

# **PRODUCT-SERVICE SYSTEMS DESIGN EDUCATION AND A NEW INTERDISCIPLINARY SERVICE DESIGN GRADUATE PROGRAM**

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## **ABSTRACT**

A Product-Service Systems (PSS) is composed of service and product elements to provide values for relevant stakeholders. PSS designing includes both service and product design aspects, but a service-dominant approach would be desirable. A service designing process can be composed of value modeling, service activity design, service interaction and touchpoint design and experience management, and the corresponding design method and design support tools have been developed at the ABC of DEF University. This paper explains the PSS design education efforts by showcasing a few student design projects and introduces the curriculum of the new Interdisciplinary Service Design graduate program. The case of DEF University in developing an interdisciplinary design program, based on solid research efforts in leading areas give a good insight for design field where combined educational innovation and research development would be necessary in reflecting ever-changing demand of industry competitiveness and human desires.

*Keywords: design education, interdisciplinary design, service design, product/service systems, experience design*

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## **1 INTRODUCTION**

A Product-Service Systems (PSS) is composed of service and product elements to provide values for relevant stakeholders (Goedkoop et al., 1999). PSS designing includes both service and product design aspects, but a service-dominant approach would be desirable. A service designing process can be composed of (1) value modeling, (2) service activity design, (3) service interaction and touchpoint design and (4) experience management, and the corresponding design method and design support tools have been developed at the Creative Design Institute of Sungkyunkwan University. Here diversity of values including economical, ecological and experience values (E3 values) is essential in value modeling (Cho et al., 2010). Activities of stakeholders are designed with rich consideration of various elements of activity contexts (Kim and Lee, 2011). Service interactions are designed with much care on touchpoints. Then stakeholder experiences are to be assessed and managed to close the loop so that designing of services can be evolutionally developed. The experience values include functional, social, emotional and epistemic values. Emotional values are further distinguished into active and reactive emotions. Active emotions such as happiness, anger, love, fun, control, and trust are of particular interests in service experience design. Those E3 value themes and their attributes are associated with value driving activities in service design.

This paper explains the PSS design education efforts by showcasing a few student design projects and introduces the curriculum of the new Interdisciplinary Service Design graduate program, called the Service Design Institute, of Sungkyunkwan University. The case of Sungkyunkwan University in developing an interdisciplinary design program, based on solid research efforts in leading areas give a good insight for design field where combined educational innovation and research development would be necessary in reflecting ever-changing demand of industry competitiveness and human desires. The course developments are first described briefly in the next section. Then a few example design projects of PSS topic are explained. Next service design graduate curriculum as developed based the research efforts on PSS design is presented. As not many curricula on service design have been developed and implemented in this emerging area, it would make a contribution by sharing the curriculum course contents and background of teaching faculty members with those planning to develop similar design programs.

## **2 INTERDISCIPLINARY DESIGN COURSES**

Interdisciplinary design education efforts have been made at Sungkyunkwan University since 2005. The course named Interdisciplinary Product Design (IPD) has been given since 2005 for seniors and master level students in mechanical engineering, industrial engineering, communication design and consumer science. Note that course contents and management details such as team composition method based on students personal creativity modes have been developed through research efforts. Recently emphasis on service design has been made for IPD. In 2012, a new course titled Product-Service Integrated Design (PSID) has been introduced where specific focus is given to product-service systems design. The specific design process introduced in the course has been developed at Creative Design Institute through a pioneering research project on PSS design (Kim et al., 2011), (Kim and Lee, 2011), (Kim et al., 2012a). Human Thinking and Interdisciplinary Design (HTID) has also been offered since 2012 so that understanding on human cognitive aspects are addressed. The course contents such as design process models (Park and Kim, 2007) and creative design education methods (Kim et al., 2010) are based on interdisciplinary research conducted at Creative Design Institute. Both PSID and HTID courses are offered to seniors and master-level graduate students for all majors, and most students in 2012 were from mechanical engineering, industrial engineering, consumer science and interaction science departments. These courses are team taught by faculty members from diverse departments.

Project-based learning opportunities in IPD cover problem finding part where diverse human values including socio-cultural aspects, designing of activities of various stakeholders to drive diverse values and systems to support those activities. Project teams are composed considering not only disciplinary diversities but also student's personal creativity modes based on cognitive preferences in perception and decision making (Wilde, 2008). Since 2010, student projects in IPD have been entered on the Knowledge-Based Services Competition sponsored by Korean Ministry of Knowledge Economy winning many prizes. In 2010, four project teams won awards. In 2011, three awards were given to our projects. In 2012, four awards out of seven in total were given the projects from our IPD courses as

shown in Fig 1. This sweeping of awards from this competition may be contributed by the fact that systematic service design methods are used in our student projects.



Figure 1. 4 Award Winning Teams of 2012 Knowledge-Based Business Plan Competition from Sungkyunkwan University

### 3 PSSD PROJECT

Three example student PSS design projects are explained to illustrate how specific service design methods have been reflected in student projects of two courses. Wheelchair Move Conn PSS and Children Playground PSS have been developed at IPD and Bag Customization PSS, at PSID respectively. Those from IPD were award winning projects.

#### 3.1 Wheelchair Move Conn PSS

The project is a service design case that aims to support the convenience and mobility of wheelchair users. Stakeholders who were involved in the product life cycle of the wheelchairs and their requirements were identified through life cycle steps analysis. According to the identified requirements, wheelchair users were afraid of using public transportation because they may fall down by obstacles on the street. To overcome this problem, highly functional wheelchairs could be designed and developed. But the project team approached the solution in human-centered way, rather than technology-driven one. Note that wheelchair users also wanted to receive some sort of supports from people. Also it was identified that there are many volunteers are willing to help others, but not aware of how to. The core values that were derived from requirements analysis were consideration, service, fear, concerns, desire and these were grouped based on E3 Values (Cho et al., 2010). fear and concerns were chosen as significant themes that may effect on the wheelchair users' activities, and the activities for the PSS were designed to reduce negative elements in various context. Fig 2 illustrates how the relevant stakeholders involved in mobility of wheelchair users are connected and interact with each other. Reflecting this, the project title of Move Conn was devised. Wheel chair users, volunteers, transportation corporations and government were defined as relevant stakeholders of Move Conn. Wheel chair users and volunteers could receive the service by joining a community. The whole service of Move Conn is provided through an application and transportation corporations offer traffic information service to the wheel chair users. Wheelchair users and volunteers could utilize the service by access to the application. Moreover, the users not only could indicate their personal information and information search but also could search other information they need. If public transportation users arrive at the place they requested, volunteer will receive the signal automatically and wheelchair users could get help from the volunteers immediately. Through this process, the wheelchair users could use public transportation more conveniently.

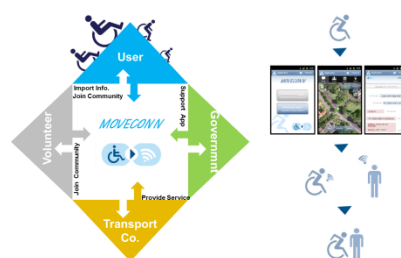


Figure 2. Concept of Wheelchair Move Conn PSS

The service that is provided by Move Conn consists of data collection from traffic organizations, connecting wheelchair users via an application, requested information service by users and activity of helping wheel chair users by linking to volunteers. Customer Journey Map for Move Conn users is described in Fig 3.

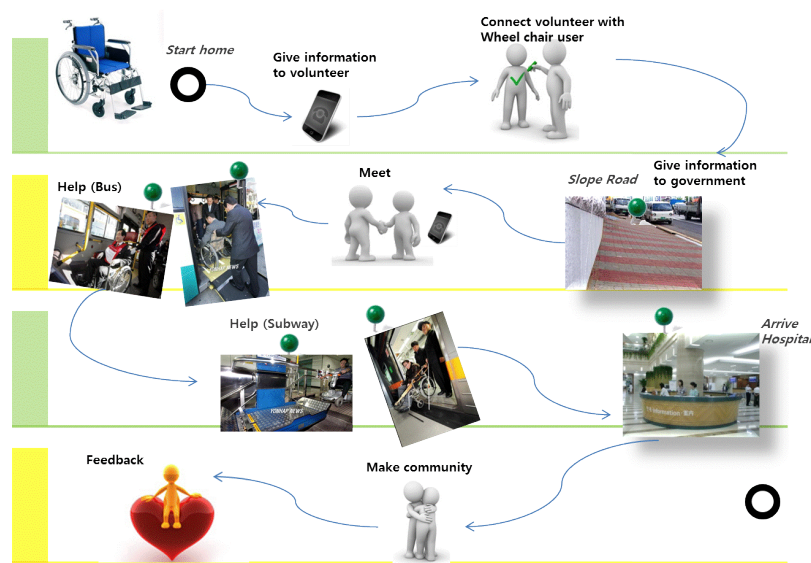


Figure 3. Wheelchair Move Conn PSS Customer Journey Map

A business model (Kim et al., 2012b) (Lee and Hong, 2011) of Move Conn is shown in Fig 4. Users, public transportation corporations and government are main partners, and connecting users with volunteers is a major activity. It is possible that users and volunteers keep in contact with each other by using an app. store which is a distribution channel and a smart phone as a key resource. The service offers mobility values to the wheel chair users and provides an opportunity to maintain support for them. In addition, it would contribute to enhance corporate reputation for sponsors by expressing positive images as corporate social responsibility. As regard to cost, server construction, server management and human resources to maintain business need to be considered. On the other hand, advertising revenue and funding by corporate sponsor are expected as profits. Whenever wheel chair users use public transportation, Move Conn enables the users to search information they want, and the users can receive the feedback after transmission of their request to Move Conn server. Therefore, the convenience of using public transport would increase and active public participation in this service would effect on the increase of social satisfaction wheelchair users feel.



Figure 4. Move Conn Business Model

### 3.2 Children Playground PSS

The project started from a town watching conducted by the team in search for socio-cultural problems. The team paid attention to playground facilities for children. Recently more children tend to play computer games at home instead of playing outside. As a result, the utilization rates of playground equipment have decreased. One of problems of the situation is that the playground facilities have been used by juvenile delinquents or adults who smoke for example in the playground exploiting that these are outdoor facilities. Young children would not come to playgrounds and thus loose chances to experience social interactions with their peers. These problems of playgrounds are depicted in Fig 5.

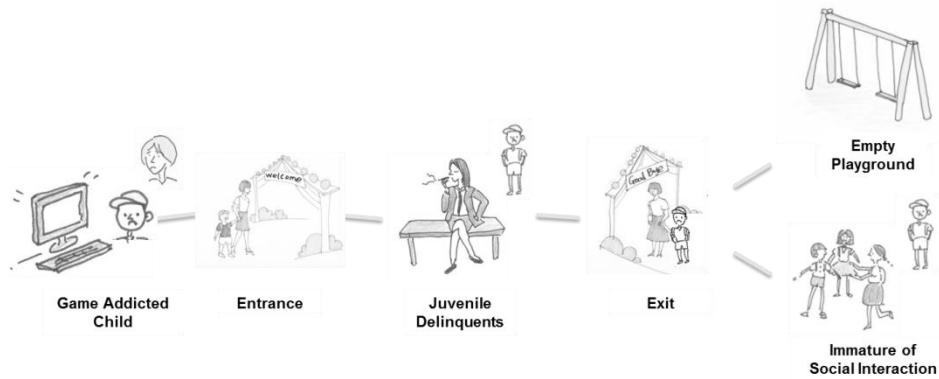


Figure 5. Children Playground Current Scenario

Requirements for relevant stakeholders were obtained to resolve the problem of empty playground and children's immature social interactions. For example, requirements addressed security issues of the playground and educational aspects through play. Key desired values are fun, relief, concern, anxiety, security and education. To drive these values, activities were designed by considering various context elements that could happen in a playground. A playground coordinator was introduced as a new stakeholder. As shown in Fig. 6 (a), children experience at playground would then be influenced by the playground coordinator. Exploiting that playgrounds are outdoor places, nature exploring could be offered and the playground coordinator can make contributions by informing and guiding children as well as managing nature exploration tools and playground conditions. Also children would experience play education through the coordinator. Both nature exploring and play education could be done in social contexts with peer children. Note that such coordinators would be dispatched when needed and proper learning and teaching tools can be provided to enable such new experiences. To identify stakeholders and their value flows, customer value chain analysis (Donalson et al., 2006) was used as shown in Fig. 6 (b). The playground coordinator offers important values such as education, socialization, safety, fun, and education to children at a playground and satisfaction to parents. To properly manage playground coordinators, agency could be introduced to interact with education office and government. This generates opportunities for employment and positive social values.



Figure 6 (a). Children Playground PSS Concept

Figure 6 (b). Children Playground PSS CVCA

### 3.3 Bag Customization PSS through Open Design

The Bag Customization PSS started from bag product. Students divided the product life cycle of a bag into three phases: Pre-, During- and Post- to identify requirements and values. Requirements were derived from defining relevant stakeholders in the each specific step. Significant steps were ‘design’ in Pre phase, ‘purchase’ and ‘use’ in During phase. Some examples of requirements were as follows: ‘I hope to have a flexible bag size depending on the situation’, ‘Designers require that consumers are trendy’ and ‘I want to have pride when I use a bag’. From E3 Values based on the requirements, students identified significant values such as customization, unique, boast, fun, pride, freshness and information as indicated in Fig 7.

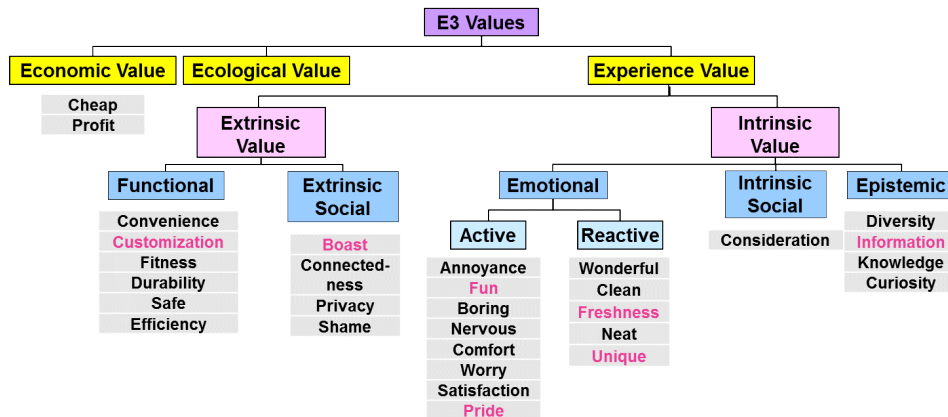


Figure 7. Bag Customization PSS through Open Design – E3 Values

Activities were designed using Service Blueprint with Activity Modeling Software (D&Tech7 Consulting, 2012) to provide above values to the relevant stakeholders. In this phase, various context elements such as goal context, relevant structure, physical context and psychological context were considered to design activities. A final PSS concept was developed with three critical service units. These three service units are shown in Fig 8 with three color codings. Also, more detailed activities are shown in the service blueprint. Firstly, amateur designers participate in a competition organized by service provider and can register their design work after evaluation by professional designers. In this process, various types of design resources for designing bags would be accumulated and it could be mass-produced by the requests of consumers. This procedure provides a business platform for amateur designers. Moreover, the accumulated design resources could be an appropriate case of open design. Secondly, customized bags with consumers’ own story and memories would be provided through the participation of consumers. The service could be co-created by consumers and professional designers as well as technical support via a web-based service and applications. Lastly, as the service happens in a bag store, consumers could obtain values such as fun and uniqueness from the customizable decorations with design resources consumers chose. Consumers could choose a design resource through a new touchpoint such as a kiosk in the store.

Corresponding new business model is shown together with the current business model in Fig 9. Amateur designers serve as a key partner in the new one. Amateur designers’ manpower and the design outcomes from them are added as key resources. Service provider offers customized values to individuals. Customer segmentation would be expanded to a new target group who prefer cost effective products and unique bags. In the new business model, the relationship between consumers and service provider are generated by participation and communication rather than brand power. These bags which were co-created by participation of customers and designers could make a profit like Razor-blade model by replacing bag design to a new design consistently. Furthermore, profits would be distributed to amateur designers who designed the key resources as well. The new PSS has two significant advantages as follows. It has the value of open design by providing an opportunity that amateur designers can participate in the design process. Furthermore, customers could have a customized bag depending on their preferences through co-creation with professional designers.

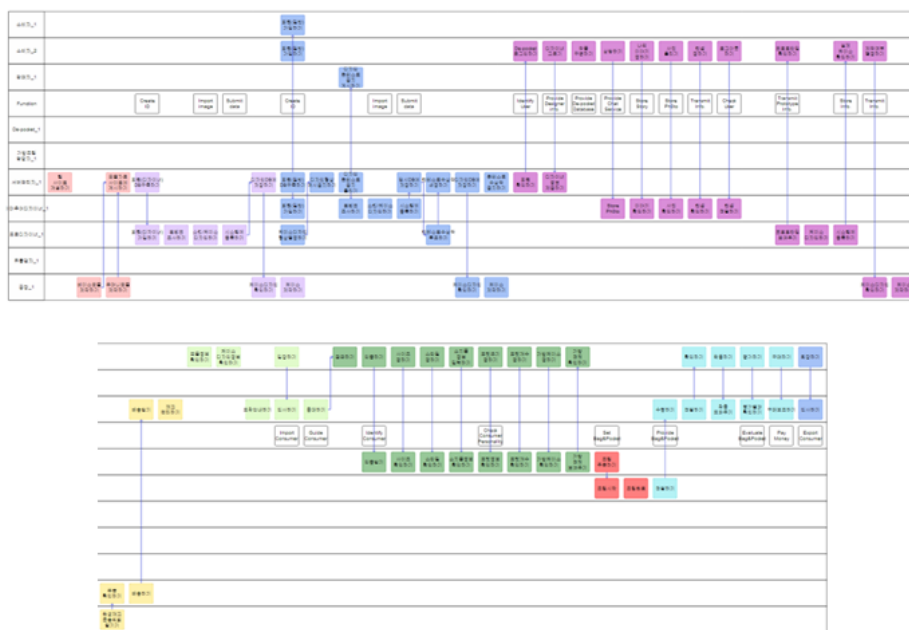
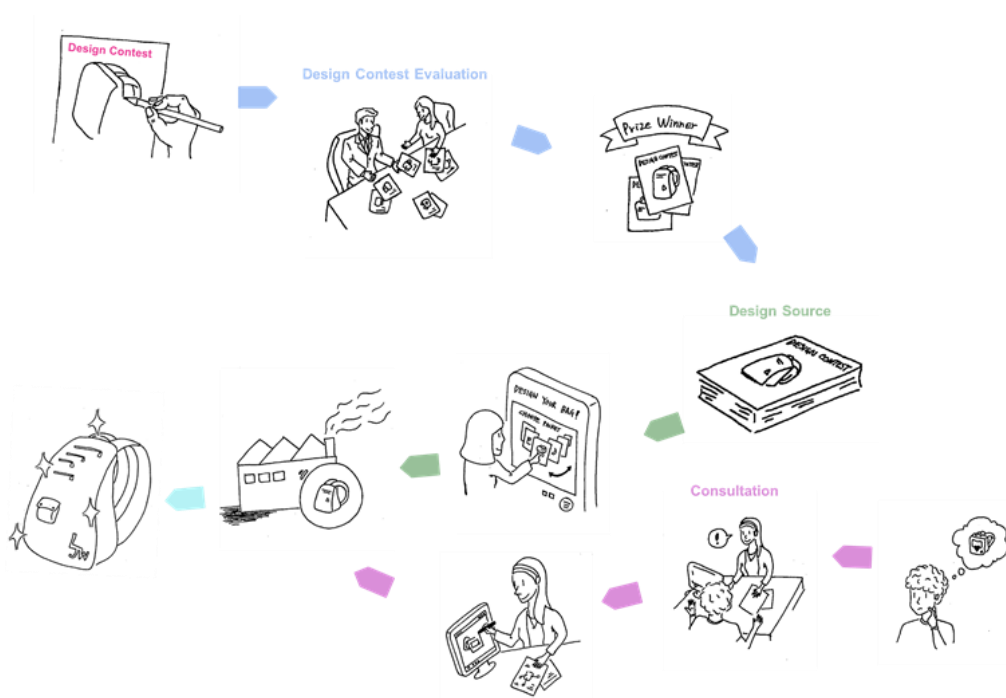


Figure 8. Concept of Bag Customization PSS through Open Design

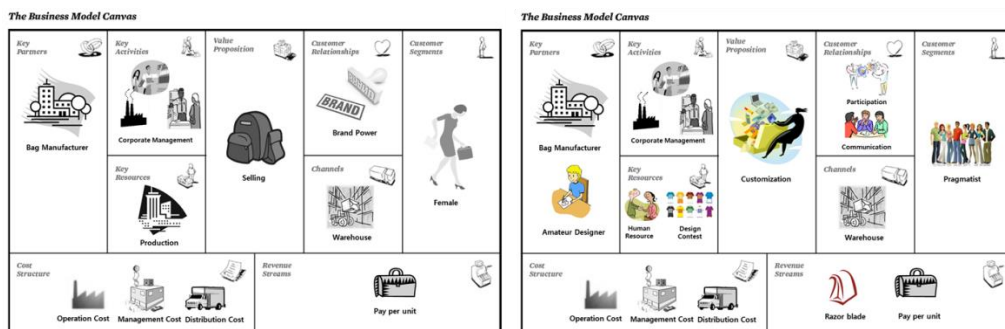


Figure 9. Bag Customization PSS through Open Design – Business Model

#### 4 INTERDISCIPLINARY SERVICE DESIGN GRADUATE PROGRAM

Based on successful implementation of several interdisciplinary design courses in the past 7 years, which are based on design research conducted in a combined manner with the course development, and the identification of critical roles of service designers with interdisciplinary learning experiences in the advancement of both service industry and manufacturing industry, a new graduate program of interdisciplinary service design has been launched at Sungkyunkwan University in 2013. The interdisciplinary program is sponsored by mechanical engineering, industrial engineering, consumer science and interaction science departments formally and receives additional teaching contributions from faculty members in business school, psychology, computer engineering as well as design department. The core curriculum is composed of three underlying courses on *interdisciplinary design issues on human thinking, human living and human environment* and *service design processes* courses. The contents of the underlying course are drawn from research results such as design reasoning processes based on cognitive steps of visual reasoning and cognitive elements of creativity that contribute to creativity enhancements in an adaptive way. Two *service design processes* courses will cover the service design process composed of value modeling, service activity design, service interaction and touchpoint design and service experience assessment and management as derived from PSS design research as well as diverse usage of service design support tools like those developed by the Creative Design Institute, a research companion part of the graduate program. Three application areas of *product-service systems, healthcare services* and *social innovation services* would be targeted with corresponding courses respectively. For business issues and social science aspects, three courses, *service management, service cognition* and *service communication*, are offered as electives. The key aspects of the service design program curriculum are shown in Fig 10.

Master degrees will be offered in two alternative manners: service design practice route with collaborative design project course and service design R&D route with independent research project course. For more advanced research directions, PhD degree student will conduct advanced research efforts. All students in the interdisciplinary service design program will have two advisors to ensure interdisciplinary aspects in their learning experiences. Profiles of the 14 faculty members of the service design program are shown in Fig 11. Please note that strong participation from social sciences reflects that understanding diverse human experience values and designing activities to drive those values would be critical in service design education. Also business and management issues are important throughout various design stages. Not only in the composition of faculty members, but also in the composition of student bodies, are rich interdisciplinary aspects reflected. Among 14 students enrolled in the first semester of 2013, five students have undergraduate degrees in design; three, in social sciences; three in engineering; three in business. Majority of the students have industry experiences.

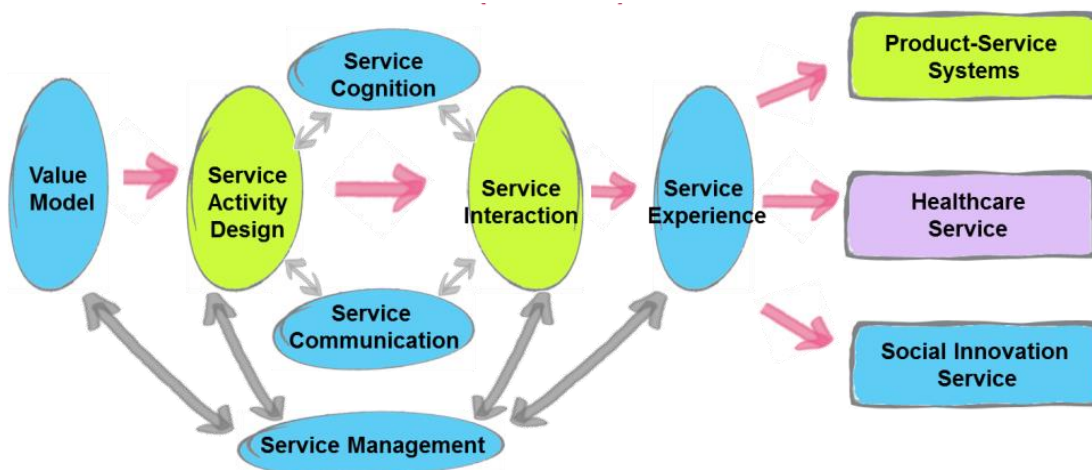


Figure 10. Service Design Institute Graduate Program





Figure 11. Faculty Members of Service Design Institute

## 5 CONCLUDING REMARKS

This paper described the PSS design education efforts by showcasing a few student design projects and introduced the curriculum of the Service Design Institute, new Interdisciplinary Service Design graduate program at Sungkyunkwan University. The case of Sungkyunkwan University in developing an interdisciplinary design program, based on solid research efforts in leading areas gives a good insight for design field where combined educational innovation and research development would be necessary in reflecting ever-changing demand of industry competitiveness and human desires. Curriculum on service design is in its rarity, it would make a contribution by sharing the curriculum course contents and background of teaching faculty members with those planning to develop similar design programs.

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