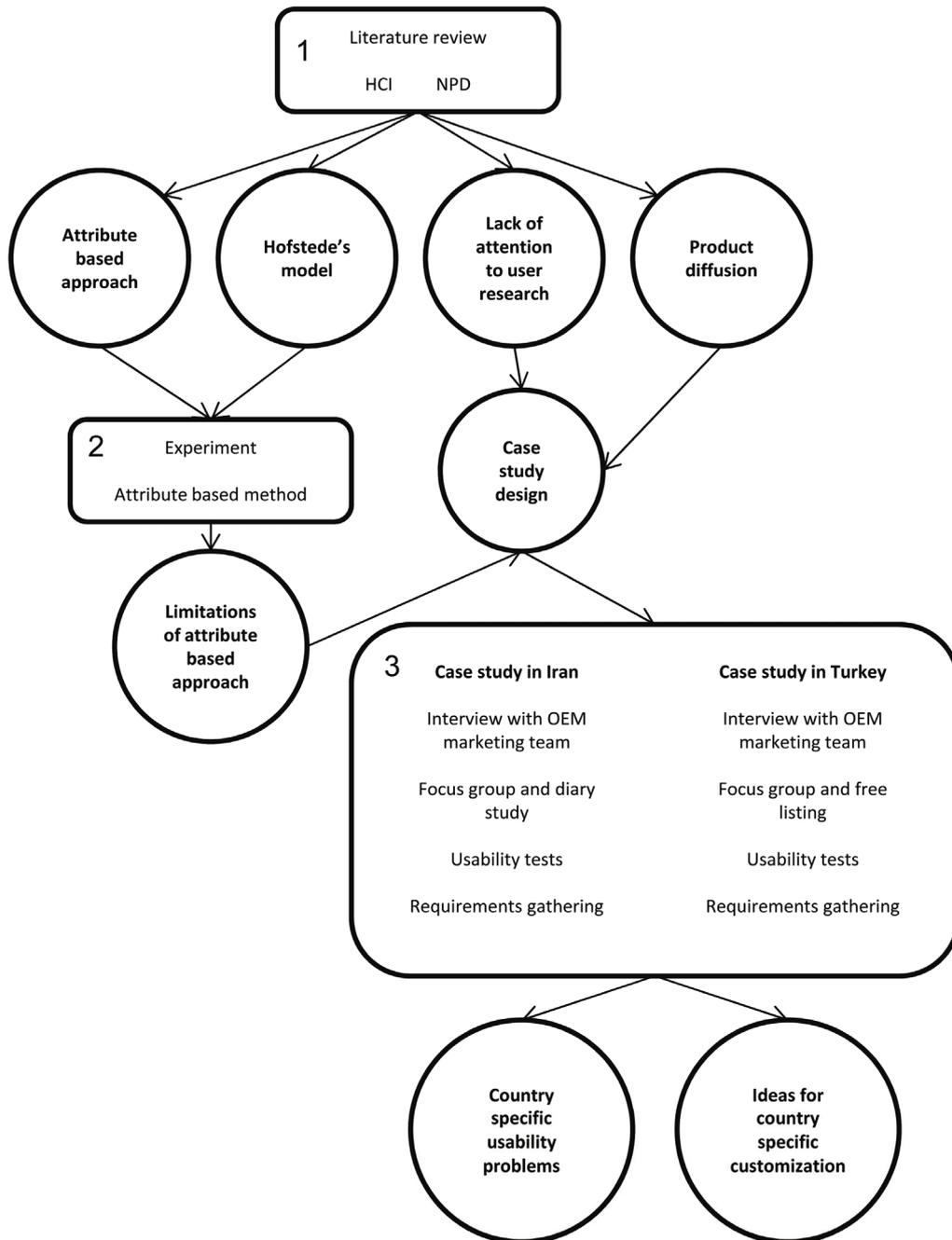


Figure 11. A summary of the project and connectivity of results

The results of the literature review, along with the experiment with the attribute-based method, showed that the empirical approach is more promising in research about country-specific differences in use of mobile phones. In addition, it is necessary to consider OEM marketing conditions in such studies, because in Iran and Turkey some important components of the studies such as defining user groups, selecting a proper device for the tests, and accessing users were dependent on information provided by the OEM.

Participants in focus group studies in Iran and Turkey addressed some themes for usability evaluation. These participants believed that these themes are country-specific usability tests designed, which according to these themes revealed a number of usability problems. Based on the tasks related to each problem, some problems were classified as theme-related usability problems. In most cases, theme-related usability problems were common among participants in the tests. However, there were other usability problems that were considered general usability problems, which could occur in other cases. Focus group members in each country were invited to requirement gathering sessions to solve the theme-related usability problems by brainstorming and sketching ideas. An analysis of the participants' ideas for customizing the applications showed that activities mentioned in the ideas had similar patterns in each country. Therefore, while theme-related usability problems were potential country-specific usability problems, the solutions for these problems were also country-specific, as participants in each country were focused on specific activities in their proposed solutions. Table 8 shows how the results are presented in papers.

Table 8. Results as presented in papers

Results	Publications
Mobile HCI literature review	Paper 1
NPD literature review	Paper 2
The attribute-based method experiment	Paper 3
Semi structured interviews	Papers 4 and 7
Focus group	Paper 5
Usability tests	Paper 5
Requirements gathering	Paper 6

5. Discussion

This chapter will start with a comparison between the current study and previous related studies. Then the most important findings of the case studies will be explained. Based on these, a conceptual solution for country-specific customization will be presented. Finally, the research limitations will be discussed.

5.1 Comparison between the current study and previous related studies

This comparison will show the differences and similarities between the results of existing research studies and the empirical phase of the current study. To this end, the main source for looking at the results of previous related studies is the literature review results.

The literature review phase showed a number of focus points in current literature, and similarities and differences in the way that NPD and mobile HCI field look at relationships between culture and use of technologies, especially mobile phones.

The main similarities between HCI and NPD include:

- Frequent use of cultural models for understanding culture, especially Hofstede's model.
- Relatively few culture-oriented solutions for design or development.
- Focusing on "attribute-based" methods in the few existing solutions.
- User research methods were not core research methods in both fields.

The most important differences include:

- While NPD is mainly influenced by the business perspective and is more "customer" oriented, the HCI perspective can be considered more "user" oriented.
- Frequent use of quantitative methods based on secondary data in NPD studies. Similar patterns could not be seen in the HCI field.
- Because of using quantitative methods, NPD studies proved clear relationships between cultural dimensions and some product diffusion parameters. Such concrete conclusions could not be seen in the reviewed HCI articles.

In addition to the above similarities and differences, it was found that, while the importance of users' cultural characteristics is recognized by the HCI community, user research methods that are common in HCI field are not used much in research studies about culture. In addition, there are only few models or processes for culture-oriented design.

By looking at the NPD field, it can be seen that the "inheritance" phase of the evolutionary framework of NPD was more interesting for the scholars who studied NPD and culture relationships. This means that most studies, especially those that addressed product diffusion and consumer psychology, were concentrated on the final steps of a product lifecycle, when a product is designed, manufactured, and ready for launching into the market. The inheritance phase can be connected to the soft customization concept, as this type of customization is usually done in the final phases of product lifecycle, and even during the use. The case studies in current research also were focused on the inheritance phase. However, if standard applications were considered as a product, the requirements gathering sessions could be classified as variety generation activities.

As product diffusion was a core subject for studies about NPD culture, most research methods used are more quantitative methods adopted for studying consumers on a large scale, and their behaviours on a macro-level. Again, the lack of empirical user research could be felt here.

Hofstede's cultural dimensions were used frequently in both mobile HCI and NPD studies on culture; however, their validity is not clear because they were primarily developed for research on organizational culture. In the results section, it was explained that studies on NPD and culture showed that there are relationships between cultural specifications and diffusion process. However, as paper 2 will explain in more detail, studies which proved a type of relationship have clear contrasts in their final results. Especially when these studies relied on Hofstede's dimensions, it is not clear which cultural dimension is more influential on the diffusion process.

Unlike the majority of research studies in the NPD and mobile HCI, this study did not build its basis on predefined characteristics of culture. As it was observed in some similar studies, especially in mobile HCI, contextual factors in each country or region could act as indexes for understanding users' specifications in those areas. That is why the term country-specific was used in this research. The empirical results supported this selection, as usability problems in Iran

and Turkey were not only dependent on what is known as national or ethnic culture. Users' experiences with similar products, regulations and market structure were among these contextual factors.

The experiment with an attribute-based method showed that the attribute-based methods are not always reliable, and another important outcome of the experiment was highlighting the weakness of cultural stereotypes for understanding users from a specific culture. While female users in Iran thought that some stereotypical characteristics such as slide form-factor and light colours are feminine attributes, they did not consider these attributes when they selected their favourite device. Similarly, results of case studies did not show any evidence of stereotypes. For example, while both genders participated in focus groups and usability tests, there was no sign of influence of gender differences on country-specific usability problems. In addition, although typical Western observers usually see countries such as Iran and Turkey from the perspective of religion, there was no direct hint to religion in the results of the study.

Of course, one would say that methods used in this study might prevent users from expressing such issues that could be considered as sensitive topics. This will be explained more in research limitations. However, it should be noted that it was the workshop facilitators' impression that users in Iran freely expressed their ideas about the influence of governmental regulations against using social network applications in Iran as a sensitive political issue in an Iranian context.

Finally, although case studies were not large-scaled in comparison with many of the related works, they provided a wide range of information about the participants, including their own insights about country-specific problems, common usability problems in actual use of the device, and typology of their solutions for such problems. This comprehensive image was rare among similar studies.

5.2. Highlights of case studies' results

The case studies in Iran and Turkey revealed some usability problems under the country-specific usability themes defined by focus group participants. In addition, they revealed that users in each country had their own customization approaches for overcoming these problems, even for similar problems. These findings provide answers to the research questions; however, there were other

important highlights in the case study results, which were not directly related to the research questions. These highlights can be itemized here:

Role of innovative users: In most HCI research studies, the process of product diffusion is not among the factors for defining the conditions of research. According to the reviewed NPD literature and insights from interviews with the OEM, innovative users are good candidates for user research when resources are not enough for doing the study with several user groups on a large scale, because these users could define which technologies will be successful among other user groups. In addition, as innovative users are usually more educated and easy to communicate with, they could be used as a medium between research teams and local users, when native user researchers are not available.

Country-specific problems in primary applications: Although the OEM suggested concentration on so-called secondary applications such as multimedia and entertainment applications, focus group studies and usability tests showed that users still had concerns about primary communication applications such as SMS and contact list. Therefore, existence of a technology for a long period of time does not necessary mean that users are completely used to it.

5.3. A conceptual solution for country-specific customization

Lack of generalization was among the major limitations of existing research studies about cultural, country-specific, and regional characteristics of users.

The case study approach, a typical country-specific customization process for an interactive product, provided extensive insights in the object of study, and suggests that a process for identifying opportunities for country-specific customization can benefit from an approach consisting of the following steps:

Step 1, Facilitation: In this step, existing marketing networks of the product could be reached. These networks can be used for accessing users and finding feasible features for customization. In the current study, standard applications were feasible features for customization, while the hardware components were not recommended by the OEM.

Step 2, Identification: In the “empirical” approaches of studying users such as human-centred design and user centred design, usability tests, prototypes and similar techniques are the primary

tools for finding problems and evaluation of a system (Gulliksen et al., 2003). Therefore, it is necessary to focus on specific country-specific tasks and problems for conducting such tests. That is why techniques such as focus groups, diary study and free, listing that are usually designed for the initial phases of design, could be used for finding specific tasks before conducting the more precise tests. In this step, local innovative users can act as a medium between the research team and other user groups in the country. At this step, the marketing team already facilitated access to innovative users in the step 1.

Step 3, Evaluation: After identifying the problematic areas, usability evaluation could be done in order to find problems during the use of interactive system.

Step 4, Participation: Local innovative users can participate in generating ideas for solving the existing country-specific problems. A Variety of existing participatory design techniques could be used in this phase. If ideas were generated by free techniques such as brainstorming and sketching, similar to what happened in current study, classification of ideas could be done based on activities addressed by each idea. This classification is important in terms of evaluating ideas base on their feasibility. For example, requirements gathering sessions in Iran and Turkey presented ideas that addressed manipulating and browsing activities. In order to apply these ideas, radical changes in user interfaces were needed. In contrast, some other ideas addressed instructing activities, which needed small changes in the architecture of the application.

Step 5, Implementation: Selected ideas from step 4 can be developed as customized solutions. Of course, another phase of evaluation can validate the results of this step. If the results were not satisfying, the last three phases could be repeated. ,

In summary, the country-specific conceptual solution, to some extent, is similar to a human-centred design process as is described in ISO 13407 (International Organization for Standardization, 1999). Moreover, this customization can be classified as a soft customization, as it is applied on an existing interactive product. Figure 12 is provided to show the following of the solution and to clarify the above statements. As can be seen, the solution is mapped into a human-centred design (Gulliksen et al., 2003; International Organization for Standardization, 1999) and evolutionary NPD processes.

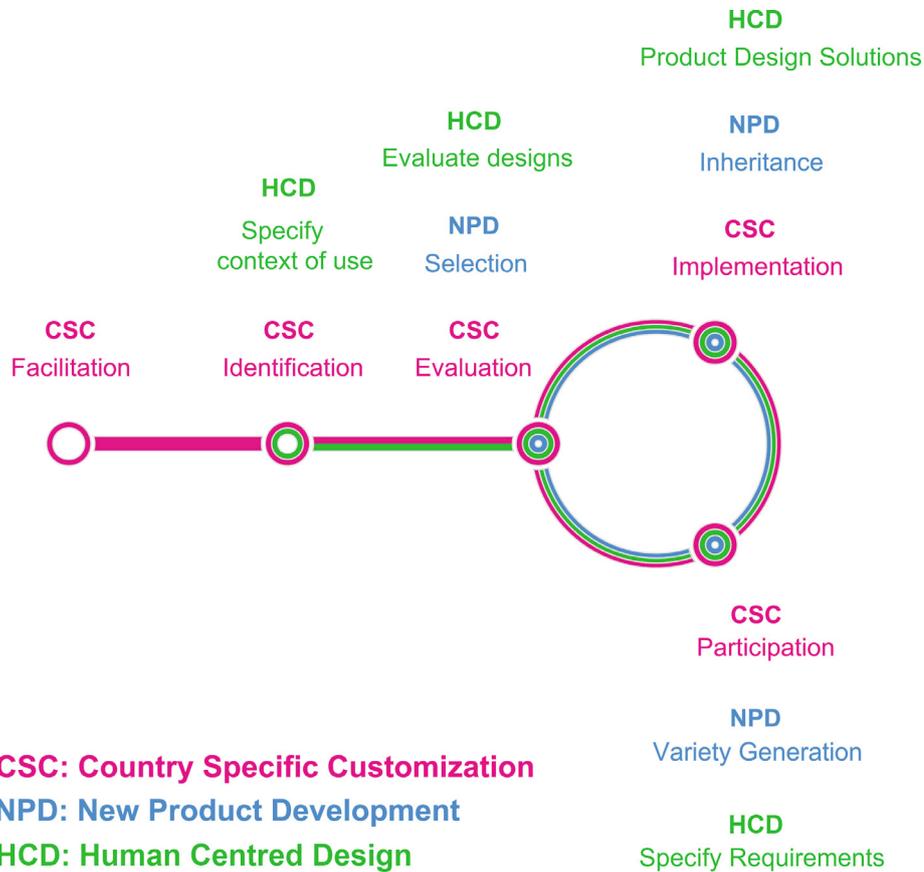


Figure 12. Country-specific customization

5.4. Research limitations

Although a combination of techniques was used in this qualitative research, as was stated before, the case studies with multiple designs were the core component of the research. Conducting such case studies in different field settings requires a precise planning. Planning becomes complicated and challenging when a variety of techniques is being used in such studies. In addition, the nature of qualitative research studies always causes concerns about validity. In Chapter 3 and in previous sections of the current chapter, there were some hints at research limitations. In this section, these limitations are summarized as follows:

1. Validity of techniques according to the context: As mentioned before, methods used in this study were not adopted for these specific countries and this may prevent users from expressing some issues, especially during the focus group studies. Some scholars suggest that user research techniques should be adapted to different cultures (Clemmensen, 2011). For example, as Indian users usually do not like criticism, an indirect method called Bollywood-style evaluation can be used for studying Indian users (Chavan, 2005). In this method, users express their ideas about a scenario similar to Bollywood movies. This scenario underlies specific usability issues that are the scope of the evaluation. In this way, Indian users express their ideas indirectly. However, for the Iranian and Turkish contexts, no reasons were found, neither beforehand or afterwards, to adapt methods because of a perceived lack of desired feedback.

2. Validity of researcher's own interpretation: The researcher's own interpretations were essential for shaping the results of research. For example, when a set of usability problems were found, the researcher's interpretation separated the theme-related problems from non theme-related ones. Although this separation was based on the activities addressed by the problem and the theme, the same results could be interpreted differently by another researcher. Of course, this is one of the characteristics of qualitative research (Creswell, 2003); however, the issue of results' validity should be realized before conducting similar research studies.

In addition, as the qualitative analysis of the current study was based upon the constructive grounded theory, the researcher's own interpretations were influential in drawing final conclusions in each step of the study, and respectively these conclusions affected the next steps, as the conclusion of each step was the input for the next steps. However, the role of focus group participants in two main steps of the case studies moderated the role of researcher's interpretation.

3. Difficulty of comparison and generalization: The multiple case research design had some advantages in terms of feasibility of conducting case studies; at the same time, it made the comparison between two countries, which was needed for generalization of the results, difficult. Of course, the main objective of conducting case studies was finding a similar approach for revealing and solving usability problems, and not making a precise comparison between two cases.

4. Dynamic changes in use of smart phones: The first-time users in these countries will change to experienced users after a short period and therefore, they will be able to select and install a variety of customized applications. Consequently, they will not be limited to the standard applications that are installed by the OEM. In addition, technology and use of such interactive devices is changing rapidly, so the significance of doing research about each technology or feature can be affected by the dynamicity of mobile industry.

5. Evaluation and implementation of results: The time plan did not allow for an evaluation of the proposed design changes that emerged from the research project. Testing the prototypes of final solutions, and asking the OEM about the feasibility of proposed ideas, would add more validity to the results of the study. In addition, the OEM interviews in Turkey highlighted the role of Operators in providing smart phones to users. The research would have more validity, if operators had participated in the study. However, this research was focused on the methodological aspects of country-specific customization, especially in terms of participation of users in the process of customization. Therefore, although in many cases the business perspective was considered, suggesting a commercially feasible design solution was not the main objective of the study.

6. Possibility of generalisation: The literature review findings suggest that only models or processes for culture-oriented or country-specific design are developed. The empirical phase of current research included two case studies with multiple designs, therefore extending the results to all similar cases is challenging. Therefore, the conceptual solution for country-specific customization can be examined in further research studies in terms of validity and feasibility.

6. Conclusion

The main objective of the research was investigating the participation of local users in country-specific customization of smart phones applications in order to overcome existing country-specific usability problems. In order to reach this objective, it was necessary to observe and understand the current situation of users' interaction with smart phones. Moreover, it was essential to know existing findings the literature that could be helpful in developing a country-specific customization process.

In the remainder of this section, after an overview of the results, three subsections discuss the research questions. At the end, a summary will show how each paper has addressed the individual research questions.

It should be noted that research questions two and three are being answered before research question one, because they are considered sub research questions. Therefore, the research questions are answered in this order: Research question two and research question three as sub questions, and finally research question one as the main research question.

6.1. Overview

The literature review showed that the “modelling” approach towards studying users' culture and mobile phone relationships is dominant in mobile HCI and NPD research. In this approach, the culture of users and the interactive system such as mobile phones is usually modelled by a number of attributes. Hofstede's cultural model is among the most used model in such studies (Aryana and Boks, 2012a; Aryana and Øritsland, 2010). The modelling approach and its underlying attribute-based methods have many limitations, as they are not always able to predict the actual situations (Aryana and Boks, 2010; Liem and Aryana, 2011). The alternative empirical approach used in this study is not tried much before in understanding cultural, regional and country-specific specifications.

A new user research technique was not invented to be used in the case studies. However, there is novelty in combining different perspectives and research methods. As an example, the idea of considering innovative users in case studies was new, as in most HCI studies, the participants are not usually selected based on their place in the diffusion process. In addition, all participants were accessed by the OEM marketing teams. In other words, unlike most HCI studies, the user

research was done based on a marketing context defined by the OEM. In fact, a combination of NPD and HCI perspectives were used for adapting user-centred design tools for country-specific customization. This characteristic can make this research unique among similar studies, especially in user-centred design and HCI domains.

The case studies in Iran and Turkey showed the importance of innovative users in user research. These users suggested some areas of country-specific problems in the use of smart phones. These suggestions were the basis of usability tests designs. These tests revealed a number of country-specific usability problems in the suggested areas. It is interesting that in each country, users were focused on specific activities in providing ideas for customization. The procedure and results of case studies suggest that existing marketing infrastructures in different countries could act as a basis for user research (Aryana et al., 2011; Aryana and Boks, 2012). In addition, innovative users could be helpful when local user researchers are not available and research on all user groups is not possible.

Finally, the results suggest that an empirical approach and qualitative research can provide information about local users that are not achievable by predictions made by cultural models. However, the validity of these types of studies is an important issue that should be developed further.

6.2. Research question two, a sub research question

Research question two was defined as follows:

What is the state of the art in research that may provide relevant background for addressing country-specific differences and design?

This sub research question addressed the following topics:

- The common research approaches about country-specific differences within the mobile HCI and NPD fields.
- The methods used in these studies.
- The most important results and findings of these studies.
- The less developed or problematic areas that can be explored more in further studies.

According to what is presented in the results section, Table 9 shows a summary of approaches, methods and tools, and findings and results. The most common approaches, methods, or findings are highlighted by a star sign in this table. Information in this table was presented before separately in Tables 6 and 7.

Table 9. Summary of approaches, methods and tools, and finding and results

	NPD	Mobile HCI
Approaches	*Product diffusion theory - Consumer psychology - Consumer need identification - Typology of markets	*Discussions about the importance of culture on a general level - Proposing solutions for culture oriented design - Case studies about cultural differences with focus on users - Case studies about cultural differences with focus on effect of designers' culture on their designs - Culture oriented designs
Methods and tools	*Quantitative analysis based on secondary data *Cultural models - Interviews and questionnaires as a source of the primary data - User research - NPD case studies	*Cultural models *Contextual research - User research
Results and findings	*Highlighting relationships between culture and NPD - Managerial recommendations - Tools and techniques	*General guidelines - Cultural dimensions and factors - Designs - Models processes
Table note: Items identified by the star sign (*) are the most dominant items in each category		

Table 9 can be used for comparing the results of NPD and HCI reviews. The table suggests that:

- HCI research studies are relatively more diverse in terms of approach compared to NPD articles. In addition, HCI studies usually address the design and development of systems, while NPD studies are more focused on adaption and acceptance of products and services.

- The NPD articles are more diverse in terms of using different types of tools and research methods. However, cultural models, especially Hofstede, are used frequently in the HCI and NPD fields.
- Using different contexts for understanding national cultures is among the interesting methods in HCI research studies that should be noted here. Contexts such as architecture and language, which are used in these studies as an indicator of national culture, can be also viewed as country-specific characteristics, which are not only an indicator of national culture, but also can represent the country to which they belong.
- In comparison with HCI articles, the results of NPD studies usually are clearer in terms of showing relationships between national culture and different steps of NPD processes, especially the diffusion process. A reason for this clarity can be the dominance of quantitative methods in the NPD studies.

Finally, the less developed or problematic areas of reviewed literature could be itemized as:

1. Empirical studies and user research
2. Conducting mobile HCI studies in real market settings
3. Considering the early phases of product lifecycle

6.3. Research question three, a sub research question

Case study results are the basis for answering research question three:

How do first-time users in Iran and Turkey interact with smart phones' standard applications?

This sub research question addresses two main topics:

- The usability problems that users face during their interaction with smart phones
- Possible country-specific reasons for such problems

Focus groups studies including the diary study in Iran and free-listing exercise in Turkey suggested a number of country-specific usability themes in each country that could be seen in table 10.

Table 10. Summary of usability themes in two countries

Iran	Turkey
<p>Theme 1: Iranian users have usability problems with the current SMS applications when they want to perform tasks that are related to their SMS social networking behaviour.</p>	<p>Theme 3: Turkish users have usability problems in sorting and finding songs by the current music application.</p>
<p>Theme 2: Iranian users have usability problems in sorting and finding songs by the current music application.</p>	<p>Theme 4: Turkish users have usability problems with the contacts application, when they want to create and classify contacts according to their preferred hierarchy.</p>

Usability tests in the two countries revealed a number of usability problems. By comparing the activities addressed in each theme and the usability problems, a number of usability problems were selected as theme-related usability problems. In addition, a number of general usability problems were also found. Because of the qualitative nature of the study, the researcher’s interpretation had an important role in the entire process, especially in defining theme-related and non theme-related problems.

A number of country-specific characteristics could be identified as the reasons behind the theme-related usability problems, for example:

- Politics and regulations:* Iranian mobile users are not allowed to use some of the well-known social networking applications and websites on their smart phones. This could be one of the reasons for their SMS social networking behaviour. They are also not able to purchase music from official channels such as iTunes. Therefore, they often download music files from unofficial websites. These files usually do not have the correct media tag information. This is one of the reasons that participants in the case studies preferred a conventional file and folder browsing for sorting and finding music on their mobile phones.
- Social norms:* Turkish users that participated in case studies were interested in having frequent contact with their family members, especially with their parents. Iranian

participants also were interested in a type of collectivist behaviour in the use of SMS, while this application is originally designed for person-to-person communication.

- *Market experience:* A number of Iranian participants were not able to scroll the smart phone's applications menu in the right direction. Most of them tried to scroll the menu in a direction similar to their ordinary mobile phones' user interface. For example, to access the applications in the smart phone's menu, participants should start the task by moving the menu top to bottom, while in most ordinary mobile phones, such an action is done the other way around. These mobile phones were manufactured by two major OEMs that were dominant in Iran's market for several years. Similarly, a number of Iranian and Turkish participants preferred the file and folder browsing method for accessing songs on their smart phones. Most of these users were using a similar method for accessing the songs on their portable music players. In summary, it can be concluded that successful products in a market may influence users' interaction with similar products in the future.
- *Economic context:* The differences between Iran and Turkey in terms of telecommunication infrastructure affect the way that users in each country use smart phones. According to the interviews with the OEM marketing team, Turkey is faster than Iran in developing 3rd generation mobile telecommunications technology infrastructures. In addition, operators have a more influential role in the mobile phones market compared with Iran. Therefore, it is predicted that in the near future, more users shift to smart phones in Turkey, and this can make differences in the use of smart phones in Iran and Turkey. As an example, in the next few years, first-time users may not be the most important user group of smart phones in Turkey, while they may be still important in Iran. Accordingly, country-specific customization can play an important role in achieving customer satisfaction in these two markets because different levels of technology adaption.

6.4. Research question one, the core research question

Research question one addressed the main objective of research, and was formulated as follows:

How can existing design methods be incorporated into a customization process for solving country-specific usability problems?

As was explained, this research question focused on two main areas:

- Finding (a) method(s) for identifying country-specific usability problems
- Finding (a) solution(s) for modifying the system (in this research: smart phones) according to the identified country-specific usability problems

In addition, there were two levels for answering research question one:

- The case-specific level: the method(s) and solution(s) that were used the empirical phase of the research
- The general level: suggesting methods and solutions that can be used in similar country-specific customization processes in the future

In the remainder of this section, each area will be explained by addressing case-specific and general levels.

6.4.1. Finding methods for identifying country-specific usability problems

Case-specific level:

The case studies showed that some of the markets' characteristics affected country-specific usability problems. Some of these characteristics were identified by conducting interviews with marketing teams before starting the user research. Other characteristics were identified by analysing the results of focus group studies and usability tests. The most important items related to market conditions include:

- *Previous successful products in the market:* Usability tests showed that Iranian first-time users had habits in their use of mobile phones that were related to their previous experience with products of certain OEMs. This means that when a company is successful in the market of a country, its products can create habits among users in that country and these habits can influence the way that users use similar products produced by other companies.
- *User segments in the market:* The OEM information was used for identifying user groups in Iran and Turkey, primarily based on their levels of innovativeness. This was also useful for facilitating the user research, as users were already segmented and accessed by the marketing activities.

- *Other important stakeholders in the market:* As was observed in Turkey, the role of operators in providing new smart phones to innovative users caused some differences in conducting usability tests between Iran and Turkey. In Turkey, most innovative users bought the most recent smart phones from operators and not the OEM. The operators usually install a number of applications on the smart phones, which can play a role similar to the OEM's standard applications for first time users. This means that these applications can be among the first applications with which first-time users interact, when they start to use smart phones. Therefore, operators can apply a type of customization (installing their own applications) immediately before the use of the smart phones. In addition, they facilitate the diffusion of new smart phones, which can change the user group segmentations and speed of technology adaption in the market. In Iran, the government can be considered as an important stakeholder, as its regulations about social networks or online music stores were influential in country-specific usability problems.

Although the market specifications explained above were important, as observed from the case studies, the user research was the primary source for identifying country-specific usability problems. In addition, not all information provided by the OEM about the users was valid. For example, while the OEM believed that primary applications are not in demand for customization, Iranian and Turkish users had country-specific issues with basic applications such as SMS and contact list.

In both countries, innovative users participated in problem identification and requirements gathering steps. In Iran, the same group of users participated in usability tests, while in Turkey usability tests were done by convenience sampling. The review of NPD studies shows that some diffusion theories (Bulte and Joshi, 2007; Mahajan et al., 2000) stated that this group of users (customers) can act as an indicator for other user groups. The innovative users who participated in the case studies have a relatively high level of social relationships (according to the number of friends in social networks and the daily time they used to spend on online communication) and education. They were also interested in consumer electronics. These characteristics made communication with these users easier. This was an important characteristic, because in some cultures, users may not be able to communicate with user research teams easily and this can affect their participation in user research activities such as

focus group studies and interviews (Clemmensen et al., 2009). Their familiarity with new technologies helped them understand the topics of focus group studies and usability tests in a short time. In addition, their high level of social relationships was helpful in the diary study in Iran, as part of the diary study was about participants' observations of other users around them.

General level:

In similar customization processes, a “market understanding” step needs to be considered before conducting user research. The important outcomes of this market-understanding step should be:

1. *Identifying market characteristics:* These characteristics include previous successful products in the market (which are able to affect the usability of new products and systems with similar features), user segments, and other important stakeholders in the market, such as regulations that are among important country-specific characteristics. Of course, the user research may also reveal some information about the characteristics of the market.
2. *Facilitating the user research:* In fact, when there is a need for country-specific customization, marketing activities can be used as a basis for user research in each country. This means that the user research team does not need to spend much time on identifying user groups, accessing users, and building connections with local participants.

While in the case studies in Iran and Turkey, interviews were the main sources of information about the market; this step can include other effective methods. The secondary sources of data and statistical analyses methods are among these effective methods. As discussed in the literature review (paper 2), these quantitative methods have been widely used for diffusion studies, and for identifying different user groups according to their level of innovativeness.

After the “market understanding” step, the user research step can begin for identifying the problems. Similar to experiences in Turkey and Iran, the more “free” user research methods such focus group studies, diary studies and free listing exercises should come first. These types of user research methods usually address areas in which some country-specific usability problems may exist. In other words, these methods usually are not suitable for identifying the country-specific usability problems one by one. However, these methods are needed to be used first, as in a

customization process that is planned for an interactive system, it is not always economically and practically feasible to focus on all features and tasks and the most important areas need to be considered first.

The more precise methods, such as usability tests, should then be planned according to the results of the “free” methods. These methods will generate a list of country-specific usability problems that need to be solved.

Table 11 shows a summary of above recommendations.

Table 11. Finding methods for identifying country-specific usability problems

Steps		Outcomes	Tools and methods
Market understanding		Identifying market characteristics Facilitating the user research	Qualitative: Interviews, focus groups Quantitative: statistics, diffusion models
User research	Identifying areas	Areas in which country-specific usability problems may exist	“Free” user research techniques: Focus groups, diary study, free listing
	Identifying problems	Country-specific usability problems	Precise user research techniques

6.4.2. Finding solutions for modifying the system according to the identified country-specific usability problems

Case-specific level:

The modelling approach towards country-specific customization was not followed in the empirical phase due to its limitations, as shown in the experiment with an attribute-based method. Therefore, the case studies were planned with user research techniques rather than user modelling techniques. In general, most techniques were primarily adapted from human-centred design techniques including focus groups, diary studies, free listing, usability evaluation and requirements gathering techniques. However, there were some differences in the way these techniques have been used. First, it has been tried to consider the diffusion process in the user research as a result of the NPD literature review. This consideration was applied by focusing on innovative users. Second, as the process was viewed from a country-specific customization perspective, the final goal was not achieving higher levels of usability and users’ satisfaction in general. Instead of this general enhancement, the process was mainly planned for eliminating country-specific usability problems. However, since the researcher’s interpretation had an

important role in the analysis, the usability problems identified as country-specific can be a matter of discussion. This will be further elaborated in the research limitations section.

The solutions found in the case studies were generated by two requirements gathering techniques (brainstorming and sketching) and were then analysed based on mentioned activities, using the model by Sharp et al. (2007). The process of using these techniques for generating the solutions was similar to a typical human-centred design process, though with the following considerations:

1. The requirements gathering sessions were integrated into the problem-finding phase, as the same innovative users who were identified and accessed by the OEM participated in requirements gathering sessions.
2. The results are not only limited to some ideas generated by users, but also include an analysis that shows which activities are addressed more in each country.
3. Similar to the problem identification phase, the main concentration is on customizing applications. This means that both users and the OEM found software components (applications) more suitable for country-specific customization.
4. The most common types of activities mentioned in the ideas were different in Iran and Turkey, even when the usability problems were similar. This means that participants in each country were focused on specific types of activities for solving usability problems.

General level:

In similar customization processes, the following steps can be taken for identifying and addressing country-specific usability problems:

1. *Identifying the users' focus:* In order to select the best solutions in each country, it is helpful to know which activities are considered most important by the users. For example, a usability problem may be solved by a change in the user interface, or by changing the scenario of the use. However, users in a specific country may be more satisfied when they see a change in the user interface, rather than the change in the use scenario. Models and frameworks that can classify or illustrate the users' interactions can be used in this step.

2. *Identifying the level of customization*: All components of interactive systems including hardware, software platform and software applications can be customized. Customizing software features is likely to be more feasible for country-specific customization, as they can be customized faster and at lower expenses. Therefore, they have a higher priority for country-specific customization.

2. *Generating solutions*: Based on the type of system that is going to be customized, different methods can be used for generating solutions. In the case studies, users participated in generating ideas, therefore, in some cases, participatory and co-design solutions can be used for generating customization solutions. However, if complexity of the system or limited access to users does not allow the customization team to use participatory and co-design techniques, solutions can be generated by a design team. In this case, a design team should have a user focus (identified in item 1) when generating ideas.

6.5. Summary of answers to the research questions

The answers to the research questions provide a summary of current studies about culture and mobile phones, and reveal that Iranian and Turkish users had country-specific usability problems in using a smart phone's applications. Marketing activities of the OEMs can be used as a basis for country-specific customization by facilitating access to local users and conducting user research studies, identifying different user groups such as innovative users, and providing initial scopes for customization. Without using existing marketing infrastructures, the process of country-specific customization would take a longer time because accessing local users, arranging user research activities, and identifying different user groups may be time consuming and expensive, especially when the design or research team are not local, or when there is no local agency that can provide the services needed for country-specific customization.

The innovative users play an important role in country-specific customization. Research questions were answered briefly in this section, and details about each research question can be found in part II. Table 12 shows which research questions are addressed in the appended papers.

Table 12. Papers and their contributions according to the research questions

	Paper 1	Paper 2	Paper 3	Paper 4	Paper 5	Paper 6	Paper 7
RQ1				•		•	•
RQ2	•	•	•				
RQ3				•	•		•

6.6. Recommendations for further research studies

As the literature review phase of this study suggests, it is important to consider user research components in future studies about country-specific differences in use of interactive technologies. These studies should consider the real business and industrial contexts in which interactive technologies are going to be diffused and adapted. This will provide researchers valuable information about user groups, market infrastructure, and technological feasibilities for customization. Moreover, generalization of results in the form of models, solutions and design processes is needed, as a large number of existing studies are built on models such as Hofstede, which are not originally developed to be used in HCI, NPD or design.

According to the conceptual solution and research limitations, a recommendation for further research studies is evaluating the provided conceptual solution in a business context.

In order to overcome validity issues of qualitative approach and techniques used, considering design based research studies is necessary. Providing customized designs and testing and evaluating them by the users will show the existing problems of the provided solution.

Such studies should be planned in short periods due to of the dynamic changes in mobile industry and other ICT industries. It should be noted that life cycles of interactive products are relatively short.

The multidisciplinary approach is also important in further studies. For the research in this dissertation, looking at the NPD literature was helpful in understanding the diffusion process of new technologies and products. The result of this consideration was to allow innovative users participate in the study. However, the role of other stakeholders such as operators and service providers was not explored. This can be a topic for future studies. By considering service providers and operators in the country-specific customization, other disciplines such as service

design should be also engaged; as today's interactive products usually act as service touch-points.

The results of this study showed the importance of contextual factors in country-specific customization. In addition, the literature review also exhibited a range of studies that focused on such factors for understanding the users' cultural specifications. Therefore, the role of each contextual factor in a customization process can be a subject for conducting future research studies. Socioeconomics, languages, scripts, thinking paradigms and regional philosophic or religious orientations are among these contextual factors.

Research on emerging markets is a core area for research on consumer culture, especially when there is a focus on NPD. These markets can be classified into different categories considering geography, economy, politics, population, or religion. Comparative studies in each category or within different categories are other ideas for developing research studies with novel contributions. In addition, these studies will not be limited to relationships between global companies and local users. They can provide new opportunities for companies from both developed and developing countries.

As this study suggested, local marketing teams can be helpful in country-specific customization. However, marketing is only one of the components of a typical NPD process. Country-specific customization can be also connected to other parts of NPD, such as developing business strategies and manufacturing. That is why there are still various opportunities for future studies about country-specific customization and NPD.

As an example, unlike what has been done in the case studies in Iran and Turkey, the "scope" of country-specific customization can be integrated into the initial phases of NPD, when the basic strategies for developing the new product are being developed. The term "scope" in the previous sentence is used for the features or aspects of the product that are potentially suitable for country-specific customization.

Another opportunity is using marketing research results in country-specific customization, as most companies conduct extensive marketing research in their regional markets. Moreover, in some cases customization and marketing user studies can be combined.

For studies in the HCI field, providing frameworks for culture-oriented or country-specific design is a topic that needs more exploration. In addition, it is important to reflect the realities of business and industry in HCI studies. Finally, as ethnographic methods are being widely used in HCI, they can be also used for identifying country-specific usability problems in future studies.

Similar to what was explained about the HCI domain, there are interesting research methods that can be adapted for country-specific usability studies. For example, cultural consensus model (Garro, 2000) is a quantitative method that can measure the level of agreement and disagreement about beliefs among a group of individuals. The quantitative nature of cultural consensus model makes it a potential method for usability studies that rely on statistics and quantitative data.

Further studies in the design field can target adaption of current human-centred design tools for country-specific design. The design solutions resulting from requirements gathering sessions in Iran and Turkey were not developed enough to be used for evaluation and further tests. Human-centred design can provide a wide range of tools for requirements gathering, design, prototyping and evaluation. These can be used for further studies in different countries.

The solutions were analyzed by the Sharp et al. (2007) conceptual model for interactive activities. Therefore, instructing, conversing, manipulating - navigating, and exploring - browsing activities were the basis for analysing the solutions. As was stated before, this model was used due to its clarity and simplicity. However, users' interaction can be viewed from other perspectives such as cognitive dimensions (Blackwell and Green 2003). Therefore, in addition to the activities that are addressed by users in their ideas, it is possible to use a cognitive dimensions framework for analysing ideas as well. As this framework consists of seven activities (searching, incrementing, modifying structure, transcribing, exploratory design, exploratory comprehension, comparison) and 14 dimensions (abstraction, hidden dependencies, premature commitment, secondary notation, viscosity, visibility, closeness of mapping, consistency, diffuseness, error-proneness, hard mental operations, progressive evaluation, provisionality, role-expressiveness), using this framework for analysing the ideas can provide for more precise results.

There are always technological solutions, such as context awareness, that can affect the future definition of customization. By using context-aware technology, a product is able to understand

the context and customize itself according to the context, so the customization process can be done without the direct interference of users, and during the use of system (Massey, 2009).

Research on this new concept of customization can be another interesting topic for further studies about country-specific customization. For example, possible research questions about country-specific customization by context-aware technology would be:

- How can interactive devices understand the country-specific contexts such as culture, language and social norms?
- How can they customise themselves to these country-specific contexts?
- Should this type of customization by context-aware technology be automatic? When do users need to be aware of changes made by the context-aware technology?

Research question three addresses current knowledge about country-specific differences in NPD and HCI literature. The results of the literature review phase exhibits a number of methods and tools that were used before for conducting similar studies in the NPD and HCI fields. In addition, a range of methods and tools were used in the empirical phase of the study. Therefore, in general, the research not only shows a range of methods and tools that can be used in studies about country-specific differences in use of technology, but also presents some experiences in mapping and adapting these methods when they are going to be used for studying country-specific differences. Therefore, a possible additional research question in the current study can be “How can we map or adapt tools and methods in fields such as NPD and HCI to be used in studying country-specific differences”. Of course, a similar research question can be posed for the practical domain: “How can we map or adapt tools and methods in country-specific design and customization”. Such research questions can be the starting points of the future studies about methods and tools for country-specific customization.

7. Summary of papers

As table 13 shows, during the research project, three journal articles and five conference papers have been published. In addition, one additional journal paper has been submitted and is under review. Among of these papers, seven papers directly addressed the research questions. These papers were also addressed in the previous chapters and are presented in part II.

Table 13. Summary of publications

	Conferences	Journals	Research questions addressed
Paper 1	Norddesign 2010		RQ2
Paper 2		International Journal of Product Development 16(1), 45-62.	RQ2
Paper 3	DESIGN 2010		RQ2
Paper 4	HCI International 2011		RQ1 , RQ3
Paper 5		International Journal of Human Computer Interaction (Accepted)	RQ3
Paper 6		Universal Access in the Information Society (Submitted)	RQ1
Paper 7		International Journal Logistics Economics and Globalisation, 4(3), 179-196.	RQ1, RQ3
Other papers	LeNs 2010 ICED 2011		-

In order to provide a comprehensive image of all papers and their contribution, this chapter will present short summaries of the papers including their objectives, method, results and contributions towards answering the research questions.

7.1. Paper 1

*Aryana B. & Øritsland, T.A. (2010) **Culture and Mobile HCI: A Review**. Proceedings of the 8th International NordDesign Conference 2010, 217-226.*

Purpose

The main purpose of paper 1 is to identify common patterns of approaches, tools, methods, results and findings in mobile HCI and HCI research about culture. In addition to identifying these patterns, the strength of these patterns in mobile HCI and HCI research were compared. According to these findings, some less explored areas were identified and suggestions for future research studies are made.

Method

The literature review method of paper 1 includes two main phases of identifying the relevant literature and structuring the review. The relevant references were selected from the ACM database and ISI journals. The selected references address culture as their primary research scope. A definition for culture in the context of mobile HCI was used for identifying the relevant studies. The information from these references was then structured using a concept-matrix method. By using this method, articles were identified based on their major concepts including their approaches, methods, tools, findings and results.

Results

The results of paper 1 suggest that research into culture in the context of HCI is still developing. This review suggests that cultural specification of users is more studied in mobile HCI in comparison to other fields of study within HCI. However, there are some limitations in the reviewed research studies. The first limitation was the frequent use of Hofstede's cultural model, and while this model is originally developed for organizational means, it is not clear whether it is valid for research studies in other fields. Marcus' (2002) solution for culture-oriented design of websites and Röse's (2004) solution for culture oriented design and development of all human machine systems have an attribute-based approach and used Hofstede's cultural dimensions to define the attributes of culture.

Another limitation is the lack of using primary data and especially actual user research. In many cases, studies rely on statistics from secondary data. Finally, experiences in business and industry

are not presented much in the papers. According to these limitations, some suggestions for future research studies about culture and mobile HCI are made. Developing cultural models for design, focusing user research and field studies, and developing studies on industrial and business settings are among the main suggestions.

Contribution

The contribution of paper 1 is providing an overview of existing studies about users' culture and mobile HCI and their limitations. Therefore, this paper addresses research question two of this study. In addition, the results of this paper influenced the research design in the empirical phase of this study.

7.2. Paper 2

Aryana B. & Boks C. (2012) **New Product Development and Consumer Culture, a Review**. International Journal of Product Development, 16(1), 45-62.

Purpose

Paper 2 assesses how consumer culture has been addressed in New Product Development (NPD) literature. Identifying common patterns of approaches, tools, methods, results and finding less explored areas in the NPD research studies about consumer culture are among the main objectives of paper 2.

Method

In general, the method and frameworks of papers 1 and 2 are similar. However, the main database used in paper 2 is ISI journals. In addition, the term culture is defined as consumers' culture and not as organizational culture or professional culture. Therefore, only references are reviewed that directly addressed consumer culture. Similar to paper 1, a concept-matrix method is used for identifying main approaches, methods, tools, findings and results.

Results

Similar to what was found in paper 1, most published research studies rely on secondary data and user research was not found to be a central method. In addition, Hofstede's model was widely used as a source for understanding culture, and in some cases, the attribute-based approaches were used for connecting consumers' cultural specifications to products' attributes. The most dominant topic was the diffusion process of new products, which can be potentially affected by cultural characteristics of consumers.

Most studies discussed the role of consumer culture in the final phases of NPD such as launching and marketing of products. The characteristics of products are already defined before these phases. A limitation in the reviewed literature was a lack of solutions for culture-oriented NPD from early phases of product development, such as design and concept generation. Therefore, adapting a user centred design approach for culture oriented NPD was suggested as a topic for future research. Another suggestion is more concentration on different user research tools and primary data instead of relying on statistics and secondary data. Finally, further studies on

emerging markets are also suggested because cultural differences play an important role in these markets.

Contribution

Paper 2 addressed research question two and its main contribution was providing a general overview of existing research about consumer culture and NPD. The results of this paper affected the research design in the empirical phase.

7.3. Paper 3

Aryana B. & Boks C. (2010) Cultural Customization of Mobile Communication Devices' Components. Proceedings of the 11th International Design Conference DESIGN 2010, 137-146.

Purpose

Paper 3 is written to show the cons and pros of the attribute-base approach for culture-oriented design. A commonality in the reviewed literature between the NPD and mobile HCI fields is the application of attribute-based methods. Another common point is the concentration on cultural models, mainly Hofstede's model for understanding culture. Therefore, an experiment was planned in which an attribute-based method was used for understanding female users' perceptions of mobile phones' attributes. The main objective of this experiment explained in this paper is to see if this attribute-based method can predict users' ideas about the final product.

Method

Masculinity – Femininity as one of Hofstede's cultural dimensions is the basis of this experiment. Moreover, the object-oriented paradigm is used for modelling the product by its attributes. This type of model is already used in mass customization production systems and is selected because of its simplicity, modularity and attribute-based structure, which is compatible with the general approach of the experiment.

Results

The experiment shows that female users considered some attributes of mobile phones as feminine attributes, which are more desirable for female users. However, they did not select mobile phones with those attributes when they faced mobile phones as a combination of different attributes, or as a "whole".

Contribution

A contribution of paper 3 is addressing the possible limitations of using attribute-based methods, as a part of the answer to research question two. In other words, the experiment suggests that relying on models for understanding the culture or the product is not enough. This conclusion shows the importance of user research and product testing in the field settings. Another

contribution of this paper is the short review of the literature on mass customization in the beginning of the study. The results of this paper are used in answering research question two.

7.4. Paper 4

Aryana B., Boks C. & Navabi A. (2011) Possibilities for Cultural Customization of Mobile Communication Devices: The Case of Iranian Mobile Users. Lecture Notes in Computer Science, Human Centred Design, 6776/2011, 177-186.

Purpose

Paper 4 is developed to present the results of the first case study in Iran. In addition, this paper shows how some user-centred design methods are combined for cultural customization in Iran. According to paper 3, the attribute based-method has some limitations; therefore, the case study in Iran presented in this paper is the first step of shifting to an empirical approach.

Method

According to the results of the literature review and the experiment with using an attribute-based method, a general plan for the case studies in Iran and Turkey was developed. User research and usability test components were considered in the case study designs, as the reviews on NPD and HCI literature show that such methods were not used much in similar studies. In addition, an OEM active in the mobile phones market was invited to participate in the case studies, as this study had a multidisciplinary approach, covering both NPD and HCI domains.

The paper was developed when the case study in Iran was ongoing and presented a short summary of all phases of the case study, including interviews with OEM marketing team, focus group sessions, usability tests, and requirements gathering sessions. This was the last time during the research that the term “cultural customization” was used.

Results

The initial results of the case study in Iran show that there were various reasons behind usability problems, which were not necessarily related to the cultural aspects. Regulations and market structure were among these reasons, which were country-specific but not necessarily cultural.

Contribution

As this paper was focused on all steps of case study in Iran, the results can be used for answering research questions three and one. In addition, a comparison between this paper and the next

papers shows how the methods used for the empirical phase have evolved from a modelling approach (the attribute-based method) to an empirical approach.

It can be seen that a qualitative approach played an important role in the analysis of the results after the case study in Turkey. Under the umbrella of qualitative analysis, other frameworks and theories such as constructive grounded theory, scenario based design, content analysis and the Sharp et al. (2007) conceptual model for interactive activities were also used.

7.5. Paper 5

Aryana B. & Clemmensen T. (2013) Mobile Usability, Experiences from Iran and Turkey. International Journal of Human Computer Interaction, 29(4), 220-242.

Purpose

The main purpose of paper 6 is to investigate the existence of country-specific usability problems in the use of smart phones in Iran and Turkey. In addition, the paper aims to show how usability evaluation of smart phones was planned and conducted in Iran and turkey, and how the data resulted from these steps were analysed.

Method

The areas of country-specific usability problems are introduced as four usability themes. These themes, which were developed by focus group studies in Iran and Turkey, were then translated to four different task designs. Among these themes, two themes belonged to Iran and two belonged to Turkey. The analysis relied on a qualitative approach based on constructive grounded theory, which allowed researchers own interpretation as a part of the analysis.

Results

The analysis shows how some common usability problems occurred frequently among participants in each country. In most cases, these common usability problems are related to the defined themes by the focus group sessions. In addition, the difference between cultural and country-specific usability problems is discussed, as some country-specific conditions were related to the usability problems were not connected to the ethnic or national culture. Although the multiple case research design does not allow a precise comparison between the results of usability tests in Iran and Turkey, there were some similarities and differences between the two countries. For example, problems with the music application were observed in both countries. In both countries, focus group sessions and usability tests both provided evidence of problems in sorting and finding songs, while the characteristics of these problems were not similar.

Contribution

Paper 5 provides information about first-time users' interaction with smart phones. The paper shows that there are potential country-specific usability problems when first-time users in Iran

and Turkey use smart phones. These country-specific usability problems are usually linked to some country-specific contextual characteristics such as regulations, market structure and socio-economics of each country. Therefore, results of this paper contribute to answering research question three.

7.6. Paper 6

Aryana B. & Clemmensen T. & Boks C. Users' Participation in Requirements Gathering for Country-specific Customization of Smart phones in Emerging Markets. Submitted to Universal Access in the Information Society.

Purpose

Paper 6 is developed to show how Iranian and Turkish participants generated solutions for solving country-specific usability problems. The main objective is to concentrate on the contents of ideas in terms of activities addressed by participants. This paper also presents the requirement gathering sessions in Iran and Turkey that were planned after the usability tests sessions.

Method

Participants in Iran and Turkey attended requirements gathering sessions in which they generated solutions for country-specific usability problems found by usability tests. In these sessions, participants used brainstorming and sketching techniques for creating solutions. Due to using both brainstorming and sketching techniques, ideas were in textual and visual formats. The generated ideas were analyzed using qualitative content analysis. In this analysis, ideas were classified based on the activities that they addressed. These activities include instructing, conversing, manipulating - navigating, and exploring - browsing.

Results

Content analysis showed that in each country, specific activities were frequently addressed in participants' ideas and similarly, specific patterns were observed in what were considered the most important usability problems. Iranian participants were interested in generating ideas for instructing activities and Turkish participants were more concentrated on manipulating and navigating activities. Even for similar usability problems, Iranian and Turkish participants concentrated on different activities when they were generating ideas.

Contribution

Paper 6 showed that it is meaningful to invite local users to participate in identifying areas of country-specific usability problems, and in generating ideas for country-specific customization. Moreover, it was suggested that existing user-centred design tools such as brainstorming and

sketching can be adopted for users' participation in country-specific customization. The results of paper 6 are used in answering research question one, as they elaborated an important step of country-specific customization.

7.7. Paper 7

Aryana B. & Boks C. (2012) Country-specific Customization of Smart phones for Emerging Markets; Insights from Case Studies in Iran and Turkey. International Journal of Logistics Economics and Globalization, 4(3), 179-196.

Purpose

The last paper in part II was written to provide an overview of all steps of the case studies in Iran and Turkey. The paper also includes a brief review on customization literature before presenting the method and main results.

Method

After a short review on the different approaches of customization, paper 7 explains the entire story of case studies and summarizes the results of case studies in a number of recommendations for country-specific customization. The paper includes brief descriptions of all research methods used, along with all different analysis methods. Finally, all results from the case studies have been viewed from the customization perspective.

Results

While customization can be applied in various forms and in different phases of a product lifecycle, the process which was passed in case studies could be categorized as a type of so called “soft” customization at purchase point. This means that the country-specific customization suggested by case studies could be applied without any change in the hardware components and manufacturing process of smart phones. In addition, the suggested customization process could not be applied during the use of the product, as it is planned for first-time users who are not experienced enough to apply their own customization by installing different applications on the smart phones, and are highly dependent on pre-installed standard applications on their smart phones.

According to the results of the case studies in Iran and Turkey, a number of recommendations are made. Some of these recommendations include participation of innovative users, using existing marketing infrastructures for conducting user research, and adapting existing user-centred design tools of country-specific customization.

Contribution

Paper 7 presents, in the first place, a part of the answer to research question one. However, as it contains a summary of case studies, it covers research question two as well. Unlike other papers about case studies, the conclusion of paper 7 does not address detailed results of different methods used in case studies. In other words, in this paper, a more general outlook is provided; in addition, the entire process of the case studies has been viewed from a customization perspective.

7.8. Other papers

Cultural and country-specific differences in the use of mobile phones could also affect other aspects of product design and development that are not covered by the research questions of this study. As the next two papers mentioned did not address the main research questions directly, they are not presented in part II.

*Aryana B. & Boks C. (2010) **New Sustainable Behaviour for New Users: Mobile Communication Devices in Emerging Markets.** Proceedings of LeNS conference, Sustainability in design: NOW! Challenges and Opportunities for Design Research, Education and Practice in the XXI Century, 322-333.*

Summary

Sustainability is one of these aspects. The mobile phone industry has used different strategies for making mobile phones more sustainable. Applying minimal designs, planning sustainable product lifecycles, design for reassembly, and using recyclable materials are among these strategies that have been used. However, users' sustainable behaviour is one of the aspects of sustainability, which is not developed as much as manufacturing and lifecycle strategies. As many mobile phone users are using these products for several years, changing their current behaviours and habits may be difficult to accomplish. The fact that large numbers of first-time users of mobile and smart phones in emerging markets may have no previous fixed behavioural habits could be an opportunity for establishing sustainable behaviour patterns.

*Liem A. & Aryana B. (2011) **Cultural "Value Creation" in the Design of Cellular Phones.** Proceedings of 18th International Conference on Engineering Design: ICED11, 254-264.*

Summary

Cultural background of users could also act as a tool for gaining an advantage in product design and development processes. The Value Creation Model proposed by Cagan and Vogel (2002) could be extended with this in mind. In the model of Cagan and Vogel, the value of a product is defined by two dimensions of technology and style. With more added values for a product, it can be sold with a higher profit margin. In the proposed extension, another dimension of culture could be added to the other two dimensions of style and technology. The data from the experiment with an attribute-based method in Iran were used for examining this proposed

extension to the Value Creation Model. In conclusion, it was suggested that extensive contextual research be done on users' preferences before adding the cultural dimension to the Value Creation Model.

References

- Alvares-Torres, M. J., & Mishra, P. (2001). Judging a Book by its Cover! Cultural Stereotyping of Interactive Media and its Effect on the Recall of Text Information. *Journal of Educational Multimedia and Hypermedia*, 10(2), 161-183.
- Annacchino, M. (2003). *New product development: from initial idea to product management*. Amsterdam: Butterworth-Heinemann.
- Aryana B. & Boks C. (2012) Country Specific Customization of Smart Phones for Emerging Markets; Insights from Case Studies in Iran and Turkey. *International Journal of Logistics Economics and Globalization*, 4(3), 179-196.
- Aryana B. & Boks C. (2010) Cultural Customization of Mobile Communication Devices' Components. *Proceedings of the 11th International Design Conference DESIGN 2010*, 137-146.
- Aryana B. & Boks C. (2012 a) New Product Development and Consumer Culture, a Review. *International Journal of Product Development*, 16(1), 45-62.
- Aryana B. & Boks C. (2010) New Sustainable Behaviour for New Users: Mobile Communication Devices in Emerging Markets. *Proceedings of LeNS conference, Sustainability in design: NOW! Challenges and Opportunities for Design Research, Education and Practice in the XXI Century*, 322-333.
- Aryana B., Boks C. & Navabi A. (2011) Possibilities for Cultural Customization of Mobile Communication Devices: The Case of Iranian Mobile Users. *Lecture Notes in Computer Science, Human Centred Design*, 6776/2011, 177-186.
- Aryana B. & Øritsland, T.A. (2010) Culture and Mobile HCI: A Review. *Proceedings of the 8th International NordDesign Conference*, 217-226.
- Ball, M. S. & Smith, G. W. (1992). *Analyzing visual data*. Newbury Park: Sage Publications.
- Barnett, Clive (2001). Culture, geography, and the arts of government. *Environment and Planning D: Society and Space*, 19(1), 7-24.
- Baumann, K. (2001). Usability engineering for different European countries. *Proceedings of the 9th International Conference on Human-Computer Interaction*, 3, 140-144.

- Bauer, H. H. (1990). Barriers Against Interdisciplinarity: Implications for Studies of Science, Technology, and Society (STS. Science, Technology & Human Values, 15(1), 105-119.
- Benbasat, I., Goldstein, D., & Mead, M. (1987). The Case Research Strategy in Studies of Information Systems. *MIS Quarterly*, 11(3), 369-386.
- Benson, S. P. (1998). Village people? The next generation. *IEEE Communications Magazine*, 36(1), 32-35.
- Berg, B. L. (2001). *Qualitative research methods for the social sciences* (4th ed.). Boston: Allyn and Bacon.
- Bijker, W. E., & Law, J. (1992). *Shaping technology/building society: studies in socio-technical change*. Cambridge, Mass.: MIT Press.
- Binder, R. (2000). *Testing object-oriented systems: models, patterns, and tools*. Reading, Mass.: Addison-Wesley.
- Bjärhov, M., & Weidman, E. (2007). The broader value of communication. *Ericsson Business Review*, 2, 24-27.
- Blecker, T., Friedrich, G., Kaluza, B., Abdelkafi, N., & Kreutler, G. (2004). Information and management systems for product customization (pp. 16-18). New York: Springer.
- Blackler, A. L., Popovic, V., & Mahar, D. P. (2007). Developing and Testing a Methodology for Designing for Intuitive Interaction. *Proceedings of International Association of Societies of Design Research Conference, IASDR07*. Retrieved August 20, 2012, from <http://eprints.qut.edu.au/13715/>
- Blackwell, A.F. and Green, T.R.G. (2003). Notational systems - the Cognitive Dimensions of Notations framework. In J.M. Carroll (Ed.) *HCI Models, Theories and Frameworks: Toward a multidisciplinary science* (pp. 103-134). San Francisco: Morgan Kaufmann.
- Blessing, L. T. & Chakrabarti, A. (2009). *DRM, a design research methodology*. Dordrecht: Springer.
- BMI (2012). *Iran Telecommunications Report Q3 2012*. London: Business Monitor International.
- Bonoma, T. (1985). Case Research in Marketing: Opportunities, Problems, and a Process. *Journal of Marketing Research*, 22(2), 199-208.

- Bourdieu, P. (1986). The forms of capital. In J. Richardson (ed.) *Handbook of Theory and Research for the Sociology of Education* (pp. 241-258), New York: Greenwood.
- Brookhuis, K. (2008). From ergonomists to infonauts: 50 years of ergonomics research. *Ergonomics*, 51(1), 55-58.
- Bulte, C. V. & Joshi, Y. (2007). New Product Diffusion with Influentials and Imitators. *Marketing Science*, 26(3), 400-421. Bürdek, B. E. (2005). *Design: history, theory, and practice of product design*. Boston: Birkhauser-Publishers for Architecture.
- Burgel, O., & Murray, G. C. (2000). The international market entry choices of start-up companies in high-technology industries. *Journal of International Marketing*, 33-62.
- Cagan, J., & Vogel, C. M. (2002). *Creating breakthrough products: Innovation from product planning to program approval*. Upper Saddle River: Prentice Hall.
- Cao, J., Wang, J., Law, K., Zhang, S., & Li, M. (2006). An interactive service customization model. *Information and Software Technology*, 48(4), 280-296.
- Chapanis, A. (1974). National and cultural variables in ergonomics. *Applied Ergonomics*, 17(2), 153-75.
- Charmaz, K. (2011). *Constructing grounded theory: a practical guide through qualitative analysis*. Los Angeles: Sage Publications.
- Chavan, A. L. (2005). Another culture, another method. *Proceedings of the 11th International Conference on Human-Computer Interaction*, Las Vegas, Nevada, United States, July 22-27, 2005, CD-ROM.
- Cherry, C. & Macredie, R. D. (1999). An Assessment of Participatory Design. *Requirements Engineering*, 4(2), 103-114.
- Chigona, W., Beukes, D., Vally, J., & Tanner, M. (2009). Can Mobile Internet Help Alleviate Social Exclusion in Developing Countries?. *The Electronic Journal of Information Systems in Developing Countries*, 36(7), 1-16.
- Clemmensen, T. (2004). Four approaches to user modelling: a qualitative research interview study of HCI professionals' practice. *Interacting with Computers*, 16(4), 799-829.

- Clemmensen, T. (2011). Templates for Cross-Cultural and Culturally Specific Usability Testing: Results from Field Studies and Ethnographic Interviewing in Three Countries. *International Journal of Human-Computer Interaction*, 27(7), 634 – 669.
- Clemmensen, T. (2012). Usability Problem Identification in Culturally Diverse Settings. *Information Systems Journal*, 22(2), 151-175.
- Clemmensen, T., Hertzum, M., Hornbæk, K., Shi, Q., & Yammiyavar, P. (2009). Cultural cognition in usability evaluation. *Interacting with Computers*, 21(3), 212-220.
- Creswell, J. W. (2009). *Research Design: Qualitative, Quantitative, and Mixed Methods Approaches (3rd ed.)*. Los Angeles: Sage Publications.
- Creswell, J. W. (2003). Qualitative procedures. *Research design: qualitative, quantitative, and mixed method approaches* (2nd ed., p. 182). Thousand Oaks: Sage Publications.
- Curtis, G. E. & Hooglund, E. J. (2008). *Iran: a country study* (5th ed.). Washington, DC: Library of Congress, Federal Research Division.
- Deligonul, Z. S. (2009). Geographic market diversification: A premium or discount in firm's value. *New Challenges to International Marketing (Advances in International Marketing)*, 20, 257-274.
- Dillard, J. F., Dujon, V., & King, M. C. (2009). *Understanding the social dimension of sustainability*. New York: Routledge.
- Douglas, L. (2007). Testing object management (TOM): a prototype for usability knowledge management in global software. *Proceedings of the 2nd International Conference on Usability and Internationalization, UI-HCII 2007*, 297-305.
- Eisenhardt, K. M. (1989). Building Theories from Case Study Research. *The Academy of Management Review*, 14(4), 532-550.
- Feitzinger, E., & Lee, H. L. (1997). Mass customization at Hewlett-Packard: the power of postponement. *Harvard Business Review*, 75, 116-123.
- Fortunati, L. (2001). The Mobile Phone: An Identity on the Move. *Personal and Ubiquitous Computing*, 5(2), 85-98.

- Garro, L. C. (2000). Remembering What One Knows and the Construction of the Past: A Comparison of Cultural Consensus Theory and Cultural Schema Theory. *Ethos*, 28(3), 275-319.
- Glaser, B. G. & Strauss, A. L. (2008). *The discovery of grounded theory: strategies for qualitative research* (3rd ed.). New Brunswick: Aldine.
- Gulliksen, J., Göransson, B., Boivie, I., Blomkvist, S., Persson, J., & Cajander, A. (2003). Key principles for user-Centred systems design. *Behavior & Information Technology*, 22(6), 397-409.
- Gwinner, K., Bitner, M., Brown, S., & Kumar, A. (2005). Service Customization through Employee Adaptiveness. *Journal of Service Research*, 8(2), 131-148.
- Hall, E. T. (1976). *Beyond culture*. Garden City, N.Y.: Anchor Press.
- Hart, C. (2005). *Doing a literature review: releasing the social science research imagination*. London: Sage Publications.
- Hinds, P. & Lyon, J. (2011). Innovation and Culture: Exploring the Work of Designers Across the Globe. *Design Thinking: Understanding Innovation*, Part 2, 101-110.
- Hjorth, L. (2004). Textperts and other Thumbomena: mobile phones and Japanese cute culture. *Natural Selection*, 1(2), 12–15.
- Hofstede, G. (n.d.). National Cultures. *Geert Hofstede*. Retrieved August 8, 2012, from <http://geert-hofstede.com/>
- Hofstede, G. (2001). *Culture's consequences comparing values, behaviours, institutions and organizations across nations* (2nd ed.). Thousand Oaks: Sage publications.
- Horton, W. K. (1993). The Almost Universal Language: Graphics for International Documents. *Technical Communication*, 40(4), 682–693.
- Huberman, M. & Miles, M. (1994). *Data Management and Analysis Methods*. In N. Denzin and Y. Lincoln (Eds.), *Handbook of Qualitative Research*. Thousand Oaks: Sage Publications.
- Hvam, L., Mortensen, N. H., & Riis, J. (2008). *Product customization*. Berlin: Springer.

International Organization for Standardization (1999). *Human-centred design processes for interactive systems = Processus de conception centrée sur l'opérateur humain pour les systèmes interactifs : ISO 13407*. Genève: International Organization for Standardization.

Ilyas, M., & Ahson, S. (2006). *Smartphones*. Chicago: IEC Publications.

Ivanovic, A., & Collin, P. H. (2003). *Dictionary of marketing (3rd ed.)*. London: Bloomsbury.

Jackson, P., Cosgrove, D., Duncan, J., Duncan, N., & Mitchell, D. (1996). Exchange: There's no such thing as culture? *Transactions of the Institute of British Geographers*, 21(3), 572-582.

Jensen, K. L., Marsden, G., Cutrell, E., Jones, M., & Morrison, A. (2012). NUIs for new worlds: new interaction forms and interfaces for mobile applications in developing countries. *Proceedings of the 2012 ACM annual conference extended abstracts on Human Factors in Computing Systems Extended Abstracts, CHI EA '12*, 2779-2782.

Kalba, K. (2008). The Adoption of Mobile Phones in Emerging Markets: Global Diffusion and the Rural Challenge. *International Journal of Communication*, 2, 631-661.

Kaplan, M. (2004). Introduction: Adding a cultural dimension to human factors. In M. Kaplan (ed.), *Cultural ergonomics* (pp. xi-xvii). Amsterdam: Elsevier JAI.

Kellner, D. (2002). Theorizing Globalization. *Sociological Theory*, 20(3), 285-305.

Kenny, C. & Keremane, R. (2007). Toward universal telephone access: Market progress and progress beyond the market. *Telecommunications Policy*, 31(3-4), 155-163.

Kidd, P. S. & Parshall, M. B. (2000). Getting the Focus and the Group: Enhancing Analytical Rigor in Focus Group Research. *Qualitative Health Research*, 10(3), 293-308.

Kirchgeorg, M. & Winn, M. I. (2006). Sustainability marketing for the poorest of the poor. *Business Strategy and the Environment*, 15(3), 171-184.

Kleijnen, M., Lee, N. & Wetzels, M. (2009). An exploration of consumer resistance to innovation and its antecedents, *Journal of Economic Psychology*, 30 (3), 344-357.

- Kodzi Jr, E. T., & Gazo, R. (2010). Operationalizing Mass Customization—A Conceptual Model Based on Recent Studies in Furniture Manufacturing. In Piller F.T. (ed.) *Handbook of Research in Mass Customization and Personalization: Strategies and concepts* (pp 79-96), New Jersey: World Scientific.
- Kuniavsky, M. (2003). *Observing the user experience: a practitioner's guide to user research*. San Francisco, CA: Morgan Kaufmann Publishers.
- Leidner, D. E. & Kayworth, T. (2006). Review: a review of culture in information systems research: toward a theory of information technology culture conflict. *MIS Quarterly*, 30(2), 357-399.
- Liem A. & Aryana B. (2011) Cultural “Value Creation” in the Design of Cellular Phones. *18th International Conference on Engineering Design ICED 11*, 7, 254-264.
- Liu, F., Chen, L. & Chen, H. (2011). Sustaining Client Relationships in the Contract Manufacturer Own-Brand Building Process: The Case of a Smart phone Firm. *International Journal of Business and Management*, 6(7), 59-68.
- Liu, Y., Kiang, M., & Brusco, M. (2012). A unified framework for market segmentation and its applications. *Expert Systems with Applications*, 39(11), 10292-10302.
- Loch, C. & Kavadias, S. (2007). *Handbook of New Product Development Management*. Burlington: Elsevier.
- Love, S. (2005). *Understanding mobile human-computer interaction*. Amsterdam: Elsevier Butterworth-Heinmann.
- van der Lugt, R. (2000). Developing a graphic tool for creative problem solving in design groups. *Design Studies*, 21(5), 505-522.
- Mahajan, V., Muller, E., & Wind, Y. (2000). *New-product diffusion models*. Boston: Kluwer Academic.
- Mann, C. L. & Kirkegaard, J. F. (2006). *Accelerating the globalization of America: the role for information technology*. Washington, DC: Institute for International Economics.
- Marcus, A. (2002). User-interface design, culture, and the future. *Proceedings of the Working Conference on Advanced Visual Interfaces, AVI '02*, 15-27.

- Marvasti, A. (2003). *Qualitative research in sociology*. London: Sage Publications.
- Massey, R. (2009). *An overview of context-aware information systems*. Ravensburg: Grinverl.
- McKenzie, S. (2004). Social sustainability: towards some definitions. *Hawke Research Institute, Working Paper Series, 27*. Retrieved December 15, 2012, from <http://w3.unisa.edu.au/hawkeinstitute/publications/downloads/wp27.pdf>
- Merriam, S. B. (2009). *Qualitative research: a guide to design and implementation*. San Francisco: Jossey-Bass.
- Metz, H. C. (2008). *Turkey, a country study*. Washington, D.C.: Federal Research Division, Library of Congress.
- Mills, J. I., & Emmi, P. C. (2006). Limits to growth: The 30-year update. *Journal of Policy Analysis and Management, 25*(1), 241-245.
- Mooradian, T.A. & Swan, K.S. (2006). Personality-and-culture: the case of national extraversion and word-of-mouth, *Journal of Business Research, 59*(6), 778–785.
- Moray, N. (2004). Culture, Context, and Performance. In M. Kaplan (Eds.), *Cultural Ergonomics, 4*, 31-59.
- Monga, A. & Roedder, J.D. (2007). Cultural differences in brand extension evaluation: the influence of analytic versus holistic thinking, *Journal of Consumer Research, 33*(4), 529–536.
- Myers, B. A. (1998). A brief history of human-computer interaction technology. *Interactions, 5*(2), 44-54 .
- Nam, C., Lyons, J., Hwang, H., & Kim, S. (2009). The process of team communication in multi-cultural contexts: An empirical study using Bales' interaction process analysis (IPA). *International Journal of Industrial Ergonomics, 39*, 5.
- Nielsen, J. (1993). *Usability engineering*. Boston: Academic Press.
- Nydell, M. K. (2012). *Understanding Arabs: a contemporary guide to Arab society* (5th ed.). Boston, MA: Intercultural Press.

- OCED (2012). *OECD Economic Surveys: Turkey 2012*. Paris : OCED Publishing.
- Paulus, P. B. & Nijstad, B. A. (2003). *Group creativity: innovation through collaboration*. New York: Oxford University Press.
- Plotnik, R. (2002). *Introduction to psychology* (6th ed.). Australia: Wadsworth Thomson Learning.
- Proctor, R. W., & Vu, K. (2005). *Handbook of human factors in Web design*. Mahwah : L. Erlbaum Associates.
- Raman, K. S., & Watson, R. T. (1994). National culture, information systems, and organizational implications. *Global information systems and technology* (pp. 493 - 513). Hershey: IGI Publishing.
- Rautenstrauch, C., Eggebert, R., & Turowski, K. (2002). *Moving into mass customization: information systems and management principles*. Berlin: Springer.
- Righi, C. & James, J. (2007). *User-Centred design stories real-world UCD case files*. Amsterdam: Elsevier/Morgan Kaufman.
- Rogers, E. M. (2005). *Diffusion of innovations* (5th ed.). New York: Free Press.
- Rosson, M. B. & Carroll, J. M. (2002). *Usability engineering: scenario-based development of human-computer interaction*. San Francisco: Academic Press.
- Röse, K. (2004). The Development of Culture-Oriented Human Machine Systems: Specification, Analysis and Integration of relevant Intercultural Variables. *Advances in Human Performance and Cognitive Engineering Research*, 4, 61-103.
- SadreGhazi, S., & Duysters, G. (2008). *Serving low-income markets: rethinking multinational corporations strategies*. Maastricht: UNU-MERIT, Maastricht Economic and Social Research and Training Centre on Innovation and Technology.
- Schmitz, H. (2004). *Local enterprises in the global economy issues of governance and upgrading*. Cheltenham: Edward Elgar.
- Scott, P. (2008). Global inequality, and the challenge for ergonomics to take a more dynamic role to redress the situation. *Applied Ergonomics*, 39(4), 495-499.

- Scruton, R. (2007). *The Palgrave Macmillan dictionary of political thought (3rd ed.)* (pp. 148-149). Basingstoke : Palgrave Macmillan.
- Sharp, H., Rogers, Y., & Preece, J. (2007). *Interaction design: beyond human-computer interaction*. Chichester: Wiley.
- Shena, S., Woolleyb, M., & Priorc, S. (2006). Towards culture-centred design. *Interacting with Computers*, 18(4), 820–852.
- Simpson, J. A., Weiner, E. S., & Proffitt, M. (1997). *Oxford English dictionary*. Oxford : Clarendon Press.
- Sinha, R. & Boutelle, J. (2004). Rapid information architecture prototyping. *Proceedings of the 5th conference on Designing interactive systems: processes, practices, methods, and techniques, DIS '04*, 349-352.
- Srinivasan, V., Lovejoy, W., & Beach, D. (1997). Integrated product design for marketability and manufacturing. *Journal of Marketing Research*, 34(1), 154–167.
- Steenkamp, J. B. E., & Geyskens, I. (2006). How country characteristics affect the perceived value of web sites. *Journal of Marketing*, 136-150.
- Stephanidis, C., & Savidis, A. (2001). Universal Access in the Information Society: Methods, Tools, and Interaction Technologies. *Universal Access in the Information Society*, 1(1), 40-55.
- Stone, D. L. (2005). *User interface design and evaluation*. Amsterdam: Elsevier.
- Sugumaran, V., Dietrich, A. J. & Kirn, S. (2006). Supporting mass customization with agent-based coordination. *Information Systems and e-Business Management*, 4(1), 83-106.
- Sung, Y. & Tinkham, S. (2005). Brand personality structures in the United States and Korea: common and culture-specific factors, *Journal of Consumer Psychology*, 15(4), 334–350.
- Tan, B. C., Wei, K., Watson, R. T., & Walczuch, R. M. (1998). Reducing status effects with computer-mediated communication: evidence from two distinct national cultures. *Journal of Management Information Systems*, 15(1), 119-141.

- Tongia, R. (2007). Connectivity in emerging regions: the need for improved technology and business models. *Communications Magazine, IEEE*, 45(1), 96-103.
- Trompenaars, F. (1993). *Riding the waves of culture: understanding cultural diversity in business*. London: Brealey.
- Vallaster, C. & Hasenöhr, S. (2006). Assessing new product potential in an international context: lessons learned in Thailand. *Journal of Consumer Marketing*, 23, 67-76.
- Van Biljon J. A. (2007). *A Model for Representing the Motivational and Cultural Factors that Influence Mobile Phone Usage Variety*. Pretoria: PhD Thesis, School of Computing, University of South Africa.
- Vatrapu, R. K. (2011). Explaining culture: an outline of a theory of socio-technical interactions. *Proceedings of the 3rd international conference on Intercultural collaboration, ICIC '10*, 111-120.
- Vertovec, S. (2009). *Transnationalism*. London: Routledge.
- Viswanathan, M. & Sridharan, S. (2012). Product Development for the BoP: Insights on Concept and Prototype Development from University-Based Student Projects in India. *Journal of Product Innovation Management*, 29 (1), 52–69.
- Webster, J. & Watson, R. T. (2002). Analyzing the past to prepare for the future: Writing a literature review. *MIS Quarterly*, 26(2), xiii-xxiii.
- Weinstein, A. (1987). *Market segmentation: using demographics, psychographics, and other segmentation techniques to uncover and exploit new markets*. Chicago: Probus Publications.
- Willig, C. (2008). *Introducing qualitative research in psychology adventures in theory and method (2nd ed.)*. Maidenhead: McGraw Hill/Open University Press.
- World Bank (2013). *World Databank*. Retrieved January 16, 2013, from <http://databank.worldbank.org/Data/Home>
- Yadin, D. L. (2001). *The international dictionary of marketing*. London: Kogan Page.

Yin, R. K. (1994). *Case study research: design and methods* (2nd ed.). Thousand Oaks: Sage Publications.

Part II: Papers

Errata

Paper	Page number	Error	Correction
Paper 3	140	Christian Rose	Kerstin Röse
Paper 3	146	Rose	Röse
Paper 4	185	[4] Hvam, L., Mortensen, N.H., Riis, J.: Product Customization. Springer, New York (2008)	[4] CIA world fact book, http://www.odci.gov/cia/publications/factbook/country.htm
Paper 4	185	[5] CIA world fact book, http://www.odci.gov/cia/publications/factbook/country.htm	[5] Hvam, L., Mortensen, N.H., Riis, J.: Product Customization. Springer, New York (2008)
Paper 4	186	Rose	Röse

Co-authors' collaboration agreement

To whom it may concern

Statement

Re. authorship to publications included in Bijan Aryana ph.d. thesis

(cf. the ph.d. regulations § 7.4, section 4)

As co-author of the following paper included in the ph.d. thesis of Bijan Aryana:

1. Aryana B., Boks C. & Navabi A. (2011) "**Possibilities for Cultural Customization of Mobile Communication Devices: The Case of Iranian Mobile Users**". Lecture Notes in Computer Science, Human Centered Design, Volume 6776, 177-186.

I hereby confirm that the candidate's contribution to this paper is correctly identified, and I consent to Bijan Aryana including it in his ph.d. dissertation.

07.12.12



.....
Azadeh Navabi (sign.)

To whom it may concern

Statement

Re. authorship to publications included in Bijan Aryana ph.d. thesis

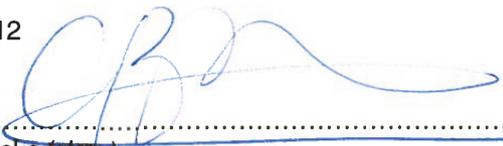
(cf. the ph.d. regulations § 7.4, section 4)

As co-author of the following papers included in the ph.d. thesis of Bijan Aryana:

1. Aryana B. & Boks C. (2012) "**New Product Development and Consumer Culture, a Review**". International Journal of Product Development, 16(1), 45-62.
2. Aryana B. & Boks C. (2010) "**Cultural Customization of Mobile Communication Devices' Components**". Proceedings of the 11th International Design Conference DESIGN 2010, 137-146.
3. Aryana B., Boks C. & Navabi A. (2011) "**Possibilities for Cultural Customization of Mobile Communication Devices: The Case of Iranian Mobile Users**". Lecture Notes in Computer Science, Human Centred Design, 6776/2011, 177-186.
4. Aryana B. & Clemmensen T. & Boks C. "**Users' Participation in Requirements Gathering for Country-specific Customization of Smart phones in Emerging Markets**". Submitted to Universal Access in the Information Society.
5. Aryana B. & Boks C. (2012) "**Country-specific Customization of Smart phones for Emerging Markets; Insights from Case Studies in Iran and Turkey**". International Journal of Logistics Economics and Globalization, 4 (3), 179-196.

I hereby confirm that the candidate's contributions to these papers are correctly identified, and I consent to Bijan Aryana including them in his ph.d. dissertation.

07.12.2012


.....
Casper Boks (sign.)

To whom it may concern

Statement

Re. authorship to publications included in Bijan Aryana ph.d. thesis

(cf. the ph.d. regulations § 7.4, section 4)

As co-author of the following papers included in the ph.d. thesis of Bijan Aryana:

1. Aryana B., Clemmensen T. "**Identifying Areas of Country-specific Usability Problems: A Participatory Approach**". Submitted to International Journal of Intercultural Information Management
2. Aryana B. & Clemmensen T. (In press) "**Mobile Usability, Experiences from Iran and Turkey**". To be appeared in International Journal of Human Computer Interaction
3. Aryana B. & Clemmensen T. & Boks C. "**Users' Participation in Requirements Gathering for Country-specific Customization of Smart phones in Emerging Markets**". Submitted to Universal Access in the Information Society.

I hereby confirm that the candidate's contributions to these papers are correctly identified, and I consent to Bijan Aryana including them in his ph.d. dissertation.

09-12-2012

A handwritten signature in black ink, appearing to read 'Torkil Clemmensen', written over a horizontal dotted line.

Torkil Clemmensen (sign.)

To whom it may concern

Statement

Re. authorship to publications included in Bijan Aryana ph.d. thesis

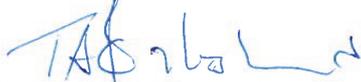
(cf. the NTNU PhD regulations § 7.4, section 4)

As co-author of the following paper included in the PhD thesis of Bijan Aryana:

1. Aryana B. & Øritsland, T.A. (2010) "**Culture and Mobile HCI: A Review**". Proceedings of the 8th International NordDesign Conference 2010, 217-226.

I hereby confirm that the candidate's contribution to this paper is correctly identified, and I consent to Bijan Aryana including it in his PhD dissertation.

07.12.2012



.....
Trond Are Øritsland (sign.)

Paper 1.

Aryana B. & Øritsland, T.A. (2010) *Culture and Mobile HCI: A Review*. Proceedings of the 8th International NordDesign Conference 2010, 217-226.

Culture and Mobile HCI: A Review

Bijan Aryana

*Department of Product Design
Norwegian University of Science and
Technology
Kolbjørn Hejes Vei 2B
7491 Trondheim
NORWAY*
bijan.aryana@ntnu.no

Trond Are Øritsland

*Department of Product Design
Norwegian University of Science and
Technology
Kolbjørn Hejes Vei 2B
7491 Trondheim
NORWAY*
trond.are.oritsland@ntnu.no

Abstract

Culture has various definitions, but regardless of discussions about its concrete definition, the importance of cultural differences has been recognized in areas such as Human Computer Interaction (HCI). In the context of mobile HCI, the importance of culture can be viewed from various perspectives such as usability and ergonomics, business advantages and social sustainability. This study reviews HCI, and mobile HCI research in order to identify common approaches, tools, methods, results and findings in current literature. It is found that the field is missing HCI specific cultural models, has an unclear theoretical basis, and needs to apply user research methods. Consequently target points for further research in mobile HCI are itemized in the conclusion.

Keywords: *Culture, Mobile HCI, Design, Review.*

1 Introduction

With the current proliferation of mobile technology, especially in developing countries, cultural differences are gaining importance in design of mobile devices. Mobile phones, and smart phones are expanding globally and play a significant role in spreading information and communication technology. Therefore developers need models of culture and methods for focusing design on cultural issues. A first step towards understanding the role of culture in mobile HCI is an overview of the current knowledge. Such an overview can be a basis for future culture related mobile HCI research studies. According to a review of culture-related Human Computer Interaction (HCI) research between 1990 and 2006, culture was not a core area of research within HCI [1] and no mobile HCI reviews have been found. Since research about culture is not mature in the HCI domain, creating new applied methods and theories in the mobile HCI, as a sub domain, is problematic. This paper investigates current research about culture and mobile HCI. The main scope is to explore different tools and methods and the resulting findings which are mentioned in the studies. Three research questions have been developed as the links in a chain, in such a way that answers to each one would be the basis for answering the next question:

1. What are the main areas of the research into culture and mobile HCI?
2. What are the research methods or tools that have been used in the literature? And consequently what are the final outcomes and results of them?

3. Which areas can be defined as the target points for the further research?

This paper starts by presenting the background and the importance of culture in the context of mobile communication devices in section 2. A summary of the literature review method will be presented in section 3 and then the main approaches to the current culture-related HCI research will be described in section 4. Section 5 will present the different methods and tools which are used in the literature. Results and outcomes of the tools and methods will be classified in section 6. Based on these findings, the final discussion in section 7 will illustrate the current situation of research about culture in the mobile HCI, and will address the main targets for further research in to the areas that are currently under development.

2 Does culture matter?

Culture is a broad concept that needs clarifying. In 1952 Kroeber and Kluckhohn reviewed different definitions of culture and found 162 definitions. Today there are even more definitions [2]; so defining culture is not an easy task but studying the major perspectives in the current literature of each scientific field is still possible. The importance of culture in the context of mobile communication devices can be viewed from three different perspectives. The following subsections present a brief summary of these perspectives:

2.1. Usability and ergonomics

Usability has been discussed as a reason for addressing the cultural aspects in design. Considering the evolution process of ergonomics, current era of ergonomics can be the era of cultural ergonomics [3]. In some academic and professional research studies about mobile devices, cultural differences have been mentioned from a usability perspective; for example "...study on different meanings for graphic symbols and motifs..." and "...multicultural usability testing..." [4].

2.2. Business advantages

Cultural diversity may be considered as a driver for customization in the global market for mobile devices. New opportunities outside mature markets of developed countries may lead to more attention to the user requirements in those markets. The mobile industry itself already signals the importance of culture in design. For instance, Culture is among the main three themes in which sociology affects Nokia's interaction design and also one of the seven dimensions, which help Nokia's design team to understand the mobile users [5].

2.3. Social sustainability and ethics

Technology can improve the life of human beings, but not all the people who need the technology can afford it. Since a large number of low income, potential, users live in the developing world, their specific needs and characteristics might not be considered in a "business advantage" approach of culture-oriented design. Therefore, for a sustainable development and a proper penetration of the new technologies around the world, more research on culture-oriented design is needed for this type of users, which are not necessarily "customers" [6].

In general, considering culture is not only an approach, but a necessity, however methods for application of this approach is rare while there is an accumulative need for systematic processes and tools. That is why this study tries to give an overview of current situation and also the guidelines for the next steps in this area.

3 Methodology

This research can be classified as an integrated literature review. The following subsections describe different aspects of the integrated review process.

3.1. Identifying the Relevant Literature

As a literature review research, the first phase was to define relevant literature. Since the scope of research was the HCI domain, articles in this field have been reviewed. The main databases were the journals of Institute for Scientific Information (ISI) list based on its scientific value and Association for Computing Machinery (ACM) digital library because of its wide coverage of the computer science literature.

In the first phase of paper selection, all articles with the term “culture” in their body text were gathered and in the second phase, articles with a specific definition of culture were selected for the review.

3.1.1. Definition of culture, as a search criteria

To narrow down the definition of culture to the mobile HCI area, Van Biljon’s definition was selected. Because it was the only definition of mobile HCI to be found, and her study used a similar approach to ours. In her research, she explored various socio-cultural aspects of mobile phones, and also presented the following definition for culture [7]:

“The patterns of thinking, feeling and acting that influence the way in which people communicate among themselves and use mobile devices.”

Based upon the definition, articles in which “culture” had another meanings were omitted, for example articles about the organizational culture. The final number of articles that were studied was 40. The process did not ignore the research studies about general ideas of HCI, if their findings could be extended to, or connected to mobile HCI.

3.2. Structuring the Review

Concept-matrix method [8] was used for structuring the review. In this method after defining major concepts each article would be categorized according to its concepts. Figure 1 shows three types of the classification in this research: classification by approaches, classification by tools and methods, and finally classification by results and findings.

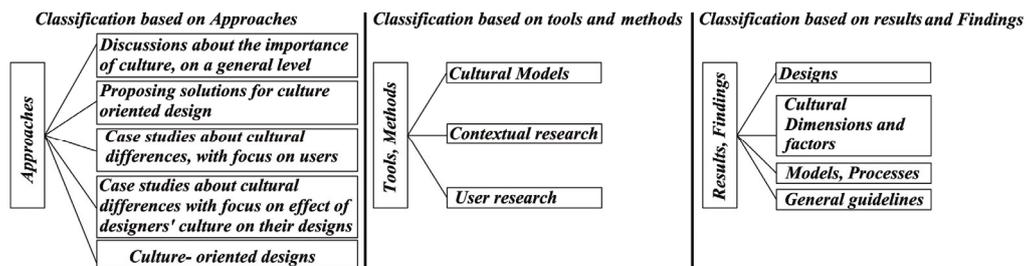


Figure 1. Three types of the classification

4 Classification of approaches to culture-oriented research in HCI

Considering the variety of definitions of culture, it is predictable that there are many ways for connecting culture to HCI. However, a few common patterns are observable in the articles which were studied during this research. From these patterns five main categories were defined:

4.1. Discussions about the importance of culture, on a general level.

Research studies in this category usually concentrate on proving or emphasizing the importance of culture in the HCI domain. A common reasoning for conducting such studies is the state of neglect of the role of culture in HCI or in one of its sub domains. This idea can be

supported by different methods, such as direct case studies about the use or design of human computer systems in different cultures, discussions about current findings in the HCI domain or drawing connections between HCI and cultural differences. Looking from another perspective, there are two dominant sub-approaches in this category. One uses marketing and business language for proving the importance. The first examples of this reasoning can be seen in the mid 1990s articles [9; 10], which are also the first research studies about culture and HCI. At that time, software developers were facing some problems in exporting their products to the countries with different cultures [9; 10]. In more recent papers, the same pattern can be seen with mobile devices as well; however the main focus is on the emerging markets. As an example, Nokia's user experience group is doing contextual research studies on markets like India, which is going to be the largest mobile phone market in the world [11; 12]. The other sub-approach concentrates on usability. A similar evolution can also be seen in this group. The mid 1990s research studies address software design (such as thinking about cultural user interfaces [13]). In the beginning of this decade a shift to website design [14; 15] or even physical products such as home appliances [16] is observable.

4.2. Proposing solutions for culture oriented design

In comparison the prior approach, some scholars have tried to propose solutions for the issue of culture in the context of HCI. Solutions are limited to the general guidelines; some include itemized dimensions or factors and even comprehensive models for considering culture in HCI design. A significant idea in this category is Markus's proposal for mapping Hofstede's cultural dimensions on the components of user interface design [17]. Hofstede's cultural model [18] defined different cultures based on five dimensions, and assigned scores to these dimensions for different countries. The dimensions were originally designated for organizational behavior, but because of their free-access database and simple structure, have been widely used in other areas as well. Markus model suggests a correspondence between user interface components and the cultural dimensions. Regarding mobile HCI, two research studies concentrate on special aspects of mobile HCI and then connect it to culture. Jhangiani and Jackson investigated the relationship between disability culture and mobile phone usage in India and United States, and used case studies to develop "guidelines for designing cross-cultural user interfaces which are nationality specific and disability specific" [19]. Choi et al. found 21 critical user-experience attributes based on the interviews about mobile data service in Japan, Korea and Finland [20]. These attributes along with some cultural dimensions were then used to define a model for developing "culturability" in the mobile data services.

4.3. Case studies about cultural differences, focusing on users

The category includes case studies which usually compare user groups from two or more countries. Both quantitative and qualitative methods have been used in this category. 17 out of the 40 references that have been studied include case studies about users in specific cultural contexts. This is the largest category among the five categories of approaches, and demonstrates that conducting case studies in the form of observation, interview or survey is the most common method for culture-related research in the HCI.

4.4. Case studies about cultural differences focusing effect of the designers' culture on their designs.

This approach is quite limited in comparison with other approaches, as there are only three articles in this category. Two show how websites that are designed in different countries reflect their country of origin [17; 18]. And one compared the ideas of Iranian and Australian students about a personal communication device, and found distinct patterns in each group, which could be because of the cultural differences [21].

4.5. Culture- oriented designs.

The common content of papers within this approach is design summaries which present culture-oriented designs. There is no example of designing a mobile device as, a product, based on the cultural specifications, but there are examples of mobile software that are designed by considering cultural differences. Windows Live Mobile interface is designed after user research and several tests in Japan, China and Unites States [22]. This research shows that sometimes it is possible to provide one design for multiple cultures.

5 Tools and methods

The second way of classifying articles is by methods and tools. Research methods were quite diverse. Some common methods can be seen in the reviewed articles.

5.1. Cultural Models

Cultural models usually include dimensions or factors to demonstrate different cultures, so they can be mapped on other frameworks such as business and management models, because of their systematic structure. Hofstede's model is the most common model that was used in the references. There are also two other common models, Hall and Trompenaars cultural models. Hall's model comprises the three factors of context, time and space. Each factor has its own varieties, which could be associated with cultural norms and behaviors in social contexts [23]. While Hofstede's model is under influence of organizational behavior, Fons Trompenaars's model addresses business and marketing issues. Trompenaars also focused on the "dilemmas" which come from the cultural differences. He defined his dimensions as the source of these dilemmas [24]. The simple structure of Hofstede's model makes it more usable in HCI research; especially where there is a need for a kind of measurement or numeric data. For instance, dimensions of this model were used for measuring the performance based on cultural differences [25] or defining attributes of virtual characters of a game [26]. However, this kind of usage is criticized by Lee et al., as Hofstede's model is not developed for a design approach. Their research about mobile phones and three other consumer electronics products represents a quantitative analysis of users in the United States, Germany, Russia and Korea [27]; and at the end, a specified set of dimensions is defined for the culture-oriented user experience design.

5.2. Contextual research

Some scholars preferred methods which are specially developed for their particular topics, so they defined culture in a certain context. This context can be a physical infrastructure like a house, or a conceptual system such as language.

Table 1: Summary of contextual research studies, mobile HCI articles are gray.

Author (s), Year	Context	Summary of the idea
Rode ,2006	House	Designs of the houses in around the world represent different cultures and lifestyles, and this fact can be considered in the development of future home appliances with HCI component.
Bell et al. 2005	House	
Acharya, 2008	Neighborhood	Lots of internet users in India access to the internet from café nets. In the Indian neighborhood structure, houses are around a central area which different professions and services (such as café nets) are centralized there. At the same time, mobile phone's rate of penetration in India is more than that of internet. Therefore research about possibility of mobile internet can be connected to the 'Indian Neighborhood'.
Churchill and Bly, 2000	Language, Geography	Language and geography can be used for studying the online culture and virtual environments.
Sacher et al. 2001	Language	Language is a key for understanding cultures, so considering language in interaction design is not just to "translate" menus or instructions. The scope of this paper is China and Chinese language.
Endrass et al. 2009	Language	Communication management in different languages can be different, as an example number of pauses in a certain period of time is not the same in German and Japanese

		languages. This characteristic can be applied in the "virtual agents" who are designed for each country.
Blom et al. 2005	illiteracy	Contextual research about illiterate mobile users in India.
Watson et al. 1994	Group Support Systems	Consensus and influence among members of a group have different patterns in different cultures, so this can affect "group support systems" software programs.
Iqbal et al. 2005	Ethnography	The value of ethnographic analysis in design of ubiquitous collaborating systems.
Asokan and Cagen, 2005	Movement Grammar	Movement grammar includes components such as lighting, emotion, action, rhythm, gender, speed, timing and firmness. These qualities can be culturally different.
Honold, 2000	Activity Theory	Activity theory is used as a tool for cultural research. Contextual research with sufficient observation of all actions during in each task is recommended.
Berthouze and Lisetti, 2002	Facial expressions	Facial expressions give useful information about users, regardless of their culture.
Fishwick et al. 2008	2nd Life	Learning about foreign cultures in virtual environments
Tosa et al. 2004	Zen philosophy	Design of ZENetic Computer based on Zen philosophy, as a way for inter-culture computing:
Agnelli et al. 2004	Fashion	Considering a place for mobile devices in different fashion design items: a way to present mobile devices as a "visible" part of the fashion.

5.3. User research methods

Currently, two categories of research methods are available for the HCI researchers. One of them includes methods which originally belong to the social science and humanistic studies, but are also usable in HCI. The main methods in this category are observation, scalar questionnaires, interviews and diary studies [28]. In the other category, there are some research methods, which are classified as HCI specific methods. Verbal protocols, heuristics and cognitive walk-throughs are classified in this category of research methods. In verbal protocols, users describe their experience during the use ("think aloud" method) or after the usage ("post event" method). In the "heuristics" method, use scenarios are evaluated by a group of professionals. The cognitive walk-through is similar to the "heuristics" but evaluators act as the users at the same time. The reviewed articles usually comprise a combination of the research methods. In terms of frequency, general research methods dominated and HCI specified methods were not mentioned directly. However, some of the interviews were a combination of normal interviews and "post event" verbal protocols (four articles). In one research about the mobile data services a method similar to "think aloud" was used for understanding users' tendencies toward those services [20]. In summary, Among 40 reviewed papers, 19 research studies include case studies, which 17 of them were case studies about specified user groups.

6 Results and findings

After classification of the methods and tools; a review of all references has been done regarding their results and findings. Therefore, some major patterns have been recognized among them, which can cover almost all of the papers. These patterns are as follows:

6.1. Designs

Some of the research studies present summaries of the designs; these design summaries sometimes support general models and suggestions (Table 2, Mobile HCI articles are in gray).

Table 2: Summary of studies, with results in the form of designs.

Author (s), Year	Summary of the idea
Asokan and Cagen, 2005	Design of utensils based on movement analysis (movement grammar)
Ramos et al. 2009	Developing "synchronous gestures" technology for multi display environments. In this technology, multiple devices use a shared multi display environment. The way that users share their spaces while using these devices is described by Hall's high-low territoriality (space) cultural factor
Aylett et al. 2009	Users of a virtual environment learn to collaborate with virtual agents from another culture.

Khaled et al. 2006	Adapting “Persuasive Technology” (the technology which changes the users’ behaviors by persuasion and not by coercion) to be used in collectivist the societies.
Anderson et.al, 2008	Windows Live Mobile user interface design
Endrass et al. 2009	Virtual agents which have common “communication management” characteristics with their users (for example, number of pauses in the dialogs).
Maniar and Bennet, 2007	A mobile game which gives some cultural information about the England to the new international students, and avoids cultural shock.
Tosa et al. 2004	ZENetic Computer, a concept which is influenced by the ZEN philosophy of Japan.
Agnelli et al. 2004	Considering mobile communication devices in the design of cloths make them “visible”.

6.2. Cultural Dimensions and factors

Under the influence of cultural models, some studies try to define new dimensions for cultural specifications in the HCI or design domains. Some other articles show the main design attributes or major issues in user research. (Table 3, mobile HCI articles are in gray).

Table 3: Summary of results in the form of dimensions or factors.

Author (s), Year	Summary of the idea
Khaslavsky, 2009	9 dimensions for user interface design, extracted from the Hofstede’s and Hall’s models.
Marcus, 2002	A mapping between the Hofstede’s cultural dimensions and user interface components. The final result is a set of 50 categories of user interface components.
Choi et al. 2006	6 important elements of the user experience: 1. Interaction, 2. Navigation, 3. Structure, 4. Information architecture, 5. Functional specifications, 6. Content. In addition there are 10 main cultural dimensions, which are extracted from the cultural models.
Blom et al. 2005	A set of issues in user mobility research, which are viewed from two different perspectives: contextual approach to the mobility research and cross-cultural approach to the mobility .

6.3. Models, Processes

There are only few articles which propose systematic models or processes as their final results (Table 4, Mobile HCI articles are in gray).

Table 4: Summary of research studies, with results in the form of models.

Author (s), Year	Summary of the idea
Iqbal et al. 2005	“Ethno Model”, a model for representing the ethnographic data for software design.
Jhangiani et al. 2007	A pyramid model for the design process of cell phones, considering disability.
Choi et al. 2006	A model which shows the interaction among graphic user interfaces, information architecture, contents and cultural dimensions in the mobile data services.

6.4. General guidelines

The rest of references don’t present their results and findings in a clear framework (similar to the 6.1 and 6.2). Final conclusions often state general guidelines, emphasize the importance of culture, or pose new questions for further research.

7 Analysis

The first step of analysis is to look at the situation of mobile HCI in comparison with other areas of HCI. Among 40 articles, 13 articles discuss culture and mobile HCI, which is the largest group among others (there are also some overlaps, as some references are about multiple areas). This trend shows that importance of cultural differences in the mobile HCI is felt more than other areas of HCI. References can also be classified regarding research methods (section 5). Figure 2 shows distribution of different approaches in all 40 references, while figure 3 shows the same information, only about the mobile HCI articles.

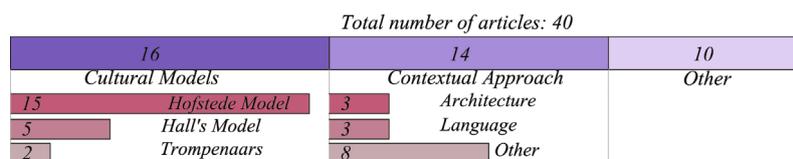


Figure 2: Distribution of research approaches in the all references

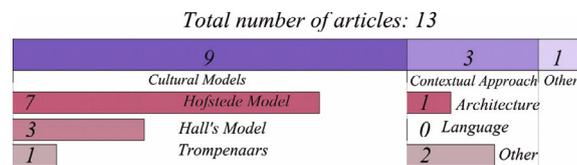


Figure 3: Distribution of research approaches in the mobile HCI references

This distribution indicates that while cultural models have the first rank among the research approaches; there is less attention to the contextual approach in mobile HCI in comparison with the software HCI. In addition, Hofstede's model is the most used cultural model in HCI. Less than 50 % of all articles (18) include user research. Majority of the research methods were general methods and only 6 papers addressed HCI specified methods indirectly and usually as a combination with the other methods. Among general methods, observation was the most used method, while "post event" verbal protocol was used more than other HCI specified methods. (Table 4, some articles used a combination of methods, so there are overlaps). It seems that the area of academic user research about culture and mobile HCI is immature, while there might be comprehensive examples in industry which are not represented in the scientific references.

Table 4: Distribution of different user research methods in the all references

General Research Methods and their frequency of use		HCI Research Methods and their frequency of use	
Observation:	10	Verbal protocols, think aloud:	1
Scalar questionnaire :	5	Verbal protocols, think aloud:	1
Interviews:	6	Heuristics	0
Diary study:	2	Cognitive walk through	1

Regarding findings and results, concrete outcomes such as itemized the dimensions and factors, processes and models and design experiments are not a core part of mobile HCI research, as they are not a major part of the culture related HCI research either. (Table 5)

Table 5: Number of the results and findings in the categories of designs, dimensions and factors, models and processes

	Frequency in all articles	Frequency in Mobile HCI articles
Designs	9	3
Dimensions, Factors	4	2
Models, Processes	3	2
Total number of articles	40	13

8 Conclusion

While HCI covers a large area of the research, culture in relationship to HCI is still developing. The main approaches of research about culture in HCI include discussions about the importance of culture on a general level, proposing solutions for culture oriented design and case studies about cultural differences, focusing on the users or designers, and finally culture- oriented designs. The same pattern can also be seen in the mobile HCI. In the reviewed articles culture was described in two main ways, cultural models and different contexts. In summary, some of the problematic issues regarding the research methods and tools in the current literature are:

1. Lack of the mobile HCI-specified cultural models and dimensions. As an example, Hofstede's model is used widely in the mobile HCI and HCI research because of its free database and simple and numeric structure, but it is not clear whether its dimensions are valid for the HCI domain or not.

2. Research studies usually don't explain why a specific cultural model, or a context has been used as the basis of the research while there are other possible alternatives.
3. There are few scientific articles with user research components and HCI specified methods for studying users. This might be because of the unfamiliarity with the HCI specified research methods, or problems in applying them in the mobile HCI domain.

Regarding the results and findings, as previously stated, concrete outcomes such as models and processes are rare. This type of outcomes can also improve research methods for further research studies. In summary, the following target points can be the main scopes of future research in the mobile HCI area:

1. Cultural models and dimensions, can be adopted to mobile HCI. In addition more research can be conducted about the contextual representations of culture, such as language, movement grammar, ethnographics and architecture, and their relationships with mobile HCI.
2. Models and processes for culture-oriented design in the mobile HCI area.
3. Increasing focus on user research and developing mobile HCI specified research methods.
4. Representation of industrial cases in the scientific forums.

9 References

- [1] Kamppuri, M., Bednarik, R., Tukiainen, M., "The expanding focus of HCI: case culture." *Proceedings of the 4th Nordic conference on Human-computer interaction: changing roles*. Vol.198, 2006, pp 405-408.
- [2] Lee, B., & Lee, S. "Case Study of Samsung's Mobile Phone Business." *KDI School Working Paper Series*, May 2004, 2004, pp 4-11.
- [3] Kaplan, M. "Introduction: Adding a Cultural Dimension To Human Factors." *Advances in Human Performance and Cognitive Engineering Research* Vol.4, 2004, pp XI- XVII.
- [4] Weiss, S. *Handheld Usability*. New York, NY: Wiley, 2002.
- [5] Keinonen, T., & Lindholm, C. "Mobile Usability: How Nokia Changed the Face of the Mobile Phone." New York, McGraw-Hill Professional, 2003.
- [6] Christiaans, H., & Diehl, J. "The Necessity of Design Research into Cultural Aspects." *Proceedings of International Association of Societies of Design Research 2007*, 2007 Retrieved September 27, 2009, from <http://www.sd.polyu.edu.hk/iasdr/proceeding/>
- [7] Van Biljon, J.A. "A Model for Representing the Motivational and Cultural Factors that Influence Mobile Phone Usage Variety". PhD Thesis, School of Computing, University of South Africa, 2007, pp 34
- [8] Webster, J. & Watson, R. T. "Analyzing the past to prepare for the future: Writing a literature review." *MIS Quarterly*, Vol. 26 (2), 2002, pp xiii-xxiii.
- [9] Khaslavsky, J. "Integrating Culture into Interface Design." *Conference on Human Factors in Computing Systems*, CHI 98 conference, 1998, pp 365-366.
- [10] Watson, R., Ho, T. H., & Raman, K. "Culture: a fourth dimension of group support systems." *Communications of the ACM*, 37(10), 1994, pp 44-55.
- [11] Blom, J., Chipchase, J., and Lehikoinen, J., "Contextual and Cultural Challenges for User Mobility Research." *Communications of the ACM*, Vol. 48 (7), 2005, pp 37-41.

- [12] Chavan, A. L. & Gorney, D. "The Dilemma of the Shared Mobile Phone Culture Strain and Product Design in Emerging Economies." *interactions*, Vol. 15(4), 2008, pp 34-39.
- [13] Yeo, A. "Cultural User Interfaces." *ACM SIGCHI Bulletin*, 28(3), 1996, pp 4-7.
- [14] Gould, E., Zakaria, N., & Yusof, S. M. Applying Culture to Website Design: A Comparison of Malaysian and US Websites. *Proceedings of the 18th ACM international conference on Computer documentation: technology & teamwork*, 2000, pp 161 – 171.
- [15] Simon, S. J. "The impact of culture and gender on web sites: an empirical study." *ACM SIGMIS Databas*, 32(1), 2000, pp 18-37.
- [16] Beu, A., Honold, P., & Yuan, X. "How to Build Up an Infrastructure for Intercultural Usability Engineering." *International Journal of Human-Computer Interaction*, Vol. 12(3&4), 2000, pp 347–358.
- [17] Marcus, A. "User-interface design, culture, and the future." *Proceedings of the Working Conference on Advanced Visual Interfaces, AVI*, 2002, pp 15-27.
- [18] Hofstede, G. "Culture's Consequences: Comparing Values, Behaviors, Institutions and Organizations Across Nations." 2003, Thousand Oaks: Sage Publications, Inc.
- [19] Jhangiani, I., & Smith-Jackson, T. Comparison of mobile phone user interface design preferences: perspectives from nationality and disability culture. *Proceedings of the 1st international symposium on Computer human interaction in mobile technology*, 2007, pp 512-519.
- [20] Choi, B., Lee I., Kim, J., "Culturability in Mobile Data Services: A Qualitative Study of the Relationship between Cultural Characteristics and User-Experience Attributes." *International Journal of Human-Computer Interaction* , Vol. 20 (3), 2006, pp 171-203.
- [21] Razzaghi, M., Jr., M. R., & Zehner, R. "Cultural patterns in product design ideas: comparisons between Australian and Iranian student concepts." *Design Studies*, Vol. 30(4), 2009, pp 438-461.
- [22] Anderson, C., Hirsh, S., & Mohr, A. "Wheels Around the World: Windows Live Mobile Interface Design." *CHI '08 extended abstracts on Human factors in computing systems*, Conference on Human Factors in Computing Systems, 2008, pp 2113-2128.
- [23] Hall, E. T. "Beyond Culture." 1976, New York: Peter Smith Publisher.
- [24] Trompenaars, F., & Hampden-Turner, C. "Riding The Waves of Culture: Understanding Diversity in Global Business." 1997, New York: McGraw-Hill.
- [25] Ford, G., & Gelderblom, H. "The Effects of Culture on Performance Achieved through the use of Human Computer Interaction." *Proceedings of the 2003 annual research conference of the South African institute of computer scientists and information technologists on Enablement through technology* , Vol. 47, 2003 pp 218 - 230 .
- [26] Aylett, R., Vannini, N., Andre, E., Paiva, A., Enz, S., & Hall, L. "But that was in another country: agents and intercultural empathy." *Proceedings of The 8th International Conference on Autonomous Agents and Multiagent Systems*, Vol.1, 2009, pp 329-336 .
- [27] Lee, I., An, Y., Kim, J., Kim, S., Lee, K., Kim, D., Han, M. Yong Park, S., Woong Choi, G. "Cultural dimensions for user experience: cross-country and cross-product analysis of users' cultural characteristics." *Proceedings of the 22nd British HCI Group Annual Conference on HCI 2008*, Vol. 1.Session: Culture, 2008, pp 3-12.

Paper 2.

Aryana B. & Boks C. (2012) *New Product Development and Consumer Culture, a Review*. International Journal of Product Development, 16(1), 45-62.

Is not included due to copyright

Paper 3.

Aryana B. & Boks C. (2010) *Cultural Customization of Mobile Communication Devices' Components*. Proceedings of the 11th International Design Conference DESIGN 2010, 137-146.



CULTURAL CUSTOMIZATION OF MOBILE COMMUNICATION DEVICES' COMPONENTS

B. Aryana and C. Boks

Keywords: culture, object oriented design, mobile communication devices, mass customization

1. Introduction

With more flexibility in technology, more segments in global markets and higher expectation of users, mass manufacturing is going to be replaced with mass customization. Modularity of mobile communication devices, and advanced manufacturing management systems make the mobile industry a good candidate for being a mass customized industry. Discussion about customization for mobile devices encompasses aspects like customization of operating systems, customization of additional software applications, customization of physical appearance, customization during usage and customization of features and components. Scope of this research is cultural customization of components, which (as it will be described later) is called static design. The next section will give a brief summary of the methodology, then in the section 3 after an introduction to mass customization discussion has been narrowed down to advantages of Object Oriented configuration systems. As explained in section 4, the mobile industry has the main characteristics of a mass customized industry. In section 4, three main aspects of culture-oriented design have been described. Section 6 will demonstrate correspondences between cultural models and elements of design. Section 7 focuses on an Integrative Approach of Culture-Oriented Design which is a unique solution among the limited number of applied solutions in this field and has a comprehensive and extendable outlook. By considering this solution in the context of the Object Oriented paradigm, a proposal for static (structural) culture-oriented design of mobile communication devices is proposed in the section 8. Section 9 discusses an experiment showing the proposal's advantages and disadvantages, and finally these findings are used for suggestions about further improvements and extensions in section 10.

2. Methodology and framework

The research presented in this paper contains two main phases. The first phase includes a theoretical discussion about connecting culture oriented design to an object oriented (OO) product model, which is usable in a mass customization system. This theoretical phase includes the following steps:

1. Exploring the current findings about mass customization, cultural models and culture oriented design.
2. Building a correspondence between an OO product model and culture oriented design of mobile communication devices.
3. Proposing a process for cultural customization of mobile communication devices, focusing on the specifications of their components and OO design.

In the next phase of the research, an experiment is used for observing the proposed process in action, using the following steps:

1. Conducting user research, using a scaled questionnaire method in order to define users' opinions or attitudes about mobile communication devices components.
2. Analyzing the results and using them in the proposed process.

At the end there is a discussion about the validity of the process by conducting another experiment about the same group of users to investigate their opinions or attitudes towards the products (not their components). The results of the theoretical discussion, experimental phase and final discussion will shape the final conclusion.

3. Mass Customization

The stereotype of mass manufacturing systems, in which limited numbers of products are being produced in high volumes for a large number of consumers can not be valid and acceptable for current customers. Today's consumers have a major influence on characteristics of products. This influence can take place in different phases of production lifecycle, especially in the wide spectrum of activities that make up the specification process and includes almost the entire life cycle of a product from product design, to use or even disposal [Hvam et al., 2008].

The broadness of this specification process means that there should be ample communication between the different parts of a manufacturing system. To make this process easier, these parts can be connected to a unified system which is called a configuration system [Hvam et al. 2008]. A configuration system defines how specifications can be applied in each phase and prevents confusing communications among different sections of the whole system. Moreover, not only the manufacturing system should be specialized for customization, but also the products must be adaptable for a customization process. The modularity enables products to be mass produced and customized at the same time. While modules can be mass produced, their combination can be customized, so the final result is a mass customized product. The existence of a configuration system and modularity of products are two main characteristics of a mass customization system. Such a configuration system can be complex and multidisciplinary and includes tasks like communication with different parts of the manufacturing system, considering the product master plan (which includes the general overview of the product's structure, available modules and the relationships between them) and managing the whole process in order to gain business advantage. In order to control and manage this complex system throughout a project lifecycle, different methods and approaches have been developed.

3.1 Application of the Object Oriented paradigm in mass customization

There are various methods for structuring a configuration system. Most of these methods use information technology in order to manage communication between different parts of the production lifecycle. This research will use one of these methods which is called Object Oriented (OO) paradigm. The OO paradigm is based on defining systems by using objects and classes data structures and was first used in software design and programming field. Application of OO paradigm in configuration systems has advantages such as modularity, maintainability and reusability [Hvam et al., 2008]. The OO paradigm can also be used for designing product variant master plans. In this way, a product and its modules are represented by a structure of classes and objects.

4. Capability of mobile communication devices for mass customization

The mobile communication devices industry has some characteristics which make it compatible for mass customization:

1. Although mobile phones (the most popular type of mobile communication devices) usually are presented in various models, they are basically modular, and are designed by using a limited number of modules.
2. Customization is not limited to the process of design, development and production of a product; it can be applied in the usage process as well. Mobile communication devices have both software and hardware (virtual and physical) components, so many of their virtual characteristics can be customized by users themselves after the purchase.

In addition to above characteristics, changes in global business models and shifts to non-western emerging markets with a high level of cultural diversity, are another reason for developing more customized mobile devices. In particular, effects of cultural differences, which is the focus of this paper, is of great importance to global players in this industry.

In this shift to (often) non-western and developing countries; global producers would face new challenges, as they are experiencing new situations which they did not meet before in regions such as Europe and North America. In these mature markets, usually countries in the same geographic area (which is a logistic area as well) have similar characteristics, but in other regions of the world situation this is not the same; for example, quite different Gross Domestic Product (GDP) scores can be seen in the same geographic areas like Middle East and South America [World Bank, 2009].

5. Importance of culture

The scope of this research is mainly the effect of culture on technology, and more specifically, the effect of users' cultural specifications on design of mobile communication devices. Relationships between culture and design have been viewed from different perspectives in literature. Generally speaking, there are three main aspects which make culture an important parameter in product design.

5.1 Usability and ergonomics

Usability has been mentioned as a reason for taking culture into account. Considering the evolution process of ergonomics, from 1950s birth in the military industries to the current decade's focus on global communications, the current era can be the era of cultural ergonomics [Kaplan, 2004]. Guidelines for considering different writing systems and needed space for different alphabets on screens, different meanings for graphic symbols and motifs, availability for changing icons and texts and multicultural usability testing are examples of this attention to cultural differences in mobile usability.

5.2 Business advantages

As a driver for cultural customization, the situation of the global market for mobile devices can be noted here again: new opportunities outside mature markets in developed countries lead to more attention for user requirements in those new markets. There are also other related changes like demographic changes in the world which increase life expectancy in some developing countries, creating new consumers groups with different needs.

5.3 Social sustainability and attention to moral values

Large numbers of people around the world with different cultural backgrounds need technology to improve their life while they are not necessarily potential consumers. Also cultural differences should be considered when technology and products are being used for a sustainable growth [Christiaans & Diehl, 2007]. In general, it can be concluded that importance of culture in product design has a number of quite different aspects, from business advantage, to moral values. This variety shows that considering culture in design is not only an approach, but may also be a necessity.

6. Culture, definitions and models

Finding a certain definition for *culture* can be an impossible task. However, when it comes to defining *dimensions and models for culture*, there is a limited number of well-known cultural models. Because of their systematic approach, cultural models can be mapped to other models, such as business and management models. Some cultural models are widely used in marketing and management fields. Among these models, Hofstede's model which is originally designated for organizational behavior, has been widely used in research studies about culture in various fields, and is the most used model in studies on Human Computer Interaction (HCI) and culture relationships in recent years [Kamppuri et. Al, 2006].

6.1 Hofstede's cultural dimensions

Geert Hofstede's work is the result of one of the most comprehensive studies about culture in more than 70 countries, between 1967 and 1973 under a project supported by IBM. This study has been updated since then [Hofstede n.d.]. The main direction of his research is organizational culture, but because of the wide range of his study in all parts of the world, and also its open source numeric database on the web, it has been referred to in many other areas which deal with culture. Hofstede's model comprises five dimensions, and the results are a set of scores for each dimension, which are assigned to different countries. Definitions of these dimensions, according to the Hofstede's open source database are [Hofstede n.d., 2009]:

1. Power Distance Index (PDI): "That is the extent to which the less powerful members of organizations and institutions (like the family) accept and expect that power is distributed unequally... "
2. Individualism (IDV): "on the one side versus its opposite, collectivism, that is the degree to which individuals are integrated into groups..."
3. Masculinity (MAS): "Versus its opposite, femininity refers to the distribution of roles between the genders which is another fundamental issue for any society to which a range of solutions are found..." "
4. Uncertainty Avoidance Index (UAI): "deals with a society's tolerance for uncertainty and ambiguity; it ultimately refers to man's search for Truth. It indicates to what extent a culture programs its members to feel either uncomfortable or comfortable in unstructured situations..."
5. Long-Term Orientation (LTO): "This fifth dimension was found in a study among students in 23 countries around the world, using a questionnaire designed by Chinese scholars. It can be said to deal with Virtue regardless of Truth. Values associated with Long Term Orientation are thrift and perseverance; values associated with Short Term Orientation are respect for tradition, fulfilling social obligations, and protecting one's 'face'..."

7. Culture-oriented design of human-machine systems

As an important user specification, culture has been noted in both academic and business domains of design; however the main concern is lack of systematic models and processes for considering cultural characteristics in design. While there are plenty of case studies about effects of cultural differences on artefacts or even design of some culture-specified products, it is not easy to find models or processes about connecting culture to design. Aaron Marcus provided a simple and practical solution for mapping websites' user interface components (metaphors, mental models, navigation, interaction and appearance) and Hofstede's cultural dimensions. This mapping then has been translated to a number of patterns for each cultural dimension [Marcus, 2002]. A few years later this idea has been used in a more comprehensive way by Christian Rose in the development of culture-oriented human machine systems [Rose, 2004]. The idea includes a detailed model which covers different aspects of human-machine system design together with an extendable model which is usable for different human machine systems such as products or virtual systems. In this model, intercultural variables and cultural factors (dimensions) are analyzed in a systematic process and then findings of this process (which can be different components of design) are integrated with design requirements (Figure 1).

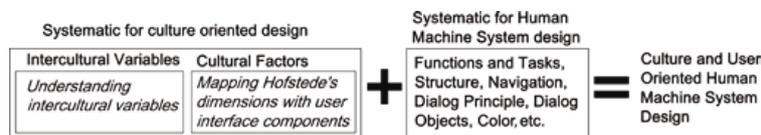


Figure 1. Integrative Approach of the Culture-Oriented Design [Rose, 2004]

There is also a focus on intercultural variables, which are defined as direct variables (information presentation, language etc.), indirect variables (general machine design, functionality) and frame variables (the educational or political system, technical standards). Another important part is a

mapping between cultural dimensions and systems' components similar to Marcus' solution. In the case of extending this approach to a product with hardware and software components such as a mobile communication device, several activities should be defined. The next section will provide a proposal for cultural customization of mobile communication devices focusing on object oriented static design, which can fit into the integrative approach of the culture-oriented design, but does not include the analyses of intercultural variables at this step. There is also a possibility for thinking about dynamic design of mobile communication devices based on cultural dimensions (for example designing usage scenarios of software and operating systems) which is not the scope of this research, however it is of great importance for further steps, in order to define a comprehensive model for considering cultural differences and also intercultural variables in design of mobile communication devices.

8. A proposal for static design of mobile communication devices, based on cultural dimensions

Although there are different methods for modelling configuration systems, modelling products and also customer need identification, finding a suitable method which can bridge all of these areas is a complex issue. This research proposes an OO paradigm for cultural customization because of the OO paradigm's simple structure, modularity and flexibility for modelling heterogeneous systems. Moreover, OO thinking is a common method in mass customization, electronics and information technology. The following subsections explain the four phases of this proposal.

8.1 Static OO model of the product

A system can be modelled by the OO paradigm on static and dynamic levels. On the static level, a model usually shows the structure and components of the system, in the form of classes and their relationships, and on the dynamic level, an observer is able to see how the system works [Booch et al. 2007]. In this phase (according to the definition of OO static design) a product variant master model will be developed. This model will show all possible modules as objects which belong to certain classes. Figure 2 shows a part of the tree structure of this model.

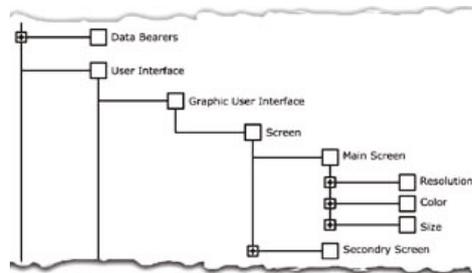


Figure 2.A part of product variant master model (tree structure)

8.2 Mapping the cultural model to the components

In the integrative approach of the culture-oriented design, a correspondence between user interface components and Hofstede's cultural dimensions was used to define the way that a state of each user interface component can be changed in a cultural context. Thinking about static design of a product (variant master model), a similar correspondence can guide designers to choose the best components; so each component can be related to a cultural dimension. In order to find these relationships, case studies can be done about target user groups. These case studies should target distinct relationships. Target users can mark scaled questionnaires to show how they think each component can be related to a cultural dimension. For instance, the question "to what extent do you think that having a Bluetooth feature can risk your privacy?" can be linked to the relationship between the "Bluetooth connectivity" component and the "uncertainly avoidance" dimension. Figure 3 shows an example of this mapping procedure. Black cells show that the component is related to the corresponding cultural dimension in

the table. Gray columns represent components that are not easily customizable, or are so technical that ordinary users have no direct interaction with them. It should be noted that the mapping in figure 3 is typical and can vary based on case studies in the different cultural contexts.

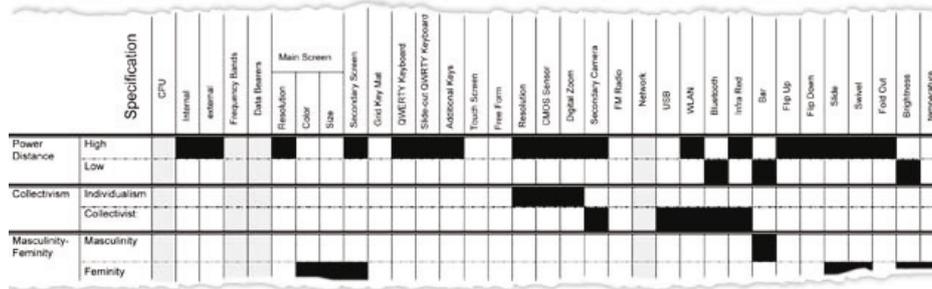


Figure 3. Mapping between hardware components and Hofstede's cultural model

8.3 Scoring components according to each component

Components which are related to each cultural dimension can have different rates of importance. For example, in a typical cultural context, “ability of reading different types of documents” (“documents / applications” component) and “flip up form factor” components can be both related to the high power distance dimension; however importance of “form factor” component may be more than “applications” component.

Therefore, the rate of importance should be considered to get optimal results in real situations, because changing all related components in a product might not be always economically feasible. The components which are related to a cultural dimension can be compared to each other, and by looking at the results of case studies, there would be some hints for understanding the main concentration of users for each dimension.

8.4 Application

Scores in 8.3 can be used in different ways. They can be used to show how a producer can customize a product for a specific cultural context, not by launching a specific product, but by modifying components of existing products. In addition, when changing a large number of components is not possible due to economic or technical limitations, the producer can focus on the most important ones to get an optimal level of customization.

9. Experiment

This experiment shows how the proposed process works in action, and also provides some clues for further improvements. The study concentrates on femininity, an aspect of the Hofstede's masculinity – femininity dimension. To make the study relevant to the selected cultural dimension, some limitations were applied to the specifications of users. Since the number of users which were studied was limited, samples were not dispersed among different clusters of the society. Therefore the results were directed to represent a limited and certain cluster of users: female users, with minimum education at bachelor level, between 25-30 years old, who live in Tehran, Iran. Iran has a medium score of masculinity in Hofstede's model which is 43. (The highest score is 110 for Slovakia, and the lowest is for Sweden which is 5)

One could say that the findings are not supportive enough to demonstrate a fact about users (for example young female mobile users in Iran), but this is not the case. Above limitations are designated based on the main goal of the experiment, which was an observation of the proposed solution, when it is applied for a specific user group, in a specific cultural context and certain cultural dimension, regardless of user group's size.

Twenty mobile phone users with above specifications filled in scaled questionnaires. In these questionnaires, each component was put against a spectrum of masculinity – femininity. Users were able to choose 3 levels of femininity (high, medium and low), 3 levels of masculinity (high, medium and low) and one neutral option. In other words, they could define to what extent each component is feminine or masculine ideas according to their opinion. Components were extracted from a product variant master model similar to the one presented in Figure 2. A part of the final results is shown in Figure 4. In this figure, each column shows a user's idea about different components. Components are categorized in two main classes of hardware and software. Further hierarchies are also drawn out from the product variant master model.

In order to define scores for each component, each level of spectrum was graded. Medium levels are graded in a way to be the average of the high and low levels, similar to their visualization in questionnaires in which they were in the middle of low and high levels. Also positive numbers were assigned for the feminine levels and negative numbers for the masculine ones. The grades are as follow:

- F3, High Femininity: 2, F2, Medium Femininity: 1.5 , F1, Low Femininity: 1
- Neutral: 0
- M1, Low Masculinity: -1, M2, Medium Masculinity: -1.5, M3, High Masculinity: -2

	Users																			
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
Color	F1	-	F3	F1	-	F2	F2	F3	F3	F3	F1	F3	F2	F1	F3	F3	-	-	F3	F2
Brightness	F2	F3	F3	F2	-	F3	F1	F2	F2	F1	F1	F3	F2	F3	F3	F1	-	M1	-	F3
Color temperature	-	-	M3	-	-	M3	M1	M3	-	F3	M1	M3	M1	-	-	M1	-	M3	-	M2
Bar formfactor	F1	F3	F3	-	-	F3	-	-	-	M2	F2	F3	F1	-	M3	-	-	M3	F1	F2
Swivel Form Factor	-	F3	F3	F1	-	F3	F1	F3	F2	M2	-	-	M2	F2	F3	F1	-	F3	-	F1
Slide Form Factor	-	-	F3	-	-	F3	F1	-	-	F2	-	-	M2	F3	-	-	-	F3	-	-
Flip up	-	-	M3	-	-	F2	F1	-	M1	M2	-	-	F1	F3	M3	-	-	-	-	M1
Flip down	-	M3	F3	-	-	F2	F1	-	F1	M3	-	-	M2	M3	M3	-	-	-	-	M1
Fold out	-	M3	F3	-	-	F2	F1	-	F1	M3	-	-	M2	M3	M3	-	-	-	-	M1

Figure 4. Results based on the scalar questionnaires

These grades then can be used to define femininity score for each component, by the following equation:

$$\text{Score for each component} = (2a + 1.5b + c) - (2a' + 1.5b' + c')$$

Where:

- a = Number of users who have assigned a high level of femininity (F3) for the component.
- B = Number of users who have assigned a medium level of femininity (F2) for the component.
- C = Number of users who have assigned a low level of femininity (F1) for the component.
- a' = Number of users who have assigned a high level of Masculinity (M3) for the component.
- b' = Number of users who have assigned a medium level of Masculinity (M2) for the component.
- c' = Number of users who have assigned a low level of Masculinity (M1) for the component.

Figure 5 shows a part of the femininity scores for the components:

	M3	M2	M1	F1	F2	F3	Scores
	-2	-1.5	-1	1	1.5	2	
Color Brightness				4	4	8	26
Color temperature				4	5	7	25.5
Monochromatic Color	4	3	5				-17.5
Bar formfactor	5	1	4			1	-13.5
Swivel Form Factor	2	1		3	2	4	8.5
Slide Form Factor		2		4	2	6	16

Figure 5. Femininity score for each component

From the numbers it can be concluded that appearance is the most important aspect of femininity for users, because the highest scores belong to the colour characteristics and form factor (colour brightness has the highest score of 26. Colour temperature' score of 25.5 and slide form factor's score of 16 are placed next). Slide and flip up form factors, along with bright and warm colors are the stereotypes for a feminine mobile phone, while a bar-type (score of -13.5) and dark (usually black or gray) mobile phone which has professional and advanced features can be a stereotype for a masculine mobile phone. More advanced components, which make mobile phones closer to the concept of "mobile computing" devices (such as the presence of a QWERTY keyboard with score of -19.5), were considered as masculine components. As an example for the application of these findings, a low-cost customization for this user group may include a change of the device's color and omitting some advanced features such as Wireless LAN (Local Area Network) and document browsing applications. In this way without a major additional cost, producers can provide a more desirable product to this user group, with lower cost in comparison with the original version of the device.

10. Discussion

The experiment suggests that the proposed model has some advantages, which can be helpful in real situations. Some of these advantages are considered to be:

1. Simplicity: The solution can be applied and learned easily. Its simple algorithm can be easily used in a software system when numbers of components and cultural dimensions are high.
2. Systematic approach, which is essential for business applications.
3. Detailed information about the attitudes and opinions of users for each component.
4. All qualitative decisions (mainly deciding about drawing relationships between cultural dimensions and components) are made by users.
5. The classified structure and use of the OO product model make the solution adaptable for OO configuration systems.

However, there are some concerns about the solution as well, which are discussed below:

1. How can this solution interact with other parts of the design process?
2. In this solution, users express their attitudes and opinions about separate components. Is there any guaranty that they follow the same patterns when they deal with the combination of these components as "a product"?

Regarding the first question, currently there are a number of OO tools such as Unified Modeling Language (UML) which have predefined interfaces for dynamic and static OO design. However, the issue of aesthetic design is more complex, as compatibility of its qualitative nature with OO design is unclear. A practical solution might be a review of existing systematic methods for analysis of aesthetics in products, and changing them to usable algorithms for OO models. The second question can be answered by a sub-experiment. After answering the scaled questionnaires about components, the same respondents were asked to select a mobile phone from 6 provided alternatives. These alternatives were then graded based on their feminine components, and grades were compared with users' selections. In order to make the results more valid, the following circumstances were applied:

- Alternatives were selected from Motorola products (Figure 6), in order to decrease the effect of brand and previous experiences on users. Although Motorola is present in Iran's market, this presence is not official, because of United States sanctions. Motorola has a small market share in Iran, since about 70 percent of market is currently owned by Nokia and Sony Erikson, and in the remaining share there are other brands such as LG, Samsung and domestic producers of mobile phones [Kantar Media Research Group 2007]. So, the provided products were new to the respondents, and the effect of previous experiences or brand loyalty was limited as much as possible.
- Respondents were encouraged to read and understand the specifications of alternatives, before selecting their favorite mobile phone.
- Alternatives were selected from a specific price range (200-250 US \$), so the effect of price was limited and overall capabilities of the products were similar.



Figure 6. Alternatives

Comparing the results of the phones' scores, (Table 1) with the respondents' selection shows that these two do not obey the same pattern and more desirable phones have even score lowest. Tracking respondents' answers also shows that some did not apply their opinions about individual components in their final selection. The main principle of Gestalt psychology can be a reason for this significant difference: "The whole is greater than the sum of the parts". Combination of these components as a product, along with the appearance and other aesthetic aspects can change users' preferences. In this experiment, users selected bar type form factors more than slide or flip up ones, because they think that two bar type phones were "more beautiful" even if they prefer slide or flip up phones in an identical situation. Therefore, appearance and aesthetic aspects should be considered quite seriously in further research.

Table 1. Results of sub-experiment

Components	Score	Zn5	Rokr E6	Rokr W5	A 1200	V3xx	Rizr Z10
Colour Brightness	26	-	-	-	-	-	-
Col Temperature	25.5	-	-	-	25.5	-	-
Swivel Form factor	8.5	-	-	-	-	-	-
Slide Form factor	16	-	-	16	16	16	-
Flip up Form factor	9	-	-	-	-	-	9
Grid keypad	4.5	4.5	4.5	4.5	4.5	4.5	4.5
Additional keys	5	5	5	5	5	5	5
Screen Colour	5.5	-	-	-	-	-	5.5
Secondary Screen	4	-	-	4	-	4	-
Mp3 Ringtone	3	3	3	3	3	3	3
SMS	7	7	7	7	7	7	7
MMS	1.5	1.5	1.5	1.5	1.5	1.5	1.5
Final Score		19.5	19.5	39.5	61	39.5	34
Number of Users who selected the Model		6	6	1	5	1	1

11. Conclusion

Although finding a definition for culture is not easy, available cultural models and related dimensions can be used in cultural customization of mobile devices. Inspired by an integrative approach of the culture-oriented design, the proposed solution in this research can give valuable and detailed information about users' tendencies toward components of mobile communication devices, based on their cultural specifications. The simple and categorised structure of this solution makes its communication with OO configuration systems easier. However, an experiment demonstrated that attention to the combination of these components as "a product" is quite important, and cultural customization is not limited to the selection of the most desirable components (static design) or even the selection of the most pleasurable and usable usage scenarios (dynamic design). "Gestalt" of products is still a dominant factor, while other aspects such as technologic features and virtual entity make the cultural customization process more complex. Further research in this field should address two important areas. First, developing similar solutions for dynamic (behavioural) OO design and the interaction between static design, dynamic design and other parts of an OO configuration system. This can be done by using OO tools such as UML (Unified Modelling Language). A second direction is to find ways for considering aesthetics (in a comprehensive and detailed manner) for cultural customization. As the experiment shows, breaking down the aesthetic characteristics to simple/ raw components such as form factor or colour brightness and temperature would not necessarily end in valid results. Researching available models for analyzing products' aesthetics, and connecting them to the current findings of OO design may provide one of the solutions.

Acknowledgement

The authors would like to appreciate Sana Hajiali, because of her great help in conducting the survey in Tehran.

References

- Advanced Visual Interfaces, AVI 2002, Trento, 2002, pp 15-27*
Hofstede, G., "Geert Hofstede Cultural Dimensions", Retrieved Sep. 27, 2009 <http://www.geert-hofstede.com>
Hvam, L., Mortensen, N. H., & Riis, J., "Product Customization", Springer, New York, US, 2008.
Kamppuri, M., Bednarik, R., Tukiainen, M., "The expanding focus of HCI: case culture", *Proceedings of the 4th Nordic conference on Human-computer interaction: changing roles, Vol.198, 2006, Oslo, pp 405-408.*
Kantar Media Research Group , "Mobile Phone Market Booms in Iran", *kmr group update, Early Spring 2007, Vol19,2007, Retrieved Sep.27,2009 form: http://www.tgisurveys.com/news/kmrupdate/KMRUpdate19_2.pdf*
Kaplan, M., "Introduction: Adding a Cultural Dimension To Human Factors", *Advances in Human Performance and Cognitive Engineering Research, Vol. 4., Elsevier, Amsterdam, 2004, pp XI- XV.*
Marcus, A., "User-interface design, culture, and the future", *Proceedings of the Working Conference on Rose, K., " The Development of Culture-Oriented Human Machine Systems: Specification, Analysis and Integration of relevant Intercultural Variables", Advances in Human Performance and Cognitive Engineering Research, Vol. 4., Elsevier, Amsterdam, 2004, pp 61-103*
World Bank, "World Development Indicators 2009", *World Bank Publications, New York, US, 2009.*

Bijan Aryana
PhD research fellow
Norwegian University of Science and Technology/ Department of Product Design
Produktdesign*343, Kolbjørn Hejes vei 2B, 7491 Trondheim, Norway
Telephone: +47 73590115
Email: bijan.aryana@ntnu.no

Paper 4.

Aryana B., Boks C. & Navabi A. (2011) *Possibilities for Cultural Customization of Mobile Communication Devices: The Case of Iranian Mobile Users*. Lecture Notes in Computer Science, Human Centred Design, 6776/2011, 177-186.

Is not included due to copyright

Paper 5.

Aryana B. & Clemmensen T. (2013) *Mobile Usability, Experiences from Iran and Turkey*. International Journal of Human Computer Interaction, 29(4), 220-242.

Is not included due to copyright

Paper 6.

Aryana B. & Clemmensen T. & Boks C. *Users' Participation in Requirements Gathering for Country-specific Customization of Smart phones in Emerging Markets*. Submitted to Universal Access in the Information Society.

Is not included due to copyright

Paper 7.

Aryana B. & Boks C. (2012) *Country-specific Customization of Smart phones for Emerging Markets; Insights from Case Studies in Iran and Turkey*. International Journal of Logistics Economics and Globalization, 4 (3), 179-196.

Is not included due to copyright

