

Requirement Analysis for Strategic Improvement of a B2B Service

F. Akasaka¹, S. Hosono², K. Kimita¹, M. Nakajima¹, and Y. Shimomura¹
¹Department of System Design, Tokyo Metropolitan University, Tokyo, Japan
²Service Platforms Research Laboratories, NEC Corporation, Tokyo, Japan
akasaka-fumiya@sd.tmu.ac.jp

Abstract

Manufacturing companies are starting to recognize that services offered through a product are important. From the viewpoint of offering products in combination with services, it is important for designers to focus on requirements. This paper proposes a method to analyze the identified requirements for a strategic service improvement. By evaluating the requirements qualitatively from both the service customer's and provider's perspectives, some significant suggestions to define specific requirements which should be focus of improvement are presented. The effectiveness of this method is demonstrated by a case study where a utility company is a client of a service.

Keywords

Service Improvement, Requirements, Service Engineering, Strategy, Service Design

1 INTRODUCTION

As society matures, services are becoming central to economic growth, especially in developed countries. Services, therefore, are becoming increasingly important in many industries. In manufacturing, offering services through a product is regarded as more important than offering only a product. As a result, "Product-Service Systems" [1-2] that provide values by combining a product and a service have been attracting much attention.

To increase the productivity of services, to analyze developed large-scale and complicated services, or to create new services, a systematic approach to design services is important. The authors, therefore, have carried out fundamental research on "Service Engineering (SE)," which aims at providing design methodology of services from an engineering viewpoint [3-4]. In SE, a service is defined as *an activity between a service receiver and a service provider to change the state of the receiver* [3-4]. This definition includes a broader sense than typical definitions in a traditional service management or marketing field, which are used to clarify the difference between services and products (e.g., [5]). In this definition, most business activities are services, including manufacturing, selling, or maintaining physical products. The term service used in this study, therefore, corresponds to PSS.

1.1 "Requirement" in the SE context

One of the most important processes in service/PSS design or improvement is identifying "requirements" in a service, since service/PSS should be developed to fulfill specific "customer needs" [2].

The term "(customer) needs" is often used to represent something that is necessary for life or the reasons for the actions [6]. "Requirements" is represented to define specified characteristics or specifications, which are more formalized into a precise description of the product [7]. When a product/service is designed to meet customer needs, the needs are translated into requirements, and the requirements are regarded as design targets [8].

According to our definition, a service is offered to realize the receiver's state change, and when the state changes to a new desirable one, the receiver is satisfied. Therefore, states that a receiver desires to change should

be a design target, that is, "requirements" in a service design. In the SE context, the target receiver's state is represented as a set of parameters called Receiver State Parameters (RSPs) [3]; namely, in this study, requirements are represented as RSPs.

1.2 Continual service improvement

Generally, the value of a service is determined by service receivers [9-10], whose needs are influenced by environment (i.e., trends or situation) with which they are facing [11]. The requirements in the service, therefore, might be changed depending on the environment. In order to meet such changeable requirements and realize the growth of a service, the key is the continual service improvement adjusted to coincide with the requirements. Within such a service improvement process, the early phase inevitably includes sub-steps for identifying requirements and analyzing the identified requirements to define specific requirements that should be the focus of improvement. The scope of this article is to propose a practical method that is used in the early phase.

In this paper, Section 2 explains a model of service growth and a service improvement over the lifecycle of a service. Based on the service growth model, a framework of requirement-oriented service improvement is illustrated in Section 3. The framework includes value analysis, service evaluation, and service design, and, in this paper, the concentration is on value analysis and service evaluation phases, in which requirements in a service are analyzed to define service elements that must/should be improved. Section 4 presents an outline of the manner in which designers examine and identify requirements, and Section 5 includes a description of a method used to evaluate the identified requirements. The evaluation result provides suggestions for the strategic improvement of a service. Section 6 explains important perspectives that the designers should focus on to obtain the suggestions. These sections, i.e., Sections 4 to 6, are the central argumentation of this paper. Section 7 is a description of how the proposed method was applied to a real B2B service. Section 8 presents a discussion of the result of the case study, and Section 9 presents the conclusion.

2 SERVICE GROWTH

2.1 Service lifecycle

Some researchers have referred to a model of service lifecycle. Aurich et al. examined manufacture and user activities in a product lifecycle and mentioned a model of service lifecycle in the product lifecycle point of view [12]. In the IT system field, ITIL (IT Infrastructure Library), a framework to operate and manage IT systems, provides a model of lifecycle of an IT service [13]. The lifecycle model in ITIL focuses on continual IT service improvement; thus, the model provides us important insights. However, it provides little information about product shares needed for service offering.

We have proposed a service lifecycle model from an objective of realizing a continual service growth. Our lifecycle model is composed of four phases: value analysis, service design, servicing, and service evaluation (Figure 1). Servicing is subdivided into three phases: introduction, operation, and maintenance. To realize service growth by modifying or improving the service, it is essential to check/evaluate the degree of current achievement toward its target value and to identify the service elements that must/should be improved. This is one reason that the model includes an evaluation phase, which is one of the features of our service lifecycle model.

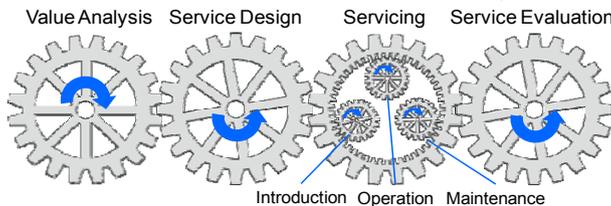


Figure 1: Service lifecycle

2.2 Service improvement

Using the service lifecycle model, service growth is modeled as shown in Figure 2. In this model, service improvement is illustrated as a pair of vertically ordered gears. As the service improvement should be executed on the basis of the result of evaluation, power to activate the upper gear in each pair is transmitted by the evaluation gear.

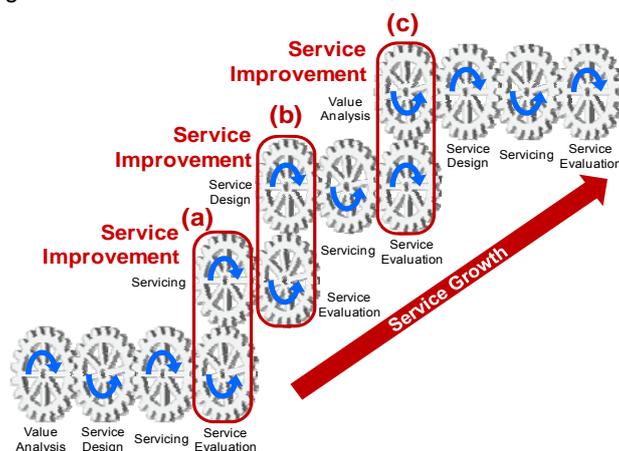


Figure 2: Service growth

Designers have to consider service improvements over the entire lifecycle [14]. Therefore, three vertically ordered gear sets should be considered, (a) Service Evaluation - Servicing, (b) Service Evaluation - Service Design, and (c) Service Evaluation - Value Analysis (Figure 2).

The first, (a) Service Evaluation - Servicing, refers to improvement without changing the current service structure, e.g., reinforcing the education for staffs.

The second, (b) Service Evaluation - Service Design, refers to the re-design of the current service elements, e.g., its functions, business partnerships, service activities, or physical products needed for service realization.

The third, (c) Service Evaluation - Value analysis, is a requirement-oriented service improvement. This improvement requires a re-analysis of customer needs and re-identification of requirements. The service could be modified and improved radically (e.g., by adding new functions to provide new values). As reported in 1.2, the focus of this paper is on requirement-oriented service improvement. Therefore, the next section presents an explanation of the framework for the third set.

3 FRAMEWORK OF REQUIREMENT-ORIENTED SERVICE IMPROVEMENT

A systematic framework of the requirement-oriented service improvement is illustrated in Figure 3. The framework is composed of three service lifecycle phases: service evaluation, value analysis and service design. Squares in each phase indicate sub-steps that should be performed by designers. This framework can be used to "PSS improvement," since, as mentioned in Section 1, the term service in this study corresponds to PSS.

The next part (3.1) briefly explains each phase of this framework.

3.1 Three phases in the framework

Value analysis

In this phase, designers re-analyze values provided through the service, namely, the purpose of this phase is to identify requirements and analyze the identified requirements. Exhaustive examination and identification of requirements without omission are important.

Service evaluation

The ideal business or solution forms a win-win relation between a service receiver and a service provider in terms of profits, costs, and satisfaction. Service, therefore, must be improved with consideration of the balance of the provider-receiver relation. Service that makes the receiver dissatisfied due to an improvement that ignores customer needs will fail, and, on the other hand, the provider should not lose by forcing himself to meet customer needs completely. Hence, the service evaluation phase should include the perspectives of both the customer and the provider.

With respect to the evaluation from the customer's point of view, it is important to clarify the degree to which customers are satisfied, i.e., the fulfillment level of each requirement.

On the other hand, from the provider's perspective, the costs, productivity, and profit of the current service should be evaluated. Some methods for evaluating a service from such criteria have already been proposed, e.g., Activity-Based Costing [15] for cost estimation.

Service design

To find solutions for service improvement, designers must first define the requirements that should be targeted in the improvement. Subsequently, some specific solutions that can satisfy the requirements are conceptualized. The resources needed to realize the solution are then determined. Here, the term resources includes both physical products and human resources. After that, designers select the best solution among them. The

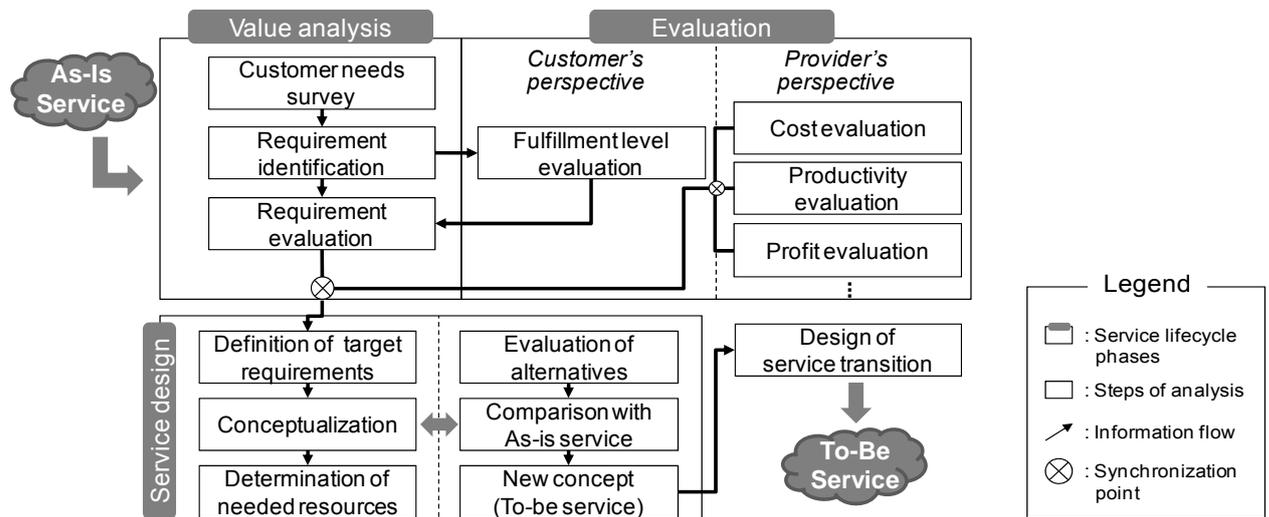


Figure 3: Framework of requirement-oriented service improvement

selected solution is then compared with the current service by some criteria. Only when the solution is better than the current service, it can be regarded as suitable for a new concept, i.e. To-be service. The to-be service should be introduced to the current business field smoothly. Therefore, after the new service concept is generated, designers need to consider how to shift the current service to the new service, i.e., they need to design a service transition [16].

3.2 Scope and challenge

The framework reported above is just an overview of requirement-oriented service improvement. We, therefore, need a more concrete method or procedure to execute each step in the framework.

One of the most important steps in the framework is analyzing the identified requirements to define design targets because this step is a starting point of the requirement-oriented service improvement; thus, the step affect the later steps, e.g., steps in the service design phase. However, it is difficult to determine target requirements due to the fact that, normally, a number of requirements are identified when they are thoroughly examined.

In this paper, our scope is set on the procedure to define the target requirements, namely three sub-steps from a “Customer needs survey” to “Definition of target requirements” in the value analysis phase and “Fulfillment evaluation” in the evaluation phase (Figure 3). The challenge is proposing a concrete and practical method to analyze the identified requirements and to define the target requirements from them.

4 REQUIREMENT IDENTIFICATION

To analyze the customer and to identify requirements in a B2B service, a method called Business process- and Goal-oriented Requirements Analysis has been proposed ([17-18]).

The first step of this method for designers is re-analyzing service receivers to clarify customers and to identify customer needs. Market surveys, interviews, or questionnaires are useful in this step [19].

Based on the collected data, customer’s business activities are modeled visually, and goals, which indicate objectives that should be achieved for each business task [20], are identified for each business activity.

The modeled customer’s business activities are then translated into a service script. The service script is written

in natural language; thus, it enables designers to analyze the customer’s behavior in more detail. From the script, designers identify some “key words” that can be considered as important elements for the service.

Finally, each key word is associated with required items/qualities and quality elements using a pre-defined template and vocabulary list (Figure 4). Here, required items refer to what customers want to do, and the required quality is a linguistic expression of customer needs related to the quality of the provided product/service [21], namely, the required items/qualities indicate representations of “customer needs” in a service. On the other hand, quality elements work as criteria for evaluating the quality [22]. Thus, the quality elements are observable and controllable for designers and could be regarded as requirements in a service, since these are elements that satisfy the required items/qualities, i.e., customer needs. (See [17-18] for more details.)

Pre-defined template for requirements identification

Keyword	Required item/ Required quality	Quality elements (chosen from the element list)	Quality elements (new elements)
Security system	Stable	13A(reliability), 13B(stability)	Trouble-proof property
.....
.....

Support

No.	Quality element	Quality element	Quality element
10	excitability	unusual stimulus	competition excitability
11	sophistication	preciousness	chicness
12	timeliness	timely convenience	timely certainty
13	reliability	stability	faultlessness
14	freshness	unexpectedness	freshness
15	rapidity	rapidity of response	rapidity of effect
16	product line-up	degree of product line-up	originality in product line-up
17	thrill	degree of pleasure	impressiveness
18	cleanliness	cleanness	purity

Vocabulary list (Service quality elements)

Figure 4: Requirement identification using vocabulary list

5 REQUIREMENT EVALUATION

5.1 Approach

Each of the identified requirements has its attributes, e.g., whether or not it is fulfilled. Urgency of the need for improving a service is influenced by the attributes of the requirements. For instance, a part of the current service related to an unfulfilled requirement should be improved preferentially compared to a service that already satisfies a requirement. Therefore, “classification” of the requirements is taken as an approach to “evaluate” the identified requirements.

For the classification, four perspectives are introduced as attributes of requirements: fulfilment level, Kano quality [22], and internal and external environments. Each perspective is explained below. The fulfilment level and Kano quality are evaluated by the customer. On the other hand, internal and external environments are evaluated by the provider.

1st perspective: Fulfilment level of the requirements

The first evaluation perspective is the fulfilment level. It refers to the degree to which the requirements are satisfied. In this study, the fulfilment level of the identified requirements is evaluated qualitatively by the customers' use of the terms "fulfilled", "partially-fulfilled" and "unfulfilled". As reported in Section 3, the fulfilment level evaluation is held in the evaluation phase (Figure 3).

2nd perspective: Kano quality

The second one is Kano quality [22], which provides quality categories of features in a product/service.

Kano quality is proposed by Kano et al. in the quality management field and is a model to categorize a quality [22]. According to the Kano model, quality attributes are categorized mainly into three types: attractive, one-dimensional and must-be quality.

Figure 5 illustrates the features of these three types of quality. The horizontal axis indicates the state of physical fulfillment. Attractive quality elements have little influence on customer satisfaction, even when they are unfulfilled. On the other hand, must-be quality elements are recognized as a matter of course, and, if they are unfulfilled, customers are deeply dissatisfied.

In this study, the identified requirements are classified into three Kano quality types.



Figure 5: Kano quality model

3rd and 4th perspective: Internal and external environment

The internal environment of a provider affects the decision to define the target requirements for the improvement of a service. For example, if the provider has a specific strength, e.g., a specific skill or knowledge, it is relatively easy to improve a part of service related to such strength. Furthermore, in general, an external environment, i.e. trends or situation, influences a customer and his/her needs. Therefore, to grasp such environment-related requirements, designers have to analyze the external environment of a provider.

SWOT [23-24] analysis is a framework to formulate a business strategy by analyzing the external and internal environments of the business. Table 1 shows a typical matrix that is provided in a series of SWOT analysis studies [24]. As shown in Table 1, in SWOT analysis, the external environment is analyzed by listing the business Opportunities (O) and Threats (T), and the company's internal environment is assessed for its Strengths (S) and Weaknesses (W).

Table 1: SWOT analysis

	Internal Strengths (S)	Internal Weaknesses (W)
External Opportunities (O)	SO strategy	WO strategy
External Threats (T)	ST strategy	WT strategy

In our method, designers judge whether or not requirements are related to internal environments, i.e., internal strengths or weaknesses, and any external environments, i.e., external opportunities or threats.

5.2 Requirements evaluation matrices

Bi-layered matrix

In this study, a bi-layered matrix to evaluate and classify the identified requirements is developed as shown in Figure 6. The upper matrix in Figure 6 classifies the requirements from a customer's viewpoint. Thus, its horizontal axis is the fulfillment level, and the other axis is the Kano classification. The lower matrix is almost the same as the SWOT matrix. However, the lower matrix has nine cells, while the original SWOT matrix has only four cells. This is because all of the requirements, including requirements that are not related to internal or external environments, should be categorized to any cells.

The identified requirements are first mapped to a cell in the upper matrix, and they are then mapped to a cell in the lower matrix. All of the requirements are then mapped onto two matrices respectively.

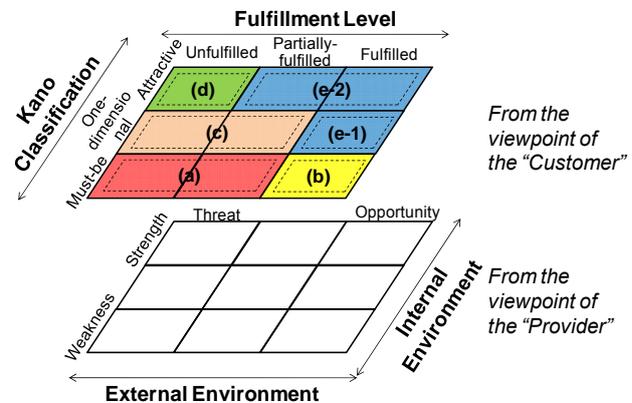


Figure 6: Requirement evaluation matrices

Five important sectors

The nine cells in the upper matrix can be classified into five sectors, (a) to (e), shown in Figure 6.

Referring to the feature of three types of quality noted in the Kano model (Figure 5), sectors (a) and (c) indicate that customers are dissatisfied, that is, the value of the customer satisfaction is negative. On the other hand, sector (e), (e-1) and (e-2), refers to customer satisfaction, namely, the value of customer satisfaction is positive.

Sectors (b) and (d) indicate neutrality, neither satisfaction nor dissatisfaction; thus, the value of customer satisfaction is nearly zero. It is noteworthy that, in sector (b), zero is the maximum, and, in contrast, zero is the minimum in sector (d). Therefore, improving a service related to a requirement in sector (d), the value of customer satisfaction can only move to the positive direction, while that is not possible in sector (b).

6 STRATEGIC REQUIREMENT ANALYSIS

This section is a description of some important points that should be addressed to conduct the strategic determination of target requirements using the requirement evaluation matrices presented in Sector 5.

6.1 Improvement strategy driven by Kano and SWOT

The Kano classification and SWOT analysis are both considered as valuable for developing design and business strategies.

Some researchers in the mechanical design field have suggested that a product's features should be designed in consideration with its Kano quality. Table 2 is a description of the characteristics of design corresponding to each quality [25]. This description can be considered as a kind of design strategy based on the Kano quality.

Table 2: Design types corresponding to the Kano quality

Kano categories	Type of Design
Attractive	Attractive Design: A product/service provides extra satisfaction to customers. An example of this kind of design in a laptop computer would be a security system that included a fingerprint scanner.
One-dimensional	Better Design: The better a product/service performs for a customer, the more satisfied the customer is. An example of better design in a laptop would be its weight.
Must-be	Essential Design: A lack of such a feature would result in customer dissatisfaction, and probably make a product/service not as useful to the customers. An example of this design in a laptop would be a spacebar.

On the other hand, in a relevant study of SWOT analysis, Wehrich proposed four conceptually alternative strategies corresponding to the four columns in the SWOT matrix [24] (Table 1).

Improvement ideas or plans described in the S-O column are called SO strategies. The strategies are means to use internal strengths to take advantage of the opportunities. Thus the company should not hesitate to realize the ideas described as SO strategies.

ST strategies appear in the S-T column. This strategy is based on the strengths of a company that can deal with threats in the external environment. In other words, if a provider can overcome the threats, a differentiated service can be realized.

WO strategies in the W-O column attempt to minimize weaknesses by taking advantage of opportunities. The business plans in the W-O column should be conducted carefully.

WT strategies aim at minimizing weaknesses and avoiding threats. Namely, actions or plans to avoid significant risks are described here.

6.2 Rough strategy for service improvement

The design types corresponding to each Kano quality derive a rough strategy of service improvement with respect to each of the five important sectors. There are two types of service improvement strategies: (i) To reduce or eliminate the potential for customer dissatisfaction, and (ii) To increase the degree of customer satisfaction.

(i). *Improvement to reduce or not to make customer dissatisfaction*

Sector (a). Improvement to warrant the minimum quality of a service: "- to 0"

The attributes of a requirement mapped to sector (a) are: Unfulfilled/Partially-fulfilled and Must-be quality.

Requirements in this sector must be fulfilled to warrant the minimum quality of the service. Anything less will result in customer rejection.

Sector (b). Improvement to maintain the minimum quality

The attributes of a requirement mapped to sector (b) are: Fulfilled and Must-be quality.

These attributes means that the minimum quality of the service is already assured. However, if a requirement is also related to Treats or Weakness in the lower matrix, designers need to consider and manage several kinds of risks that impede the quality of the service.

(ii). *Improvement to increase the degree of customer satisfaction*

Sector (c). Improvement to eliminate customer dissatisfaction and increase satisfaction from a negative to a positive: "- to 0/+"

The attributes of a requirement mapped to sector (c) are: Unfulfilled/Partially-fulfilled and One-dimensional quality.

A part of service related to a requirement mapped here is now considered as one reason for customer dissatisfaction. To eliminate the dissatisfaction, therefore, designers should improve the part of a service. When such improvements are made, there is a possibility to change the dissatisfaction into satisfaction.

Sector (d). Improvement to add a new value by the attractive design: "0 to +"

The attributes of a requirement mapped to sector (d) are: Unfulfilled and Attractive quality.

Focusing on the requirements mapped here, a novel service might be created, and then the value of the customer satisfaction will be increased. This occurs because fulfilling an attractive quality element means pleasing the customer, i.e., the attractive design.

Sector (e). Improvement to obtain higher customer satisfaction: "+ to ++"

The attributes of a requirement mapped to sector (e) are: Fulfilled and One-dimensional quality (e-1), or Partially-fulfilled/Fulfilled and Attractive quality (e-2).

The current services related to requirements mapped here have already created relatively high customer satisfaction. Therefore, the provider does not need to modify the services. However, effective improvement of the service can raise the degree of customer satisfaction dramatically and will be an important source of profits.

Here, sectors (e-1) and (e-2) are different in terms of the design type, namely, (e-1) relates to the better design and (e-2) relates to the attractive design. Therefore, improvements concerning requirements in (e-1) are more realistic, whereas those in (e-2) are more creative.

6.3 More precise suggestions to define target requirements

The rough strategies reported in 6.2 are obtained from the mapping result on the upper matrix. It is, therefore, possible to provide more detailed suggestions by combining the mapping result on the lower matrix. In this study, a vector that connects the same requirement between two matrices is described. The vectors possess four kinds of attributes of the requirement: fulfillment level, Kano quality, and internal and external environments.

Strategies for the vectors are generated by combining the strategies driven by the SWOT matrix with the grand strategies reported in 6.2. A strategy template developed in this study organizes these two strategies, and, thus, it provides suggestions or hints that are more precise to define the target requirements. Namely, the template helps designers define the target requirements for improvement.

7 CASE STUDY

This section discusses how the proposed method was applied to a real B2B service, facility construction and maintenance service, in which a utility company was the service receiver. Figure 7 shows the overview of the service.

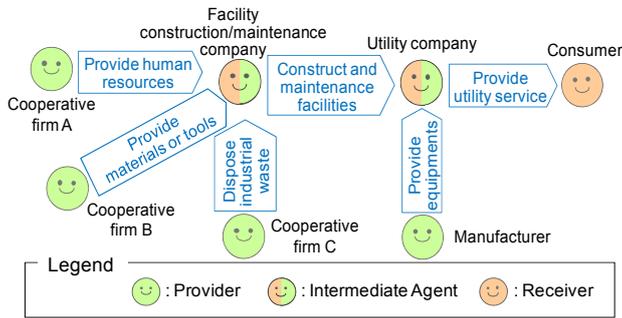


Figure 7: Overview of the case example

In this example, the utility company offers a social infrastructure service and maintains lifelines for the public. Thus, the utility company has to operate its facilities safely. A facility construction/maintenance company constructs and maintains the facilities of the utility company. The utility company purchases the equipment needed to operate its facilities from a manufacturer. Cooperative firms provide human resources, materials, and tools or are entrusted to dispose of industrial wastes.

The focus was to improve the facility construction and maintenance service received by the utility company. Namely, in this case study, requirements in the service were identified, and then the identified requirements were analyzed by using the proposed matrices and strategy template.

Requirement Identification

First of all, the requirements for the service were identified with the Business process- and Goal-oriented Requirements Analysis method. Table 3 illustrates a part

of the process to formulate requirements, and the leftmost column in Table 4 shows a part of the result. In this case study, nearly 50 requirements, e.g., "Reliability of an equipment" and "Accuracy of an inspection," were identified.

Table 3: Requirement Identification

Keyword	Required item/ Required quality	Quality elements (chosen from the element list)	Quality elements (new elements)
Construction / Repair Planning	Valid		Validity
Work situation	At various situations		Without limitation
Quotation	Fast	15D(Rapidity in processing)	
Equipment	Decrease renewal costs	1A(Cheapness)	Long life

Requirement Evaluation: Classifying

To analyze the identified requirements, the fulfillment level of the requirements was evaluated qualitatively through a discussion with a person involved in the service. The result is shown in Table 4. Secondly, the identified requirements were classified into three types of Kano quality. Questionnaires were adopted for the objective classification. Table 4 illustrates the result.

Thirdly, internal strengths and weaknesses as well as external opportunities and external threats were extracted on the basis of some discussions and data collection.

- The service provider's internal strength was an advanced technological capability.
- Their internal weaknesses were: more poorly constructed technical training within the company than several years before and relatively-weak relationship with the customer, i.e. the utility company.

Table 4: Requirement evaluation

Requirements	Fulfillment level	Kano Quality	Internal Environment		External Environment	
			Strength	Weakness	Opportunity	Threat
Reliability of [equipment]	Fulfilled	Must-be	Unrelated	Unrelated	Related	Unrelated
Environmental friendliness of [equipment]	Unfulfilled	Attractive	Unrelated	Unrelated	Unrelated	Related
Long life of [equipment]	Unfulfilled	Attractive	Unrelated	Unrelated	Unrelated	Related
Stability of a [facility]	Fulfilled	Must-be	Unrelated	Unrelated	Related	Unrelated
Accuracy of [inspection]	Fulfilled	Must-be	Related	Unrelated	Related	Unrelated
Stability of [power supply]	Fulfilled	Must-be	Unrelated	Unrelated	Unrelated	Unrelated
Degree of handing down of [skills] to younger employees	Partially-fulfilled	Must-be	Unrelated	Related	Unrelated	Unrelated
High capability on self-managing of a [team]	Fulfilled	One-dimensional	Related	Unrelated	Unrelated	Unrelated
Small amount of [waste of materials]	Partially-fulfilled	One-dimensional	Unrelated	Unrelated	Unrelated	Related
Punctuality of [work]	Fulfilled	Must-be	Related	Unrelated	Unrelated	Unrelated
Diversity of [work techniques]	Partially-fulfilled	One-dimensional	Related	Unrelated	Related	Unrelated
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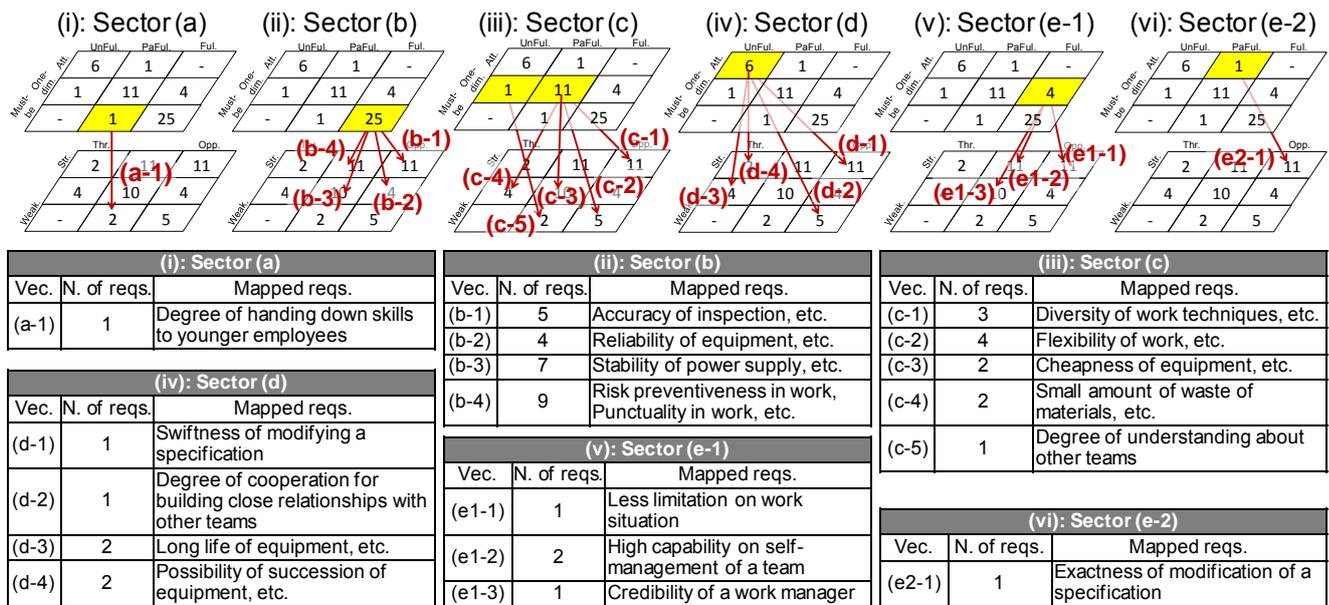


Figure 8: Distribution of requirements

- The external opportunities for their services were: an increase in disasters caused by climate change and an increase of the difficulty level of construction/repair work because of the complexity of equipments. (The first is a risk factor to maintain facilities for the utility company; thus, for the facility construction/maintenance company, this situation will be a chance for their maintenance business.)
- The external threat for their service was societal demand for the reduction of the environmental burden. (Up to now, the facility construction/ maintenance company has been unconcerned about environmental burden and just focused on safety or output due to the fact that they are involved in public infrastructure.)

Subsequently, the identified requirements were evaluated whether they were related to the above-mentioned S, W, O, and T or not. The results are shown in Table 4.

Based on each result, the requirements were mapped to the bi-layered matrix. Vectors to connect the same requirement were then described. The results are shown in Figure 8. The numbers in each cell indicate how many requirements belong to the cell in the matrices.

Determination of the target requirements

The facility construction/maintenance company, which was a service provider in this case, intended to improve its service toward the two objectives described below.

- Fortifying the basics of their current service.
- Providing new values to the service receiver, where the new values must fit into the customer needs.

Considering the five rough strategies corresponding to the five important sectors, for the first objective, i.e., fortifying the basics of their current service, we analyzed some vectors which start with sectors (a) and (b). As shown in (i) in Figure 8, there was a vector related to sector (a), which represented a requirement “Degree of handing down skills to younger employees.” As reported in 6.2, requirements in sector (a) must be fulfilled to warrant the minimum quality of the service, and anything less will result in customer rejection. Therefore, the “Degree of handing down skills to younger employees” was insufficient from the customer’s viewpoint; thus, the provider has to improve it by, e.g., reinforcing education or reorganizing work teams. It is noteworthy that concrete solutions should be conceptualized in the “service design” phase.

Meanwhile, we could find 25 requirements that were represented by vectors starting from sector (b), e.g., “Reliability of equipment” and “Punctuality of work”. These requirements were considered as the must-be quality elements and have been fulfilled. It means that the minimum quality of the services related to these requirements was assured. Furthermore, according to the rough strategies reported in 6.2, there seems to be no significant risks that impede the quality of the service, since the vectors were not headed to Weakness- or Threat-related cells in the lower matrix.

On the other hand, focusing on vectors starting from sector (d) was the most effective way to examine requirements that relate to the second objective, namely, providing new values to the service receiver. Six requirements were found in the sector, and new values might be provided by considering additional services to meet some of these requirements.

Furthermore, observing the mapping result on the lower matrix and using the strategy template helped identify the requirements that deserved attention. In this case, for example, the requirement “Swiftness of modifying a specification,” which was translated from customer needs “A specification should be changed or modified swiftly in response to requests,” was found in sector (d) in the upper matrix. In the lower matrix, this requirement was mapped to the Opportunity – Strength cell; thus, its vector was headed to the Opportunity – Strength cell. It means that, according to the strategy template, the requirement was easy to fulfill, since the requirement was not related to the internal weaknesses and the external threats. Therefore, when an immediate improvement is needed for the service provider, conceptualizing a service that meets this requirement was the best way. On the other hand, in sector (d), there was a requirement “Possibility of succession of equipment,” which means that equipments in a facility should not be disposed of without reusing. This requirement’s vector was headed to the Threat – Strength cell. Referring to the strategy template, there may be risks caused by the external threats, when the provider attempts to create a new service that meets the requirement. However, if a provider can overcome the threats, a differentiated service can be realized with providing a new value to the utility company.

8 DISCUSSION

Once requirements in a service are identified, finding out the target requirements from them is the designer's responsibility, and it depends on the capability of the designers. In many cases, this puts a burden on the designers, since designers have to consider or manage a number of requirements; for example, we had to consider nearly 50 requirements in this case.

Concerning this problem, by classifying the identified requirements into the developed matrices and analyzing the classification result, we could obtain some significant suggestions to define the target requirements. For example, in this case, we could find that fulfilling the requirement "Degree of handing down skills to younger employees" was important to warrant the quality of the service. On the other hand, designing a new service that meets the requirement "Possibility of succession of equipment" will be effective to provide novel value for the utility company. Namely, the proposed method provided important suggestions to define the target requirements based on a service provider's strategy.

However, the matrices do not provide sufficient information to determine the target requirements, as they do not deal with the data of cost, productivity, and profit evaluations, which can be regarded as important criteria for a service improvement from a provider's viewpoint. Therefore, future work will include a scheme to combine other evaluation criteria with the proposed method. Namely, we need to clarify the details of the biggest connecting point in Figure 3. Of course, we have to establish a more concrete method for each step in the service design phase.

9 CONCLUSION

In this article, we propose a framework of requirement-oriented service improvement. In this study, we concentrate on the early phase of the framework, which is requirement identification, evaluation, and the definition of specific requirements that should be focused on improvement. As a concrete and practical method for this challenge, the requirement evaluation matrices and the strategy template were developed.

It is difficult for designers to define design targets, i.e. target requirements, in service improvement. To overcome this problem, the proposed method enables designers to obtain some significant suggestions or hints to define the target requirements.

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