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REQUIREMENT NEGOTIATION FOR FEASIBLE SERVICE DEVELOPMENT

Kentaro Watanabe, Koji Kimita, Takeshi Tateyama and Yoshiki Shimomura
Tokyo Metropolitan University, JAPAN

ABSTRACT
Service design has been generally discussed in the engineering field in recent years. Though the focus of service design tends to be on customer values, the requirement of service providers is also important from the aspect of the feasibility of a designed service. However, there are few standard methods to represent the service provider's requirements for its own service and to design a service to fulfil it. In this research, the authors suggest a method to express a service provider's requirement based on the service design methods of Service Engineering. In addition, the authors suggest a process to adjust the specifications of a designed service in order to fulfil the requirements of both service providers and service receivers simultaneously.

Keywords: Service Design, Service Engineering, Requirement Negotiation

1 INTRODUCTION
To provide more values to customers, service design has been generally discussed in the engineering field in recent years. Many manufacturing companies have started providing various services by themselves or by the cooperation with other companies. For the design of attractive and sustainable services, it is important to satisfy not only service receivers, but also service providers. However, there are few standard methods to describe the service provider's requirements for its own service and to design a service to fulfil it.
Therefore, the authors suggest a method to express a service provider's state to describe its requirements for a designed service based on the service design methods of Service Engineering [1]. In addition, the authors suggest a design process to adjust the specifications of a designed service in order to fulfil the requirements of both service providers and service receivers simultaneously.

2 SERVICE DESIGN

2.1 Objectives of Service Design
In recent years, many researchers have been focusing on the design of services. One of the major objectives of the service design research is to enrich customer values by providing services, since it has become a common understanding that it is difficult to satisfy various customer values with standardized mass products. On the other hand, it is also an important issue whether a designed service is desirable for a service provider. Without the simultaneous satisfaction of both a service provider and a service receiver, the designed service can't be provided continuously.
The researches on the design of services started in the service marketing and management field first. Though there are various important researches on the service design model [2] and design processes [3], the aforementioned aspects for the design of a feasible and attractive service haven't been discussed sufficiently.
In the researches on Product/Service Systems (PSS), it is one of the main issues to fulfil the requirements from various perspectives. PSS is a specific type of value proposition that a business offers to its clients, consisting of a mix of tangible products and intangible services designed and combined so that they jointly are capable of fulfilling final customer needs [4]. There are several approaches to design a service from multiple viewpoints. For example, the qualitative analysis of the value characteristics and environmental impact of the classified PSS types [5] and the design methodology which focuses on the communicational, social and economic aspects of a service [6][7]

have been proposed. However, there are few researches which focus on the modelling method to describe the various perspectives of a service provider and reflect it to a design solution in a direct manner.
As for the needs of various stakeholders, the interesting approach to deal with a service from the system engineering viewpoint is requirements engineering [8]. Especially, the viewpoint oriented requirements engineering describes the multi stake holders' requirements and applies them to the design of systems [8][9]. However, the viewpoint of requirements engineering is basically on the systems composed of hardware and software, and the activity of people or organizations tend to be considered as an assumption to design those systems. As to the design of actual services, various interactions including the activities among humans or organizations should be considered as design objects.
Based on the above discussion, the authors focus on how to describe a service provider's requirement and how to design a service to satisfy the requirements of both a service receiver and a service provider based on the Service Engineering approach.

2.2 Service Engineering

Service Engineering is an engineering approach to develop the design methodology of a service [1]. To fulfil the service receiver's requirements, the following design methods have been proposed to describe a service.

1. Receiver's State Parameter (RSP)

In Service Engineering, a service is defined as an activity of a service provider to change a service receiver's state. To express a service receiver's state, Receiver's State Parameter (RSP) has been proposed [1]. An RSP is a target parameter of a service and also represents a service receiver's requirement which means the desirable state change.

2. Service models

In Service Engineering, several models have been proposed to describe a complex structure of a service. Flow model is a model to describe the agents who participate in a service and their relationships [1]. In a flow model, a service is described like chains of agents, and can be decomposed into sub-services from one provider to one receiver (see Figure 1). An intermediate agent, who mediates a sub-service to another receiver, can be identified as a service provider or a service receiver depending on the focused sub-service.

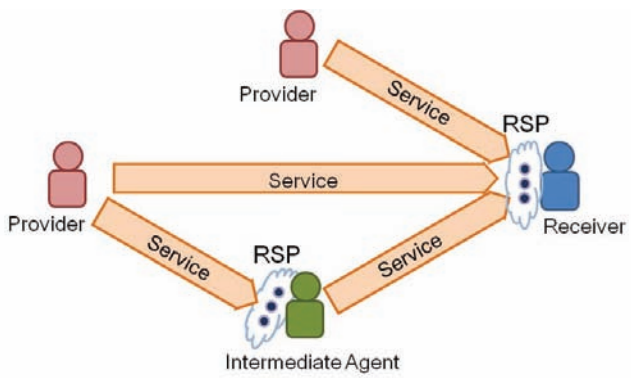

Figure 1. RSPs and flow model

A service designer describes functions and a realization structure of each sub-service in a view model [1]. A view model expresses the influence of a service to an RSP as a parameter map of function parameters (FPs). A service designer can verify the influence of a service with a view model and evaluate the satisfaction of each service receiver with RSPs [10].
By means of RSPs and the service models, a service designer can describe the whole picture of a service and evaluate it from the aspects of service receivers.

On the other hand, the authors have proposed the cost estimation of a designed service by means of the Activity Based Costing method [11] to evaluate the service from the service provider's viewpoint. However, the authors assume also that the service providers' requirements or expectation to a designed service include not only the financial cost to provide a service, but also the values gained by providing a service. In this research, the authors propose a method to describe those value and cost as the service provider's states for service design.

3 STATE EXPRESSION OF SERVICE PROVIDER

3.1 Provider's State Parameter (PSP)

In this chapter, the authors propose a Provider's State Parameter (PSP) to express the state of a service provider. A PSP describes the change of a service provider's state when a service is being provided. The authors assume that the requirement of a service provider can be considered as its preferable state change. Based on this assumption, a PSP expresses a service provider's concern and requirement for the target service.
For the above-mentioned purpose, the authors assume that a PSP is controllable and observable as an RSP is. A service designer can evaluate the satisfaction of a service provider whether the change of the PSP is a value or a cost to it.
To describe various aspects of a service provider, a service designer should take the following three points into consideration

1. Role (personal or corporate)

Generally, companies (in some cases NPOs or government offices) provide their services as service providers. Those organizations provide services according to their goals. When a service is being designed, those corporate aspects of a service provider tend to be considered in detail. Meanwhile, the requirement of the people working in such a company should be considered to design an excellent service in some cases. For example, film creators are sensitive to the freedom of expression for their contents. In this case, a service designer should take care of the regulation of their expression or the length of their films as their PSPs.

2. Tangibility (tangible or intangible)

When the contents of a service are discussed, the consumption of a service provider's resources tends to be a main issue. Though tangible resources of a service provider including people, facilities and finance are of course treated as the states of a service provider, the change of intangible resources [12] is also an important factor to evaluate a service. Intangible resources related to a service include know-how, corporate relations, and customer information to provide more personalized services. The tangible resources tend to diminish by the supply of a service, which means a cost for a service provider. In contrast, the intangible resources increase by providing a service in some cases.

3. Immediacy (prompt or later)

Every state change of a service provider isn't necessarily taken as a value or a cost promptly. In a business based on the maintenance fee, the number of its product users influences the revenue largely in the long term, though it may need a lot of cost to increase the number of users at first. As another example, the customer information is also valuable to provide more personalized service at the next timing. The state change which has a lag to be a value or is valuable to another service should be taken care of also in service design.

3.2 Provider's View

To apply PSPs to the service design, it is an important topic how to describe the influence of a service to stakeholders. The authors discuss this issue from two types of viewpoints for service design.
The first viewpoint is how a service receiver experiences a service. The authors call it "receiver's view". In the existing service design methods, a view model is utilized to determine realization structures of a service from the receiver's view. On the other hand, a service designer should care

about how a service provider experiences a service, also. On the contrary to the receiver's view, the authors call it "provider's view".
From the provider's view, a service designer can acknowledge the following types of influences to a PSP (see Figure 2).
The first type is an influence by providing a service. The typical influence is the decrease of tangible resources to provide a service, such as the number of usable rental cars in a rental car service. On the other hand, the learning effect to provide a certain service can be considered as a valuable influence to a PSP. In this research, the authors focus mainly on this type of influence.
The second type is an influence by a receiver's return action to the provided service. This type of influence includes not only the payment to a service, but also any beneficial action to a provider such as registering a receiver's personal information. The authors assume that the influence of return actions isn't as complex as a service described in a view model, since most of the service provider's states would be related to the corporate resources and they can be categorized into several patterns. A service designer can apply a return action from those patterns to describe the influence to a PSP.

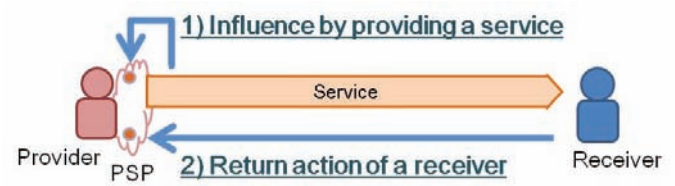

Figure 2. Influence to a provider's state

4 REQUIREMENT NEGOTIATION PROCESS IN SERVICE DESIGN

4.1 Requirement Negotiation in Service Design

As is mentioned in the previous chapter, a service influences both service receivers and providers. If the designed service based on the receiver's view is difficult to accept from the provider's view, the requirement negotiation should be performed to adjust the state changes of both providers and receivers. The requirement negotiation of a service can be performed in the following steps.

1. Specify contradicting requirements

For the requirement negotiation of a service, it is necessary to specify the requirement contradiction between a provider's requirement and a receiver's requirement. A service designer can detect such a contradiction by reviewing a designed service from both the receiver's view and the provider's view, and specifying a function or a realization structure which influences the contradicting state parameters.

2. Prioritize the contradicting requirements

To resolve the specified requirement contradiction, the prioritization of the requirements is important. In this research, the authors propose an importance analysis method to prioritize the requirements of service providers and receivers using the AHP method [13]. The AHP is a widely used method for decision-making in operation research. The AHP quantifies the relative importance of individual elements on a subjective scale by conducting paired comparison among the elements. The importance analysis method of RSPs using the AHP method has been proposed in the previous research [14]. In this research, the authors expand the targets of the AHP method to service providers and their PSPs, and prioritize the requirements of both service providers and receivers (see Figure 3). With this method, a service designer can compare the requirements of service providers and receivers.

3. Adjust the contradicting requirements

Based on the importance of RSPs and PSPs obtained in the previous step, a service designer adjusts the conflicting requirements to satisfy both a provider and a receiver. The approaches to adjust requirements vary from the slight control of service quality to the drastic change of a service flow.

One thing to be taken care of is an intermediate agent, which works as both a service provider and a receiver. A service designer should fulfil both PSPs as a provider and RSPs as a receiver to satisfy an intermediate agent.

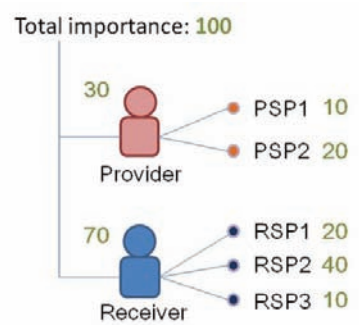

Figure 3. Importance analysis of RSPs and PSPs

4.2 Expanded Service Design Process

In this research, the authors expand the existing service design process [15] to adjust the requirements of service providers and receivers based on the above mentioned methods. Figure 4 shows the expanded service design process. The steps with broader frames in Figure 4 are the expanded steps from the original process.

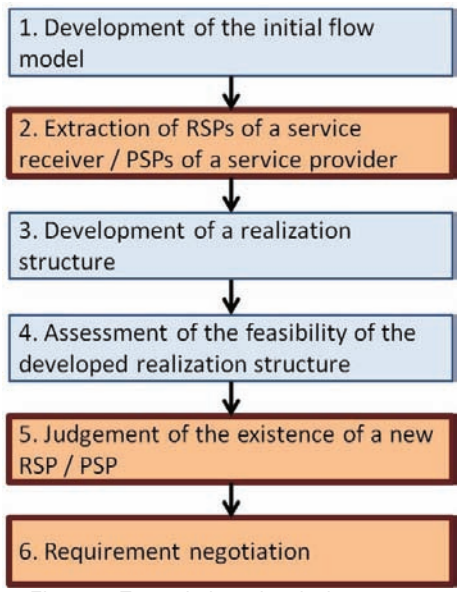

Figure 4. Expanded service design process

The followings are the brief explanation for each step.

1. Development of the initial flow model

In step 1, a service designer extracts the related service providers and receivers as Agents, and describes them and their relations in a flow model.

2. Extraction of RSPs of a service receiver / PSPs of a service provider

In step 2, a service designer extracts the target parameters of a service based on the requirement of service receivers. Meanwhile, the service designer sets PSPs. To determine adequate PSPs, the service designer should take care of their personal / corporate goals, tangible / intangible resources, total service line-up and long term activities.

3. Development of realization structures

In step 3, a service designer designs a realization structure of a service to fulfil each RSP, which is described in view models.

4. Assessment of the feasibility of the developed realization structure

In step 4, a service designer assesses the technical feasibility of the designed realization structures. The assessment items include such as the adequacy of the function deployment and the technical feasibility of the realization structure of a service.

5. Judgement of the existence of a new RSP / PSP

In step 5, a service designer detects new RSPs which are necessary to describe the requirements of a service receiver which he or she couldn't notice at step 2. After the new RSP is added, the additional modification of the realization structure of the service may be required. Meanwhile, the service designer should think over the possibility to add new PSPs also. New PSPs to be added are considered from the provider's view mentioned in section 3.2.

6. Requirement Negotiation

After the design of the realization structure and the state parameters of each agent, a service designer detects and adjusts the conflicting requirements among service providers and receivers according to the requirement negotiation steps in the previous section.

5 APPLICATION OF THE PROPOSED METHODS

For the verification of the proposed methods, the authors take up a music download service as an application case. A music download service is one of the typical and successful services realized by the collaboration between different service providers. In this research, the authors apply the expanded service design process and the proposed methods to this service.

5.1 Development of the initial flow model

The flow of this service has been described as a flow model in Figure 5. In this flow model, there are three agents: music player manufacturer, music labels, and music listeners. A music player manufacturer provides its music players to music listeners (Service-A) and a system to distribute music to music labels (Service-B). Using that system, music labels provide their music to music listeners (Service-C).

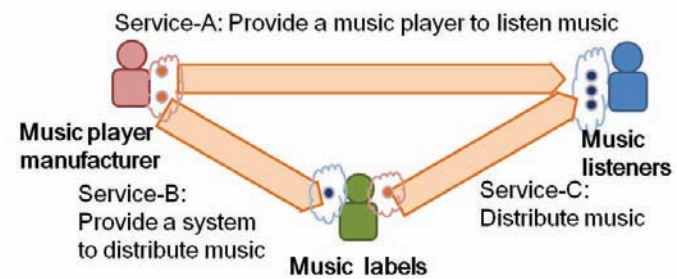

Figure 5. Flow model of music download service

5.2 Extraction of RSPs of a service receiver / PSPs of a service provider

Next, the state parameters for each agent have been determined. For the music listeners, three RSPs have been extracted from their requirements, which are "number of available music", "portability of the downloaded music", and "quality of available music". Then, to determine PSPs of the music player manufacturer and the music labels, their corporate and personal requirements have been considered. The corporate goals of them are to obtain a new source of revenue from the music download service. According to them, the number of music player users, which is an intangible resource to be a value in the long-term, has been determined as a PSP of the music player manufacturer. The number of users can be considered as a PSP of the music labels also, since the number of target users influences the revenue of the music labels largely. In addition, the portability of the downloaded music has been determined as a PSP of the music labels, since the digital music can be easily copied and the copied music may influence the revenue of the music labels. On the other hand, the music labels, especially small labels or individual musicians have their personal requirements to obtain their channels to provide music more freely. According to their requirements, the cost to distribute music has been set as an RSP of the music labels.

5.3 Development of realization structures

After the determination of the initial PSPs and RSPs, the design of realization structures has been performed to fulfil the RSPs. Figure 6 shows a view model which describes the realization structure to affect the music listener's RSP "portability of downloaded music". As an initial design idea, the music players and the distribution system have been designed to prohibit the copy of downloaded music to satisfy the RSP "portability of downloaded music". The storage of downloaded music has been designed not to allow any user's direct or remote access.

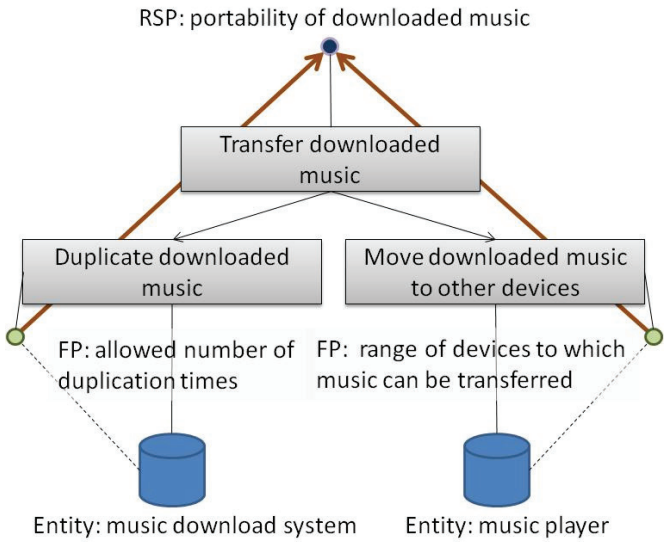

Figure 6. View model of music download service

5.4 Assessment of the feasibility of the developed realization structure

The designed service models have been examined from the technical aspects, such as the adequacy of the function deployment and the technical feasibility of derived products to provide a service. As a result, it has been clarified that the designed service and its realization structure are realizable.

5.5 Judgement of the existence of a new RSP / PSP

After the design of the realization structures and their assessment, new RSPs and PSPs to be added have been considered. As a result, the number of alliance labels has been extracted as an important factor to improve the line-up of the available music which influences the music listeners' RSPs.

Therefore, the PSP “number of alliance labels” has been added to as one of the music player manufacturer's PSPs.
As a result, the PSPs and RSPs for the design of the music download service have been determined (see Table 1).

Table 1. PSPs and RSPs in the music download service

Service	PSPs	RSPs
A	[Music player manufacturer] •Number of music player users	[Music listeners] •Portability of downloaded music •Number of available music
B	[Music player manufacturer] •Number of alliance labels	[Music labels] •Cost to distribute music
C	[Music labels] •Portability of downloaded music •Number of music player users	[Music listeners] •Quality of available music

5.6 Requirement Negotiation

Finally, the requirement negotiation has been performed as follows.

1. Specify contradicting requirements

In this service, the PSPs and RSPs are intricately interrelated. It can be noted that both the music listeners and the music labels have the same state parameter “portability of downloaded music”, and it is recognized as a value by the music listeners and as a cost by the music labels. In addition, the music player manufacturer’s PSPs, ”number of music player users” and “the number of alliance labels” are influenced by the portability of downloaded music in the opposite way from the provider’s view. Therefore, the portability of downloaded music can be specified as a contradicting requirement of this service.

2. Prioritize the contradicting requirements

To resolve this contradiction, the importance analysis method has been performed. Figure 7 shows its result. According to the result of the importance analysis, the portability of downloaded music should be determined from the aspect of the music listeners rather than from the aspect of the music labels. In addition, the number of music player users should be cared more than the number of alliance labels based on the result.

3. Adjust the contradicting requirements

According to the result of the importance analysis, the durable level of the state parameter “portability of downloaded music” for the music listeners and the music labels has been configured. As a result, it has been confirmed that if the downloaded music is transferable only among the appliances of the same user, the value of the parameter “portability of downloaded music” is acceptable for both the music listeners and music labels (see Figure 8). In addition, the estimated values of the PSPs “number of music player users” and “number of alliance labels” are also the acceptable levels for the music player manufacturer. Therefore, the function to transfer downloaded music among correlated appliances has been added in the realization structure of the music download service.

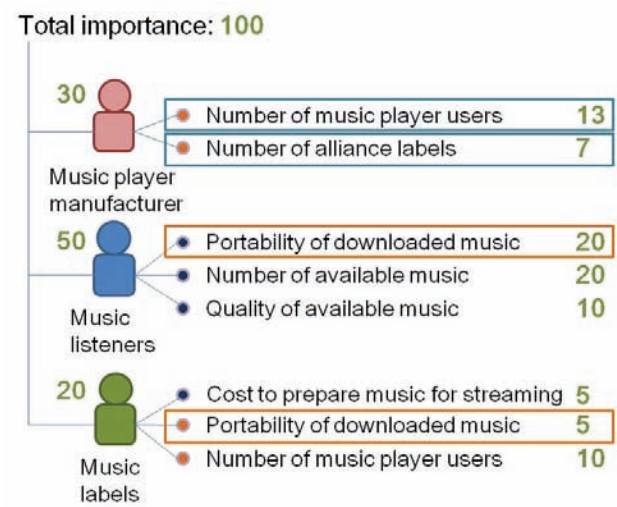

Figure 7. Result of importance analysis

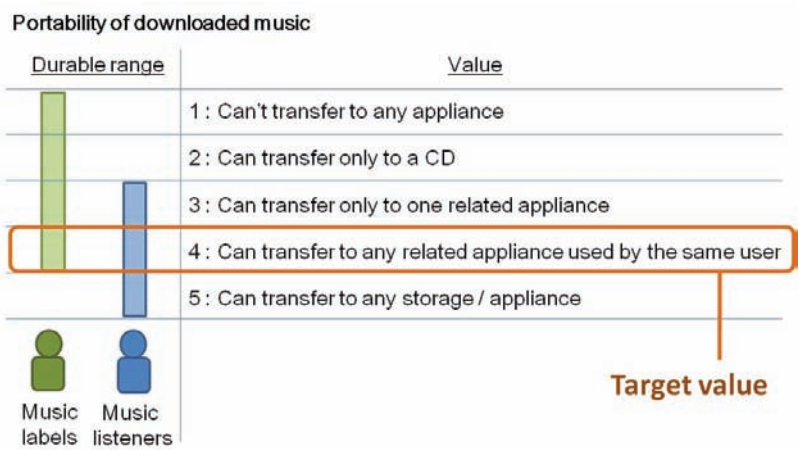

Figure 8. Adjusted value of the PSP "portability of downloaded music"

6 DISCUSSION

From the application case, the authors have obtained the following insights.

- Application of PSPs

The authors have confirmed that a service designer can consider the specification of a service by describing a service provider's requirements as PSPs. In addition, various types of provider's requirements can be taken into consideration from the proposed aspects of service providers.

In this research, the authors propose the general indications and approach to extract PSPs. However, it is still difficult to extract PSPs exhaustively from the viewpoint away from the existing services. The PSP extraction methods or process to realize it would be the future research. Since the provider's intention toward services could be simpler than the receiver's requirements, the authors assume that the more detailed classification of PSPs would be possible, and effective to clarify the specification of desirable services.

- Requirement negotiation

The authors have confirmed that the adjustment of contradicting requirements can be performed from various aspects by applying two types of viewpoints. However, PSPs and RSPs are correlated manually in this research. The more direct expression of the provider's view and its relation to the receiver's view will be effective to understand the relationship among RSPs and PSPs more precisely.
As to the prioritization of the contradicting requirements, the result of the importance analysis provides a service designer some indications to determine the specification of a service. On the other hand, there could be unacceptable change of RSPs or PSPs, which the importance analysis can't deal with. For the evaluation of those parameters, an additional research on the analysis of the requirements should be considered.

- Applied design process

In this research, the authors have applied the expanded service design process to utilize PSPs for service design. As a result, the general process of the service design to satisfy both service providers and receivers has been clarified.
On the other hand, the reduction of environmental impacts is also an important goal of service design. The total assessment including the evaluation of environmental impact (for example [16]) is an interesting theme for the future research.

7 CONCLUSION

In this research, the authors have proposed the method to describe a service provider's state and the requirement negotiation process among service providers and receivers.

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Contact: Kentaro Watanabe
Tokyo Metropolitan University
Department of System Design
Asahigaoka 6-6, Hino-shi
Tokyo 192-0065
JAPAN
Phone / Fax: +81-42-585-8425
E-mail Address: watanabe-kentaro@sd.tmu.ac.jp

Kentaro Watanabe has been doing his Ph.D study at the Department of System Design, Tokyo Metropolitan University since 2008. He received the master's degree of engineering in 2005 at the University of Tokyo. His specialties are Service Engineering and product design.