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CONSUMER NEEDS ON SMART ARTIFACTS FOR THEIR DREAM LIVES

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ABSTRACT
The purposes of this study are to search for consumer needs on smart artifacts for their dream lives by the Generative Tools and to give insights for designers of innovative and creative products and services. Fourteen participants are divided into three groups and actively participated in three-step-sessions of the Generative Tools with workbooks, collages, and 3D modeling. All the voices expressed in the three steps are recorded and transcribed into Excel files. The statements containing any clues of consumer needs are highlighted and mutually exclusive need statements are extracted with a series of bottom-up clustering until no more clustering is possible.
As a result, 159 extended needs are extracted and categorized into 14 sub-attributes and, finally, into five main attributes. The main attributes that are required for fulfilling their needs on smart artifacts for their dream lives are Empowering, Efficiency, Ubiquitous, Boostering, and Peacefulness. The results imply designers and developers to take importance in improving functionality to usage whenever is wanted in life and in focusing on parts that could be self-controlled and self-made, and even sensitive and aesthetic.

Keywords: user centered design, innovation, new product development, consumer needs, dream life

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1 INTRODUCTION

Consumers always dream of a better life. Great designers and developers seek to accurately determine consumer needs and attempt to reflect them in every way. They constantly pursue innovation and try to attract consumers with new products. In spite of these devoted efforts, not all new and innovative products are chosen by consumers. This implies that, in order for new products or services to succeed, there should be a focus on new features rather than existing ones. This study focuses on smart artifacts, and explores a rich collection of contemporary consumer voices about their future dream lives and the necessary characteristics of smart artifacts to achieve the dream. The concept of smart artifacts encompasses products and services for the smart life of consumers.

Successful human-centered design demands profound knowledge of consumers and their needs. In order to understand the real needs of consumers, a designer's goal is not to be led solely by the expressed needs of consumers, but to amaze them by anticipating and fulfilling their unarticulated needs as well (Kim, 2012; Hamel and Prahalad, 1994).

This study employs Sander's Generative Tools on Korean consumers in order to extract their latent needs. The methodology allows us to describe the future smart lives of consumers, thus extracting the idea of what constitutes optimal smart artifacts according to consumers. The extracted information is then categorized through a bottom-up method, providing necessary characteristics about the development of future smart artifacts.

2 BACKGROUND

2.1 Research on consumer needs

Current market circumstances have motivated user-oriented (friendly) design to occupy a critical role in the field of product design in order to actualize the needs of users with appropriate products. This shift is reasonable when it comes to Archer's definition of design (Archer, 1984), namely, that design begins with a need, which involves a design problem. The primary goal of product design is developing products to satisfy human needs, which rests on the capability of designers to understand those needs. Because designers are concerned with the needs of users, knowing how to capture those needs is crucial for designers in the process of new product development.

Current tools for participatory design fields include cultural probes, Generative Tools, and context mapping, each of which provides a view to reveal latent needs and future states. These techniques focus on what people make with unique toolkits. This helps researchers capture the tacit and latent needs of consumers (Kim and Hwang, 2010).

2.2 Generative tools

Consumer needs are composed of four levels of expression (Figure 1). Explicit needs refer to the needs of which people are aware and can express explicitly. Observable needs are needs that are not easy to be expressed, however, which can be figured out through consumer behavior. Tacit needs are needs that consumers might be able to recognize when confronted with a visual representation of aspects they want. Latent needs are needs of which consumers are unaware, but which consumers are able to imagine. As the level of need gets less superficial, it is easier to understand the needs of consumers, but only improvements rather than innovations can be accomplished in new product design. Accordingly, extracting the latent needs that are embedded within consumers may be the appropriate way to approach an understanding of what consumers want.

Generative Tools (Sanders, 2001a) describe one of the methods that focuses on what people "make" rather than what they say or do (Sanders and Colin, 2001). Participants in a Generative Tools-focused research express their tacit and latent needs by making and telling stories about their own artifacts with a given toolkit (Sanders, 2001b). The toolkit contains various simple and ambiguous components for supporting the free expressions of participants regarding their experiences, hopes, and dreams (Sanders, 2000). A Generative Tools (GT) method is composed of four steps: preparation, individual sessions for sensitization or immersion in the experience being investigated, group-session exercises with collage toolkits for activation of feelings and memories together with modeling toolkits for expressing ideas and dreams, and finally, analysis of all the artifacts and storytelling (Kim and Hwang, 2010; Sanders and Colin, 2001).

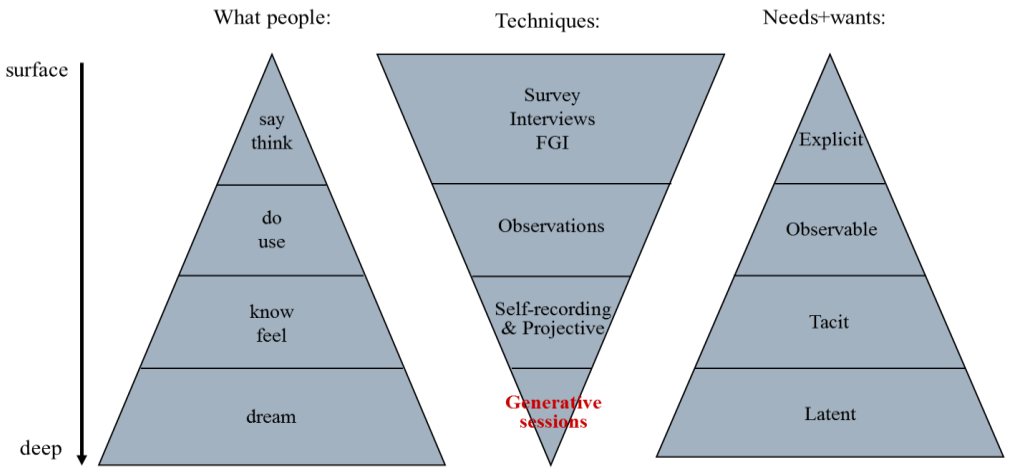

Figure 1. Levels of expression of needs

3 RESEARCH METHOD

3.1 Preparation

Any GT session is divided into an individual session and a group session. The individual session is made up of several questions that enable session participants to recollect past-to-present daily experiences so that they are able to concentrate on the subject matter when creating a workbook. The group session is composed of two stages, including a collage stage and 3D modeling stage. In the collage stage, the participants are encouraged to use various words, symbols, and images in a sticker form to express their experience and thoughts about products or services that they have used. In the 3D modeling stage, the participants are asked to use various materials to express their future dream lives in three-dimensional form.

To obtain GT participants for this study, 14 general consumers with diverse user experience regarding products and services were recruited. The research participants were divided into three groups, with each group comprised of four to five research participants. The ages of participants ranged from 20 to 50 years.

3.2 Individual session

The workbook stage is an individual activity stage for the immersion of participants in a theme, in order to derive the thematic experiences of participants. Having participants fulfill workbook-based guidelines causes immersion in their relevant experiences and needs.

The individual session in this study took five days, including workbook completion days. In the workbook, the questions are divided into two parts, including common questions and additional questions. The common questions deal with the experiences of participants about their use of products and services in their daily lives. This makes participants immerse in their actual past-to-present experiences. To enable the participants to express what happened today, the workbooks in this study constructed questions with time flow arrows, time schedules, and a diary format.

Additional workbook tasks include questions that ask participants to describe interests, troublesome matters, working experiences, and innovative products that have caused changes in their habits and that introduce a participant's know-how in their living experience. These tasks trigger participants to think in more detail about their past-to-present experiences. Figures 2 and 3 are sample images of workbook results used in this study.

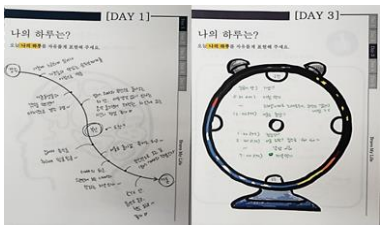

Figure 2. Common task

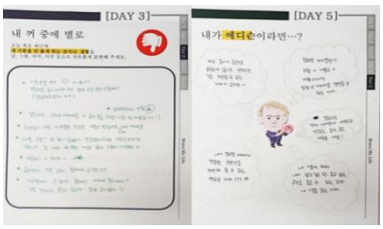

Figure 3. Additional task

Before the group session, participants underwent individual pre-interviews about their workbooks. They explained how they did their workbook by date, and some questions followed their storytelling for more detailed explanations.

3.3 Group session

3.3.1 Collage

After completing the workbook and pre-interview tasks(i.e., storytelling about workbooks), participants had a group session. In the first step of the group session, they made a collage to express their experiences and feelings about using products and services in everyday life. Each participant was provided with many tools to utilize, including about 90 words, 36 symbols, 126 images, and 18 blank labels. With these various tools, the free creation of collages was encouraged for approximately 30 minutes. Then the artifacts of participants were shown to other participants and thoroughly explained. The collage step is shown in Figure 4.

Figure 4. Collage making and storytelling

3.3.2 3D Modeling

In the 3D modeling session, participants used toy clay, colored paper, and many other materials to design and create something smart, including products and services, to fulfill their dream lives. Participants were encouraged to make innovative and creative products to represent services they desired in their future lives. They worked on smart products and services as if they were producers or designers for approximately 30 minutes. Artifacts from this session were created out of a need to express their own dream lives. They subsequently participated in storytelling about their modeling. The entire process was recorded on video, with some scenes captured in photos, by agreement. The 3D modeling step is shown in Figure 5.

Figure 5. Model making and storytelling

3.4 Analysis process

During the group session, all the conversations and interviews among the 14 participants were recorded for research purposes with the consent of participants in advance. At the beginning of the analysis process, all parts of the recording were transcribed into an Excel format. The analysis process was carried out with a bottom-up method through three steps, as shown in Figure 6.

Step1. A researcher parsed all of the transcribed contents and interpreted the information in consideration of context and nuances. Redundant contents were deleted, however, similar contents with different contexts or nuances were allowed to remain. After interpretation, researchers cross-checked every result in entirety. As a result, 159 extended needs that may be applied in the development of smart artifacts were extracted.

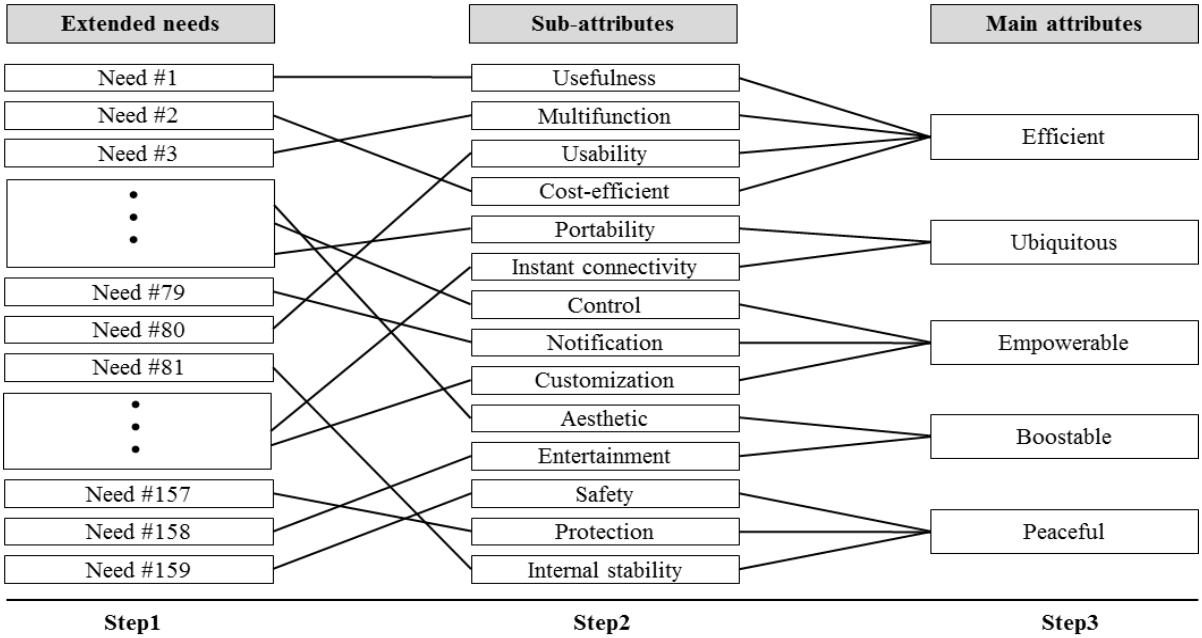

Figure 6. Bottom-up needs analysis process

Step2. As extracted, the 159 extended needs were then categorized into 14 sub-attributes through a bottom-up method. Respective attributes were not intentional, but rather empirical, based on common attributes. The 14 attributes are defined as follows.

Table 1. Meanings of sub-attributes

Sub-attribute	Definition
Control	Able to control user's psychological and physical condition
Notification	Giving advice, or notifying user of information appropriate to the situation
Customization	Customize to personal use
Usefulness	Functional and convenient
Multifunction	Multi-functioning
Usability	Easy to use
Cost-efficient	Economical, cost-efficient
Portability	Easy to use in mobile situations
Instant Connectivity	Accessible anytime, anywhere
Aesthetic	Demonstrating one's unique characteristics, fancy
Entertainment	Enjoyable
Safety	Preventing information leakage or theft
Protection	Protection from danger
Internal Stability	Stabilizing feelings or state of mind

Step3. The 14 sub-attributes were then categorized into five main attributes. As in Step 2, the attributes were not intentional and were assigned based on similar attributes. The five identified main attributes are as follows.

Table 2. Descriptions of main attributes

Main attribute	Description
Empowering	Enhancing capability levels of an individual in innovative ways
Efficiency	Efficient usage, improving inconveniences
Ubiquitous	Ready-use everywhere
Boostering	Making one's life energetic as well as enjoyable
Peacefulness	Pacifying mind and body

In the course of categorizing the sub-attributes, an important attribute that emerged was the enhancement of individual ability, which is identical to the "Empowering" attribute from a previous study. Accordingly, the attribute was used once again (Kim, 2012). The attributes were then organized into a matrix with a representative attribute from each category.

4 RESULTS

As a result of analysis, the frequency of each attribute is shown in Table 3. Empowering showed the highest frequency of identification as a consumer need at 36.48%, and among its sub-attributes, Control and Notification showed 18.24% and 16.35%, respectively. This shows that the ideal smart product should help consumers to manage their lives or should provide them with appropriate information for various situations. Efficiency showed a high frequency of 32.08%, and among its sub-attributes, Usability showed the highest frequency of 13.84%. This shows that convenience and usability are important qualities in a smart product. Ubiquitous was the third-highest main attribute. Given that smart products emphasize telecommunication features, this shows that accessibility is an important feature in smart products. Boostering and Peacefulness showed low frequency among specified consumer needs, yet they are unique attributes. This finding shows that consumers seek emotional happiness and psychological stability through smart products. The next sections provide more specific details on each of the main attributes.

Table 3. Matrix of the frequency of consumer needs

Main attributes		**Sub-attributes**	
Attributes	**N (%)**	**Attributes**	**N (%)**
Empowering	58 (36.48%)	Control	29 (18.24%)
		Notification	26 (16.35%)
		Customization	3 (1.89%)
Efficiency	51 (32.08%)	Usefulness	10 (6.29%)
		Multifunction	14 (8.81%)
		Usability	22 (13.84%)
		Cost-efficient	5 (3.14%)
Ubiquitous	31 (19.50%)	Portability	15 (9.43%)
		Instant connectivity	16 (10.06%)
Boostering	4 (2.52%)	Aesthetic	2 (1.26%)
		Entertainment	2 (1.26%)
Peacefulness	15 (9.43%)	Safety	5 (3.14%)
		Protection	2 (1.26%)
		Internal stability	8 (5.03%)
Total	159 (100%)	Total	159 (100%)

4.1 Empowering

Contemporary consumers like to be in control when using products and services. This is different from the established notion that consumers prefer utility, multi-functionality, and cheap prices in order to improve their lives. The definition of the Empowering attribute is the relinquishment of control to consumers so that they can do whatever they please. Empowering is divided into sub-attributes of Control, Notification, and Customization. Control is described as a product or a service to help consumers control and manage their lives, and this category shows the highest frequency among specified consumer needs. The main needs in this category include weight or time management services, or a credit card overuse prevention system.

The case of Notification involves the notification of consumers regarding various information about themselves or other things, and consumer need for this feature shows the second-highest frequency. Features in highest demand among consumers include lost-item notification, road navigation systems, or restaurant information. Regarding Customization, participants want products that suit their individual needs for housing and indoor activities. Representative consumer needs for the Empowering attribute are shown in Table 4.1.

4.2 Efficiency

The results show that consumers still emphasize convenience in product usage. Efficiency is a collection of needs for the efficient improvement of existing inconveniences, and it is categorized into four sub-attributes, including Usefulness, Multifunction, Usability, and Cost-efficient categories. Usability shows the highest percentage among these four categories of specified consumer needs, at 13.50%. This percentage demonstrates that consumers indeed focus on convenience in product usage. Multifunction and Usefulness resulted in 8.59% and 6.13%, respectively, showing the relative demand

of consumers for various functions in one product and the practicality of a product. Table 4.2 indicates all of the representative needs for the attribute of Efficiency.

Table 4.1. Representative consumer needs (Empowering)

Control (18.24%)	I wish there was a very effective tool to help me quit smoking instantly.
	Highly concentrated oxygen capsules or a bed to instantly induce deep sleep would be great.
	I always carry mints or gum before going to work. These help a lot when I have to talk for a long time.
	A growing device would be great so I can grow organic vegetables at home.
	Something to control my diet would be nice.
	A comprehensive time-management device would be nice.
	I wish there was some sort of eraser to erase unwanted memories.
	A device that controls credit card usage would be nice.
	Alarm-integrated pillows for people that have trouble waking up in the morning like myself.
	A device that transforms one into a "morning person" by controlling wake-up time would be nice.
Notification (16.35%)	I want to know what kind of activities or foods will help me wake up in the morning.
	It would be great if there were devices that record the barcodes of various objects in order to alert me when something is missing.
	A device that checks for missing objects before leaving the house would be great.
	It would be great if there were devices to show how many people are on a subway, or the number of empty seats.
	It would be great if I could record where I parked my car on something like my car key.
	A traffic information app or transportation app is very convenient and saves time.
	People ask for advice from friends when making decisions. I wish there was a device that could provide the same function.
	It would be nice if a pair of glasses could provide information on the glass like an airplane windshield.
	A device that tells what others think or feel would be great.
	A way to search and download coupons on a phone.
	I often use my phone to search for restaurants or coupons for a date.
Customization (1.89%)	A high-technology home full of smart gadgets would be nice.
	A bed, sofa, or chair made out of an elastic material would be nice. A personalized chair would be nice too.
	Sports are a great way to get to know people. I wish there was a virtual sports environment at home so that I could play with other people.

4.3 Ubiquitous

Ubiquitous is an attribute that describes a collection of needs emphasizing ready-use quality, and it is categorized into sub-attributes of Portability and Instant Connectivity. Portability exhibits a frequency of 9.20% among specified consumer needs. Instant Connectivity reflects the needs of people who want to take care of daily business remotely. These findings are probably due to the tendency of consumers to associate the keyword –smart– with smart phones exclusively. Representative consumer needs regarding the Ubiquitous attribute are shown in Table 4.3.

4.4 Boostering

This attribute shows that, when picturing their dream lives, consumers want not only functional aspects to technology, but also aesthetic entertainment. The Boostering attribute describes needs regarding energy boosts or enjoyable goods or services, mainly including sub-attributes of Aesthetic and Entertainment categories. The characteristics in highest demand include features that are fancy or that satisfy all senses. Representative needs for the Boostering attribute are shown Table 4.4.

4.5 Peacefulness

The Peacefulness attribute represents products or services that pacify a user's mind and body, and it is categorized into Safety, Protection, and Internal Stability. Safety describes the need to secure oneself and one's surroundings, mainly in terms of door locks and privacy issues. Protection means protecting and taking care of weak people via products designed to locate and identify the children of users or the elderly from a distance. Internal Stability stands for options that pacify a user's mind and mood, such as providing suitable scents or music for different moods. These results are meaningful in that not only common preferences for functional aspects, but also for emotional aspects of technology, have caused

an independent attribute to emerge among consumer needs. Table 4.5 indicates representative needs for the attribute of Peacefulness.

Table 4.2. Representative consumer needs (Efficiency)

Usefulness (6.29%)	It is uncomfortable when a navigation system indicates the wrong way.
	It might be useful to have a reservation service for test-driving or repairs using an application.
	It would be great to be able to move in three dimensions, especially in places with horrible traffic jams.
	I sometimes jot down ideas or record them on the phone. But it would be better if I could just transfer and save my ideas directly.
	There are a lot of translating tools out there, but I have to write everything down word by word. An application that translates what I say in real-time would be great.
	I wish I could just insert a chip in my brain and transfer knowledge back and forth so that I would not have to spend time studying.
	It is very hard to download large-sized files on smart phones.
	Bigger screens are useful when watching YouTube videos with kids on the road.
Multifunction (8.81%)	A mirror function on cellphones would be nice.
	It would be nice if I were able to sync my car key with my smart phone so I could easily find where I parked my car.
	A machine that immediately records my ideas would be great.
	After a long, hard day, it is very tiresome to take a shower and change cloths. I wish I could do these things in bed.
	Galaxy Tab is convenient when it comes to viewing documents, but it is hard to edit or create new documents. Feasible editing features would be nice.
	Cell phones should have scanning functionality.
	It would be great if a cell phone, a clock, and a commuter pass were in one gadget.
	iPhones need a real-time radio function.
	Three-dimensional video chats would make calls more lifelike.
Usability (13.84%)	It would be great if a robot could create any dish I want, anywhere, with a single touch on a screen.
	(At work) it would be great if a robot would bring me dishes that I have selected on a touch-screen.
	Fingerprint locks at home or work would be nice so that I would not have to carry around multiple keys or worry about losing them.
	A high-technology home full of smart gadgets would be nice.
	A home water fountain that filters rain into drinkable water would be nice so that I wouldn't have to buy water.
	It would be nice if taller shelves could be lowered with a push of a button so that short people or kids could easily get things without help.
	Cars would be smarter with an integrated smart phone function.
	Artificial intelligence cars that drive and park would be great.
	A portable chair for subway or bus rides would be nice.
	Low-fare airlines or public transportation on a larger scale would enhance accessibility to travel.
	It is very uncomfortable when using a mouse because of its cord or easily breakable wheel.
	It is uncomfortable that I have to change settings in my iTunes account when downloading a large-sized file.
	I just want to press the call button to make calls, but in the case of smart phones, I sometimes touch the wrong place and cause heavy data usage.
	Smart phones are difficult for the elderly to use.
	Limitless batteries would be nice so that I wouldn't have to charge them or carry around an extra set of batteries.
	It is hard to transfer files with an iPad because it doesn't have a USB port.
	Bigger screens are useful when watching YouTube videos with kids on the road.
	The cords on Bluetooth earphones still bother me. I wish there were chip-sized Bluetooth earphones to go directly into my ear.
Cost-efficient (3.14%)	A self-generator is economic because you would only produce electricity when you need it.
	Low-fare airlines or public transportation on a larger scale would enhance accessibility to travel.
	There are a lot of translation apps out there but most of them aren't free.
	People like to use apps provided by stock brokering firms because they are free of service fees.

5 CONCLUDING REMARKS

This qualitative research was conducted on Korean consumers in order to identify attributes of smart artifacts that consumers want in their daily lives. According to the results, consumers want an

Empowering attribute that is quite different from existing attributes. Consumers do not passively accept the predetermined functionality of a product, but rather want to change and maintain their lives in positive ways through smart artifacts. Consumers also want to be able to acquire any information that they need anytime, anywhere. In other words, people want not only functional performance in products, but they also want this performance to be reflected in ways that change and develop into better lifestyles.

Table 4.3. Representative consumer needs (Ubiquitous)

Portability (9.43%)	Noodles or rice in a heatable/microwavable container would be nice.
	Some sort of teleportation device would be great.
	A portable chair for subway or bus rides would be nice.
	A portable bag hanger would be nice for bars or restaurants.
	I think there will be more hand-held TVs rather than big-screen TVs in the future.
	How about a foldable and portable smart phone so I can adjust screen size however I want?
	Device charging through anything that produces energy, such as walking, would be great.
	Solar-charging phones would be nice.
	I wish iPhone batteries would last longer.
	Laptop chargers are hard to carry around.
	Laptop batteries don't last very long-usually 2 to 3 hours maximum.
	A home projection system with an automatic roll-up screen and a small beam projector would be nice.
Instant Connectivity (10.06%)	Smart door locks that can be remotely accessed by phone or apps would be nice.
	Stock apps are very nice because they are always accessible and real-time.
	Wi-Fi hotspots on public transportation would be great.
	I wish I could just insert a chip in my brain and transfer knowledge back and forth so that I would not have to spend time studying
	The great thing about Facebook is that I get feedback right away from friends as soon as I upload a picture or a video.
	There are a lot of translating tools out there, but I have to write everything down word by word. An application that translates what I say in real-time would be great.
	It is really frustrating when I have to search for working Wi-Fi or switch to 3G.
	3G is too slow.

Table 4.4. Representative consumer needs (Boostering)

Aesthetic (1.26%))	iPhones have various accessories that we can use to appeal to individual personalities.
	The design is very pretty, and the light-up features are very pretty as well.
Entertainment (1.26%)	Already there are many visual and tactile methods to check health conditions. It would be great if there were methods that employ other senses, such as the olfactory sense, to do health checks.
	Current camera apps are great because they make people look prettier and there are many fun features.

Table 4.5. Representative consumer needs (Peacefulness)

Safety (1.26%)	Smart door locks that can be remotely accessed by phone or apps would be nice.
	An application or device to search for malevolent Wi-Fi access points would be nice.
	The problem with uploading pictures on SNS is that privacy can be violated through certain vile group efforts.
Protection (1.26%)	It is nice because a remote mom would be able to see a household robot sing a song for a child and play with him.
	Some sort of registration process would be nice to prevent lost children or to easily find elders with Alzheimer's disease. For example, a strand of hair in a machine would identify the location of such vulnerable people.
Internal stability (3.14%)	A device that reads my mood and produces an appropriate scent or plays appropriate music would be nice. And also it would be nice if the device could read my biorhythms or pulse when placed in my hand.
	It would be great if there were a device that produces various scents according to different moods.
	(Capsule) coffee gives me inner peace and makes me comfortable.

Nevertheless, this does not necessarily mean that improvements on existing qualities, such as a product's performance or usability, are no longer meaningful. Consumers still want practical qualities (Efficiency, Ubiquitous) in products. That is, even though the Empower attribute is of highest

importance for consumers, the attribute must be together with features of the Efficiency and Ubiquitous categories.

In developing smart artifacts, it is natural for designers and developers to focus on excellent performance and convenience. In order to make products that consumers love, however, developers must take one more step. Developing new smart artifacts must be focused on intuiting and providing what consumers need for a better life. And through this, smart artifacts must be able to be used according to the different lifestyles of consumers.

REFERENCES

Archer, B.L. (1984) Systematic method for designers. In Cross, N. (ed.), *Developments in Design Methodology*. New York: John Wiley & Sons, pp. 57-81.

Hamel, G. and Prahalad, C.K. (1994) Competing for the future. *Harvard Business Review*, July-August, pp. 122-128.

Kim, K.O. and Hwang, H.S. (2010) User research methods: Distinctive need expressions from an in-depth interview and a generative method, *7th International Conference on Design and Emotion*, Chicago, USA, October 4-7.

Kim, K.O. (2012) Search for dimensions of consumer needs: Differences among generative tools, *8th International Conference on Design and Emotion*, London, UK, September 12-14.

Sanders, E.B.-N. (2000) Generative tools for codesigning, In Scrivener, B. and Woodcock (eds.), *Collaborative Design*, London, UK: Springer-Verlag, pp. 3-12.

Sanders, E.B.-N. (2001a) A new design space, *Proceedings of ICSID 2001 Seoul: Exploring Emerging Design Paradigm*, Seoul, Korea, October 7-11, pp. 317-324.

Sanders, E.B.-N. (2001b) Virtuosos of the experience domain, *Proceedings of the 2001 IDSA Education Conference*, Boston, USA.

Sanders, E.B.-N. and Colin, T.W. (2001) Harnessing people's creativity: Ideation and expression through visual communication, In Langford, J. and McDonagh-Philip, D. (eds.), *Focus Groups: Supporting Effective Product Development*, London, UK: Taylor and Francis, pp. 63-72.