JÙJŪ, AN ENABLING SOLUTION TO GUARANTEE DIGITAL INCLUSION IN THE PERSPECTIVE OF THE SMART CITY

Diego DALIA
Eindhoven University of Technology, The Netherlands

ABSTRACT

Shanghai is a modern environment in which modernity coexists with tradition. Expo 2010 provided a huge contribution to this transformation, accelerating its development and improving quality of life. Although, the rapidity in which these changes occurred created an imbalance that brought out the existing gap between social groups and urban areas.

Local government settled on the Shanghai Smart City project that prefigures the pervasiveness of technology in every aspect of urban life, in order to create a smart city.

In this framework of exhaustive renewal, I decided to investigate the effects that these changes will have on the citizens both before and during its implementation.

The aim is to understand if the users are ready to accept this umpteenth change that will have a great fallout on their lives.

The data collected during the research phase has been analyzed and interpreted in order to find design opportunities useful to develop an output along the design phase.

The final outcome is a computer based platform made to deliver an enabling solution that can guarantee to users digital and social inclusion in the perspective of the Smart City.

Keywords: product-service systems design, digital inclusion, social innovation, interaction design, service design

Contact:
Diego Dalia
Eindhoven University of Technology
Industrial Design
Eindhoven
5612AZ
The Netherlands
diedal@live.it

1   INTRODUCTION

Shanghai is a modern environment in which smart technologies; innovative services and a fast way of living coexist with tradition, local habits and basic living. Moreover it is the Chinese metropolis with the most open mind, in which East & West have found the right balance, providing opportunities and enabling solutions that satisfy any taste. Recently, Expo 2010 provided a huge contribution to this transformation, accelerating considerably the development of the city and providing inhabitants with a better quality of life. In spite of this, the rapidity in which these changes occurred created an imbalance that brought out the existing gap between different social groups and areas of the urban grid (Valsecchi et al, 2012). Often, what progress and technology try to solve and improve generates unexpected and latent problems. Social inclusion, quality of life, hygienic conditions, accessibility to services and urban spaces have been improved by the latest urban reform, but the glittering of modern districts and the impressiveness of their buildings should not make our eyes blind. China has changed its face rapidly in recent decades with a velocity that no other country in the western world can match. Modern urban infrastructures appeared from one day to the next, traditional houses disappeared and entire neighbourhoods radically changed their shapes, undergoing a transformation in the local social and lifestyle system. What citizens got from this transformation is undoubtedly the sign of progress; this change was necessary to make a metropolis such as Shanghai, which presently hosts 22 million of inhabitants, a more liveable environment; it was a way to manage an uncontrollable flock and to offer to almost every citizen his personal living space and those services that enhance the life in the city.

However, this kind of changeover cannot happen in such a brief time. Shanghai's inhabitants often accepted it passively: they had to adopt new ways of living, change their habits and learn to follow new rules. New generations responded positively, but the same did not occur with the older citizens and to those groups of inhabitants that, for reasons related to their level of education, budget restraints and any other motivation related to their social positions, answered back in different ways and are now subjected to its effects.

This recent transformation was only the starting point of a bigger one that is expected to happen in the next five years. The Shanghai Digital City project, was started three years ago, and counts on the adoption of latest technologies to provide innovative services to citizens. This project is the forerunner of another impressive change that will happen in 2015. Shanghai is one of a large group of worldwide cities that settled on a program to make the city smarter. Shanghai Smart City project prefigures the pervasiveness of technology in every aspect of urban life, the settlement of sensors and other actuators in the whole city, in order to create a smart environment that can control the city and its evolvement, aspiring to improve further on the quality of life (Z. Li, 2004). In this framework of exhaustive renewal, many interrogatives and doubts occur about the final results and effects of this plan. The local government is putting in a big effort to make everything possible and, with the investments done, the involvement of several actors as private companies and organizations, foresee the success of its bid .

In spite of this, we should also evaluate the effects that this change is going to have on the city. We should focus our attention on those citizens that are not friendly with new technologies, and that do not really need all the service solutions that are going to be provided to improve their lives. Moreover, we should care about the social relapse and the subsequent effect that it will have, as social inclusion and alienation due to the low knowledge level of technology.

2   RATIONALE

This research project originates from a preliminary research based on an in-depth observation of Shanghai's urban context, pushed by the aim of learning by osmosis from the environment, and simultaneously to collect information. My attention was drawn to several aspects that resulted relevant during the research phase. During a preliminary ethnographic research I focused my attention on citizens behaviors, on those habits that I later labeled as "unusual behaviors", like sleeping wherever, whenever or cutting the back of babies' pants in order to avoid the use of diapers. Moreover I tried to understand the environment and the elements that compose it, such as those machines installed on streets corners, useful to recharge the electric motorbikes or to refill the water tanks.

These signs are an evident demonstration that Shanghai is a city that has not yet digested the latest shifts; it seems like it has been forced to accept it, in order to become competitive with any other metropolis on the global scene. Even if a part of the population responded to this change positively,

using daily the new infrastructures and services offered, another big group is still tied to its habits, and in most of the cases ignore these solutions that could improve their lives.

In order to complete the whole scenario and have a clear idea of the general picture, I have added to the results of the the preliminary research, some information collected during my work experience at TekTao Urban Consulting. I had the opportunity to join a research project powered by Nokia, doing researches on inclusivity in low tech contexts, basic living in rural areas and the comparison between Shanghai's countryside and its urban areas. The existing gap between these two realities derives from the double speed with which the Country is evolving, creating an imbalance between its social groups (Valsecchi et al, 2012). This experience allowed me to enter in contact with a reality that is quite far from urban life and which trigged my interest over new topics that, later on, became the main focus of my research.

Even if we do not have two straight and well-marked group of users, but a mild and stratified structure, the inequality between rural and urban population is quite evident. More hidden instead is the discrepancy between Shanghai's inhabitants, where a larger number of factors play a key role.

In view of the Shanghai Smart City project, I have decided to investigate a series of topics that is related to its realization and the effects that it will have on the users both before and during its implementation.

The aim is to understand if the users are ready to accept this umpteenth change that, more than the ones which happened previously, will have a great fallout on their lives, enlarging their vision of the city and influencing the way they perceive and interact with it.

3   METHODOLOGY: A STRUCTURED USER CENTERED APPROACH

The whole design process has been conducted using a User Centered Design approach. Product/Service System design shares the same goals with it, since it emerged in a close relation with industrial design at the times when more holistic perspective towards users' needs and wishes gained emphasis by industrial designers and researcher (Holmid and Evenson 2006).

The first part of the research project has been dedicated to the understanding of the context and the identification of the design problem, adopting several methods useful to collect datas and analyze the users target. I started from an established knowledge about the urban environment, trying to understand better its weakness and the opportunities it offers. In order to clarify the scope of further design intervention both in the direction of devices then services design, I had to focus on a better definition of the potential, relevant and significant users. It is not possible to conceive Shanghai citizens as a unique and homogeneous typology of users, especially for the different level of technological knowledge.
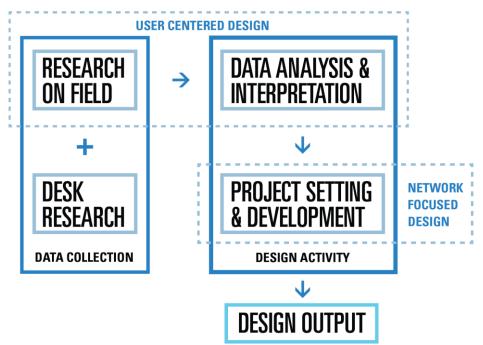

Figure1. Research's methodology structure

3

The methodology of research has been structured balancing qualitative and quantitative tools of inquires (Fielding, Schreire -2001); later on, followed a deep analysis of data collected through the use of the affinity diagram (D.W. Emerling et al. 2000). Their interpretation allowed defining the users target and the personas that represent it (K. Goodwin, 2009); scenarios building helped to understand the hypothetic situations in which they could operate and to generate some early concepts. The second part of the research started from the analysis of these concepts, taking in account the design opportunities founded. Through the placement of collected data into the scenarios matrix, I have been able to define a design direction useful to develop a complex system made of product and services, a Product Service System (N. Morelli, 2002).

Three main topics of investigation have been chosen as guidelines, in order to have a clear vision of the research topic and the context of inquiry.
- Urban living and future "smart perspectives"
- Shanghai, a real context: current living, existing solutions, services & opportunities, technology presence for a better quality of life
- Technology knowledge, social interactions and digital inclusion

The data collected during the research phase has been analyzed, interpreted and organized in order to find design opportunities useful to develop an output along the design activity.

The final outcome is a strategic solution in a computer-based platform, open to users with several levels of technological knowledge. The aim of the project is to deliver to citizens an enabling solution that guarantee digital and social inclusion in the perspective of the Smart City.

3.1 Desk Research

Desk research has been established in order to collect, summarize and organize available information on the research topics. A review of the existing literature has been done to gather information about the development of Smart Cities worldwide (M. Da Costa Lobo et al., 2010) and in China (Z. Li, 2004), and data sources on chinese mobile market and users current behaviour trends (Mc Kinsey - 2011). Particular attention has been given to the current and future development of the city of Shanghai, to the way users approach and use technology in China, and the services settled to improve the quality of life in urban areas; data referring to enabling solutions that offer new services to citizens through the use of Information Technologies also have been consulted (F. Casalegno et al., 2000). Relevant case studies have been selected taking in account the way they imply the use of communication devices and relative apps; they have been analyzed in order to understand which possibilities they offer in social innovation and entrepreneurship, and the digital inclusion of inaccessible users (Valsecchi et al., 2012). This research brought some conclusions. The ultimate goal of a smart city is to deliver sustainable prosperity for its citizens. Cities stand on the cusp of their century, with new power and new responsibility, economically, politically and technologically. Cities must use new technologies to transform their systems into smarter systems that optimize the use resources. So, a city is defined "smart" when the investments in human and traditional resources, and ICT infrastructures generates a sustainable economic development, able to improve citizens lives. (IBM, 2012). In order to realize a smart city is necessary to have a perfect synergy between the stakeholders and the actors involved in the process. So, we can say that a city works in a smart way only when these agents interacts with each other and their role is complementary, offering enabling services to the citizens, that are the main users.

3.2 Research on Field

Designers should consider besides the aesthetics, production and usability also user experiences, which binds user, product and use context together. User Centered Design places users in the hearth of the design process highlighting user needs as driving forces in design. (K. Vaajakallio et al, 2009). The research was made in order to define the users target according to their technological literacy, devices' context of use, and their personal habits and needs. The chart below (Figure 2) summarizes the tools designed and used to acquire data related to the users target.

	Tools	Objectives	Strategy		Contents			
			Analyze	Explore	Habits	Devices	Literacy	Interaction
DESK RESEARCH	trend spotting	general context understanding	X		X	X		X
	existing literature	technology scope	X			X		X
	case studies	smart city/citizen relationship		X		X	X	X
FIELD RESEARCH	in-depth interviews	tech literacy, user behaviour		X	X	X	X	X
	On line Survey	tech literacy, user behaviour		X	X	X	X	
	Postcards (focus group)	technology literacy,user behaviour smart city/citizen relationship			X	X	X	X

Figure 2. Research Tools used during the research phase

The experience of using a product or service is always related to the people who use them and the context were the interaction takes place. Thus it's important to identify who is the user we are designing for and take that into consideration in design (K. Vaajakallio et al, 2009). The first part of data collection has been conducted in order to gather relevant data about the users target and understand properly who is part of it. I did a research on field mixing several techniques useful to collect data. I had the chance to enter in contact with Shanghai's citizens and understand all the existing diversities between local people. Every district of this huge urban centre hides a "small world" with its own inhabitants. Different ways of living in several type of housing (medium height buildings, skyscrapers, and traditional houses with some services in sharing), and consequently diverse living standards that highlighted a socio-economic discrepancy. In-depth interviews have been conducted between citizens with a medium-low standard of living. Verbal communication helped to ease off and creates empathy. Through several questions, it has been possible to investigate about their habits, the relationship with communication devices and technology and the way they interact with the city. The results collected confirmed some of the primary insights about their approach and confidentiality with technology. An on-line survey allowed to reach a group of users different for lifestyle and habits from those met around the city. From the data collected is possible to deduce that this group of citizen has a higher level of technological knowledge and a more familiar approach to smart devices. They use them frequently in their daily life, both for work reasons and pleasure. Users shadowing helped to understand from a different point of view their behaviors respect the use of tech devices. Many users showed a different attitude compared to what declared in the interviews.This data helped to look at the problem from a different angle and have a complete vision of users target. A focus group organized with TekTao design research team helped to approach users differently and to stimulate their interest about the research topic, focusing their attention on several specific aspects that have not been treated in the in-depth interviews. A series of cards have been designed to enhance their participation and help them to discuss about some particular needs and problems that emerged from the previous data collection (Valsecchi et al. 2012).

4   TARGET DEFINITION

Throughout the first research phase, several people living in different areas of the city have been interviewed. Information about their lifestyles has been collected in order to understand needs and problems. Data collected showed a remarkable difference over their technological literacy and the way they use technological devices.

Three big clusters have been identified; they are useful to group those users that present similar characteristics, like behaviours, the type of communication device owned and their social connections. The results founded through the primary analysis were fundamental to understand how much technology influence their lives and their proneness to adopt it in order to experience differently the city in which they live, that is going to become smart in a very short time. The users target identified has been divided in three subgroups labeled as "Flat", "Clever" and "Smart". Each of them represent

their level of tech-knowledge, according to the type of devices they own and use, the relationship they have with technology and the way they use it. The chart below (Figure 3) represent graphically this subdivision. These cluster are a guideline to better understand the target and do not represent an absolute value that is valid for all the users.
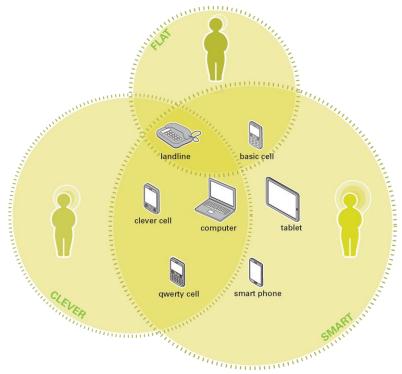

Figure 3. Target definition chart

5   FROM RESEARCH METHODOLOGY TO CONCEPT DESIGN

Through ethnographic research and users target analysis I have been able to get a complete overview of the general topic. The design guidelines identified with the affinity diagram allow to chose two couples of polarities useful to build a scenarios matrix. The first axis includes the polarities "Private/Personal" and "Public/Community Sharing"; they represent the way in which users will adopt and use the enabling solution. The other axis is made of the other couple of polarities, "Intangible/Virtual interaction tools" and "Analog/Smart interaction tools"; it identifies the kind of tool that users are going to use in several situation, such as tangible communication device or an intangible service. In the four areas of the matrix are represented the four scenarios that come out from the combination of these polarities. Each scenario represent a specific situation of use of the artifact that is going to be designed.

The data found through the analysis of the existing literature and those that have come out from the ethnographic research helped to reframe the topic and to enhance the problem understanding, in relation to the scenarios developed. At first sight we can notice that this troubles are based on two different sides: *'Setting and management of the System'* and *'Usability and users involvement'*.

Local governance could administrate and take care of the first problem identified, setting the projects with a large scale of action, and using resources provided by external and private companies that require citizens participation only after their fulfillment. This fact highlights that those users who are not trained in the use of smart services/devices, will be indirectly counted out of the smart system. Training and awareness programs could solve these issues.

The problems identified so far, and the personas defined in the research and analysis phases have been positioned on the scenario matrix in order to figure out which scenarios results more significative for the development of the a design concept.

6   CONCEPT OUTLINES

Data collection is one of the hardest problem to solve in a smart city system. Data come from different source and are not easy to interpret and manage. Thus there is a remarkable quantity of data that gets

lost because there is dissimilarity between the system that receive and the tool that provide it. So it is necessary to design a system that allows users to insert data and have access to it through the devices they are equipped. The system will send a codified message that will allow the communication between the several types of users, generating information customized according to the device that has to receive and read it. This solution will allow users with low tech-knowledge to use differently their device and have access to the smart system in a more effective way. Users will adopt different type of devices and will provide several kind of information. Smarter is the device, heavier and more complex will be the set of data sent. At same, the data that the server will send back will be equally elaborate according to the device features (Figure 4).

This solution will allow several kinds of users to send and receive data from the system guaranteeing their accessibility. The design activities that will happen in the last phases of the project will provide, as final output a set of services developed specifically for each group of users, in order to provide a tool that they will able to use through the devices they already own.
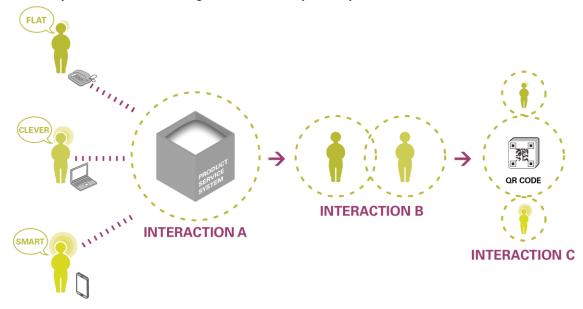

Figure 4. Product-System Interaction

7   PRODUCT SERVICE SYSTEM DEVELOPMENT

From a traditional marketing perspective the notion of Product Service System (PSS) originates from a shift of focus from marketing products to a more complex combination of products and services which support production and consumption (Manzini, 1993). The design concept previously described has been developed in an artifact that refers to the idea of PSS that comes from Meier and Massberg (2004). They assert that a PSS provides solutions that integrate products, services and business models. The name chosen to identify the PSS and its values comes from the Chinese verb *jùjū*, that means *to live in a community; to inhabit in a region*. Communities are an important feature of Chinese society but, due to urban and social changing factors, they are disappearing. A community in a neighbourhood guarantees social cohesions and gives to citizens sense of ownership to the place, creating a stronger link to it and between users. Neighbourhoods in Chinese modern urban centres could be compared to "regions" for the high density of their population, so the verb represent perfectly the idea of a community that is living and is settled in a precise place. The aim is to create awareness between districts' dwellers (neighbours) on existing resources (human and physical) in the changing context of Shanghai's urban area. It was created to be an open service based on a wide growing community, where everyone can join up, shares and upload notices and activities to improve communication between strangers and create new relationships between them. *Jùjū* wants to create awareness on the value of each person who is living in the district. Through the exchange and supplying of personal skills, expertise and generic abilities, each user can provide to the community the "best of himself" and cover a position inside the local community. Moreover, since existing local communities are disappearing, the service will enhance their reinforcement and the creation of new ones, creating connection between neighbours that have never been in contact before.

The system is based on several types of touch points, that are an app for smartphone and tablets, a web platform, a clever phone app, a community card powered with RFID, and a booklet to explain its use. Each of them has been developed in order to allow users with different "tech- knowledge" to access the services through the devices that they already own, guarantee e-Involvement & technological accessibility (Figure 5). In the expectation of the Smart City, it enables users to have access to a virtual system and avoid any type of frustration, combining analog and digital interactions. The system wants to improve the idea of the community in a local district and, at the same time, it sets a strategy useful to make users aware of the role of technology in the next future. Learning through experience how to use a digital based system, they will become aware of its potentialities and gradually prepared to use more complex services.

At last, through this usage, they will implicitly collect and provide data to the smart city system.
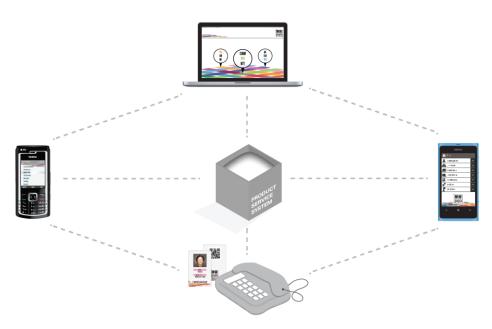

Figure 5. User-System Interaction

8   CONCLUSIONS AND FUTURE DEVELOPMENT

Jùjū is a Product Service System (PSS) that was conceived as a solution that can be implemented in the present context in order to satisfy some needs and create new opportunities for users. The factors that have driven the project conception and development have already been widely described so far.

Current users need & problems, plus a far-sighted vision of the changing reality that takes in account of the smart city project implementation pushed the PSS towards a growing direction. Technology's progress, new needs that derive from the smart city, and users tech-knowledge improvement should be taken in consideration. In this vision, some possible alternative solutions, which could be adopted in the next future, have been evaluated. they are substitutive alternatives that will keep the project functioning in the next future, avoiding any possibility of obsolescence and impropriety with the current context and scenario.

The possible solutions have been inserted in a timeline, that shows how the level of accessibility of the users could change due to different enabling solutions adopted - both services or products.

1. basic community card with qr code + booklet

2. community card with rfid
- it contains users profile with personal information
- allows to register to events & activities through an rfid reader
- allows to exchange contact info with other users
- allows to collect information through the interaction with smart objects as smart posters and other metaproducts

3. community card with advanced RFID (RFID+)
- integration of transport system profile
- integration of health system information
- access to egovernment platform & services
- connect the card to your bank account to realize controlled micro payments

4. metaproduct (Internet of things devices)
- gather automatically information from the environment
- improve exchange of information through automated interactions between users
- integrate functions previously developed

REFERENCES

S. Cordoba, W. Hazenberg, M. Huisman (2011) Meta Products : meaningful design for our connected world, Amsterdam, BIS

M. Da Costa Lobo (2010) Smart Cities/Smart People, Guiding Ideas, Lisboa

D. W. Emerling, L. B. Hare, R. W. Hoerl, S. J. Janis, J. E. Shade, (2000) Improving Performance Through Statistical Thinking, McGraw-Hill

Evenson S, (2005) Designing for Services - Proceeding of the Designing Pleasurable products and interfaces conference, Pages 149-161, Eindhoven, Netherlands

N. Fielding, M. Schreirer, (2001) Introduction: On the Compatibility between Qualitative and Quantitative Research Methods, Forum Qualitative Social Research, Volume 2, No. 1, Art. 4 – February 2001, Available online at: http://www.qualitative-research.net/index.php/fqs/article/view/965/2106

K. Goodwin (2009) Designing for the Digital Age: How to Create Human-centered Products and Services, John Wiley & Sons

S. Holmid, S. Evenson (2006) Bringing design to services - IBM Service Sciences Management and Engineering Summit: Education for the 21st century - October 2006, New York

IBM, (2012) Learning from Leaders, the smarter Cities Leadership Series, Shanghai, ibm.com /smarterplanet /us /en /smarter_cities /cities

IDEO, (2010) Human Centered Design Toolkit, A free innovation guide for social enterprises and NGOs worldwide, http://www.ideo.com/by-ideo/human-centered-design-toolkit.

Z. Li (2004) Socioeconomic transformations in Shanghai, 1999-2000, Cities in China, the next generation of urban China researchers, Hong Kong Baptist University, Hong Kong, Dec 2004, http://mumford.albany.edu/chinanet/events/past_conferences/hongkong2004/lizhigang_text.pdf

D. Lin, L. Narasimhan, J. He - Mc Kinsey & Company (2011), Understanding China's digital consumers, http://www.mckinseychina.com/wp-content/uploads/2010/10/understand_china_digital_consumers.pdf

E. Manzini (1993) Il Design dei Servizi,La Progettazione del Prodotto- Servizio, Design Management, 4, pp. 7–12. Politecnico di Milano, Milano

A. Meroni (2007) Creative communities, People inventing sustainable ways of living, Politecnico di Milano, Milano, http://81.246.16.10/videos/publications/creative_communities.pdf

H. Meier, W. Massberg, (2004) Life Cycle-Based Service Design for Innovative Business Models, CIRP Annals - Manufacturing Technology

F. Casalegno, W. J. Mitchell (2000) Connected sustainable cities, USA, MIT Mobile Experience Lab Publishing, http://connectedsustainablecities.org/downloads/connected_sustainable_cities.pdf

N. Morelli (2002) Designing Product/Service Systems: A methodological Exploration, Design Issues, Vol. 18, N° 3, pp 3-17, The MIT Press

N. Morelli, (2002) The design of Product/Service System from a designer's perspective - International Conference Common Ground 2002, Melbourne, Australia

A. Osterwalder, Y. Pigneur (2009) Business Model Generation, John Wiley & Sons, USA

O. Rexfelt, V. H. Ornäs (2009) Consumer acceptance of product-service systems Designing for relative advantages and uncertainty reductions, Journal of Manufacturing Technology Management, Vol. 20 No. 5, pp. 674-699

Vaajakallio K., Mattelmaki T., Lehtinen V., Kantola V., Kuikkaniemi K. (2009) Literature Review on Service Design, eXtreme DEsign project, Helsinki University of Technology & University of Art and Design Helsinki, Helsinki

F. Valsecchi, S.Pollastri, Y. Lou, D. Dalia (2012) 'Mobile Marketplace. Designing Digital Devices to Connect Rural & Urban China', DRS2012 Bangkok - Research: Uncertainty, Contradiction and Value, Bangkok, July 2012 Design Research Society

B. Verplank (2003) Interaction Design Sketchbook, http://www.billverplank.com/IxDSketchBook.pdf

G. Vijaykumar, R. Rajkumar, A. Lelah D. Brissaud (2011) A review of Product-Service Systems Design Methodologies - Journal of Engineering Design 23, 9 (2012) pp 635-659