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A MODELING METHOD OF SERVICES ON THEIR CONTENTS AND DELIVERY PROCESSES

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ABSTRACT
Manufacturers are required to supply more services to customers in addition to material products. This paper aims at presenting a method to model services contents and its delivery process for developing a design methodology of services. To serve this need, using function design tools in engineering, we extend traditional service blueprinting methods to include physical processes and its relationship with service activities as well as the relationship with customer value. As a result, we developed graphical representation of service that marketers and engineers can share during the design phases of service. For engineering field, by incorporating information of service delivery process into conventional function model, the value of both physical products and human activities throughout product lifecycle can be well balanced. For marketing field, by incorporating functional quality in service delivery process, evaluation of customer satisfaction on services based on their contents can be performed. As a consequence, the maximization of customer value in service can be expected by the proposed blueprint.

Keywords: Service design, Service Blueprint, Function design, Customer requirement, CAD

1 INTRODUCTION
As our economy matures, manufacturers are required to supply more services in addition to just material products to customers toward improvement of the Quality of Life. As a result, new concepts such as Product/Service-Systems (PSS) [2], Functional Sales [3], and Functional Products [4] have been developed so far. PSS can be defined as consisting of 'tangible products and intangible services designed and combined so that they jointly are capable of fulfilling specific customer needs' [5]. The business concept of Functional Sales can be defined as "…to offer a functional solution that fulfills a defined customer need. The focus is, with reference to the customer value, to optimize the functional solution from a life-cycle perspective. The functional solution can consist of combinations of systems, physical products and services" (modified from [3]). Functional Products, also known as "total care products" are products that comprise combinations of "hard" and "soft" elements [4]. In spite of these many studies, effective design methodologies have not been developed enough until now.
Among them, the discipline that our group attempts to establish is called Service/Product Engineering (SPE) [6] [7]. The motivations of SPE research include the importance of service activities that have been getting more critical in manufacturing industries. We do not regard physical products as prerequisite in provided offers, while most of the other existing research (e.g. PSS) does. One of our goals is to develop a CAD (computer-aided design) system that designers can effectively utilize upon designing services with the SPE discipline. Our development of the service CAD system named Service Explorer [6] [7] is among very few research of constructing computer support tools for designers.

This paper presents a modeling method of services on their contents and delivery process. We design products and activities in parallel according to the customer's needs. In addition, we focus more on the creation of new services than on the analysis of existing services using conceptual design tools in engineering. The rest of this paper is organized as follows: Section 2 describes the motivation of this paper: problems of service blueprinting method. Section 3 illustrates the modeling method of services. Then, its modeling procedure and an example are discussed in Section 4. Section 5 discusses and Section 6 concludes the paper.

2 MOTIVATION

2.1 Definition of service

In this paper, service is defined as "a deed between a service provider and a service receiver to change the state of the receiver [6]". This definition is broader than typical definitions encountered in traditional management and marketing fields with the obvious difference from products. They emphasize the characteristics of intangibility, heterogeneity, perishability, and simultaneity [8]. According to the definition, most business activities are services, including selling physical products. Services to be targeted in this study correspond to PSS (designed to change the state of the receiver), while a pure service (that comprises human activity) is called a service activity.

2.2 Problem of existing service blueprinting methods

In marketing field, customer analysis and service activity design are the focus of service development. The service blueprint [9] [10] [11] and the service map [12] are the most famous tools used by marketers to sequentially and visually design service activities. It represents service activities as flow charts with interactions among providers and customers. In the service blueprint, service activities are arranged with respect to two lines as shown in Figure 1: (1) the line of interaction around which the customer and the service provider interact and (2) the line of visibility that separates the "onstage" (visible) activities from the "backstage" (invisible) activities performed by the provider.
The service blueprint is known to be an effective tool for designing the delivery of services prior to the actual delivery. The service blueprint, however, has the following problems in terms of service development.

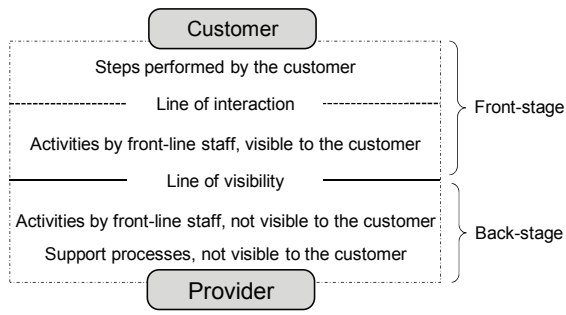


Figure 1. Schematic illustration of service blueprint (modified from [1])

Difficulties to evaluate customer satisfaction

A number of researches (e.g., [13] [1] [14]) have pointed out that the service blueprint is more an operating manual of the provided service, rather than a depiction of customer requirements. The service blueprint is unable to properly correlate a customer value and service activity. While there is considerable research on service process development in the reference literature [15] [16] [17], service activities are often directly related customer needs with little discussion of the effect of such activities. This problem makes it difficult to assess customer satisfaction on services based on their contents.

Need for physical processes in addition to human processes

Academic literature on the service blueprint has placed considerable emphasis on the interpersonal service delivery system. In this study, however, we strive to develop a service offering comparable to PSS, which itself is a combination of products and service activities. Since human processes and physical processes have alternative and/or complementary relationships with each other in PSS, understanding product behavior and its relationship with service activities is essential in the design, evaluation, and simulation of a service throughout the lifecycle of products. Therefore, the blueprint of a service such as PSS should contain information concerning the product and its service behavior as well as information on the human activity associated with the service.

Lack of normative notation
Shostack's blueprint notation in earlier literature was basically a simple flowchart. Consequently, the detailed meanings of graphical elements are often ambiguous and not well defined [18]. Normative notation and explicit control flow are needed for analyzing and evaluating the described service delivery processes.

The objective of this study is to solve these three problems of service blueprint for developing a design methodology of services. In the following section, we extend the service blueprinting method to include physical processes and its relationship with service activities as well as the relationship with customer value. We develop a graphical representation of service contents and its delivery process that marketers and engineers can share during the design phases of service.

3 MODELING METHOD OF SERVICES

3.1 Overview
Figure 2 shows a schematic illustration of service elements and the proposed modeling method. Elliptical nodes represent customers and service entities such as humanware, hardware, and software. Here, software is any component such as the computational code, policies, norms, rules, procedures, practices and any other formal or informal rules that define the way in which the system components interact [19]. In this paper, software is grouped with hardware or humanware: software is either related to hardware or humanware. Rectangular nodes represent service elements such as customer value, functions, and processes to analyze and design the relationships between customers and actual entities. Service activities are tasks performed by humanware and its related software, and product behaviors are tasks performed by hardware and its related software.

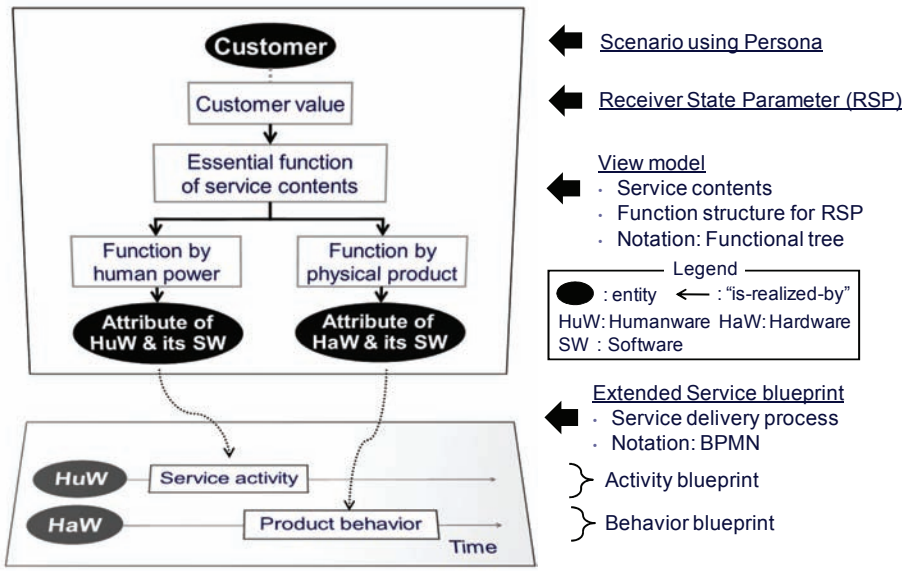


Figure 2: Schematic illustration of the proposed method for modeling services

3.2 Representation of customer value: Receiver State Parameter (RSP)
The upper part of Figure 1 shows the customer, customer value, and the corresponding modeling methods: scenario using persona and Receiver State Parameters (RSP) [6] [7]. A set of RSPs represent customer value and they are indices of customer satisfaction in receiving service offerings.

3.3 Representation of service contents: function structure for an RSP

The middle section of Figure 2 shows functions of service contents and the corresponding "view model" method [6] [7]. After identifying the customer value as RSPs, functions and attributes of entities for each RSP can be described. Function structure in the view model works as a bridge between the customer value and actual entities via a tree structure. Yoshikawa's General Design Theory (GDT) [20] provides a basis for our approach. The theory is discussed in terms of two topologies defined by functions and attributes of artifacts. The projection from functions to attributes can be universally recognized as design of products. Assuming that services can also be designed by the same projection, RSPs may consist of parameters in both function and attributes.

Function representation

A function is defined in this paper as "a description of behavior abstracted by humans through recognition of the behavior in order to utilize the behavior" [21]. Here, the term behavior implies both physical phenomena and human activity. According to this definition, a function can be represented in two ways: (1) as symbols represented in the form of to do something and (2) as a set of behaviors. In order to emphasize the flexibility of the description, let us consider the first representation wherein functions in a view model can be represented as lexical symbols (i.e., (1)). Although the symbols are meaningful only to designers, this information, which is associated with the RSP, is essential for clarifying the roles of the design objects. On the other hand, the behavioral aspects of functions (i.e., (2)) are incorporated in the linkage with the service blueprint in Section 3.4.

Embodiment of function: entity

Some of lowest-level functions are implemented through humanware (such as staff and customers), and some of lowest-level functions are implemented through hardware (in the form of machines and facility). Software involves both these functions. Since the customer value (represented through RSP) is related to an embodiment of a service, whose characteristics are recognized as attributes, designers can perform a static evaluation of customer satisfaction based on these entities and their attributes.

3.4 Representation of service delivery process: extended service blueprinting method

The traditional service blueprint is extended so as to solve the problems pointed out in Section 2: to include product behavior and its relationship with service activities as well as the relationship with customer value. As shown in Figure 3, the extended service blueprint consists of an interrelated activity blueprint and behavior blueprint. The Business Process Modeling Notation (BPMN) [22] [23] [24] is used for describing the service blueprint so as to have consistent semantics. The modeling in

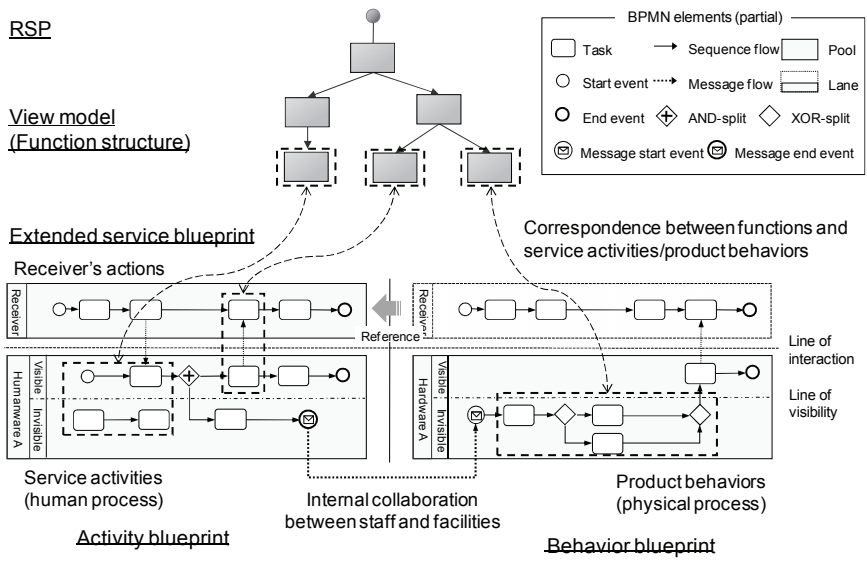


Figure 3: Detailed illustration of the modeling method focusing around service delivery process

BPMN is made by simple diagrams with a small set of well-defined graphical elements. The adoption of BPMN supports wide variety of control flows and provides a graphical representation that is readily understandable by all business users, from the business analysts, to the technical developers, and to the business people who will manage and monitor those processes [24].
By connecting the view model aforementioned and the extended service blueprint, it is possible to describe service activities and product behaviors while clarifying their influence on the receiver (i.e., quality of service). In other words, by focusing on customer value and the roles of entities as described in the view model, service activities and product behaviors can be equivalently dealt in the extended service blueprint. The extended blueprint can be especially used as a communication tool for managers, marketers, and engineers in service development.

Activity blueprint
The activity blueprint corresponds to Shostack's blueprint and illustrates the activity-oriented aspects of a service. The left section of Figure 3 represents an activity blueprint using BPMN. Each humanware of a service is arranged as a BPMN pool, and the line of visibility is denoted as the border between a visible BPMN lane and an invisible BPMN lane in the pool. Some of the steps performed by the receiver in the activity blueprint are selected from the scenario presented in Section 3.2.
The activity blueprint specifies the interactions between the receiver and the staff; these interactions are represented as BPMN message flows. Human processes, which are represented by a set of service activities and BPMN sequence flows among them, are subject to organizational rules, employee manual, and so on.

Behavior blueprint
The product blueprint illustrates the behavior-oriented aspects of a service. Physical processes in the behavior blueprint are described as well as the activity blueprint using BPMN for the sake of achieving a simple user interface. Since BPMN is a general-purpose modeling language for business process, it can be applied to a technology-oriented process in PSS.
The behavior blueprint specifies the interactions between the receiver and the products including self-service machines. These interactions are represented as BPMN message flows. Physical processes, which are represented by a set of product behaviors and BPMN sequence flows among them, are subject to physical lows and/or computational algorithms.

4 MODELING PROCEDURE AND EXAMPLE
Figure 4 shows a modeling procedure of services according to the modeling scheme described in Section 3. The framework in Figure 4 consists of four layers: receiver state layer, function layer, process layer, and attribute layer.
Let us describe the modeling procedure step-by-step while discussing an example by applying the method to an elevator operation service. This elevator business is chosen for working on heightening the value of product throughout its lifecycle. In addition to regular maintenance of elevators, this elevator company tackles and develops new service including building security control.

4.1 Step 1) Analyze the customer and his/her requirements
Primitive customer actions in receiving a service are arranged on the process layer. Concurrently, state parameters of the customer are enumerated on the receiver state layer according to the Persona-based scenario and a set of RSPs are identified from them. Through this step, customer value that the service targets is determined.
The authors collaborated with an elevator company and worked out a customer survey. As a result, the following four RSPs were identified from this process: "the security and safety of the service", "ease of movement", "service availability", and "comfortable environment".

4.2 Step 2) Design service contents
After identifying the customer value as RSPs in the previous step, service contents that affect each RSP are described in tree structure on the function layer. By detailing upper-level functions and constructing a functional structure, customer value (represented through RSP) is related to concrete functions on the function layer.

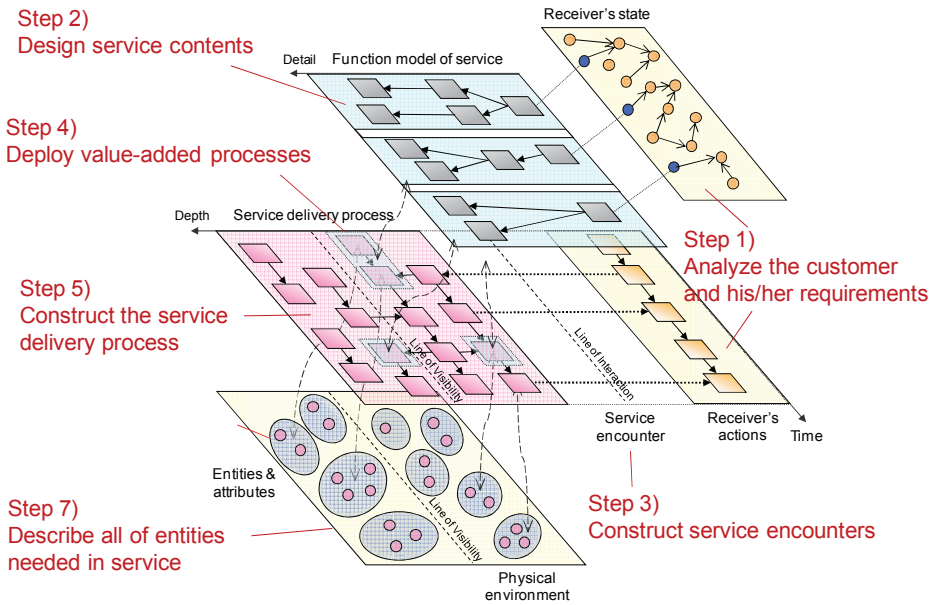


Figure 4: Framework to design services focusing their contents and service delivery process

According to the results of RSP identification in step 1, the target service was expressed with the view model scheme. Figure 5(a) shows the upper part of service contents corresponds to the RSP "security and safety". The root function for this RSP in elevators was decomposed into three functions: responding quickly and certainly to an emergency, deterring crime in elevators, and maintaining the reliability of elevators. These three functions themselves were decomposed further into several sub-functions. Consequently, the following entities are associated with the lowest-level functions: humanware entities are monitoring staff, staff for emergency, and maintenance staff; hardware entities are an elevator, a control system, a sensor for disaster, an intercom in elevator, a monitoring system, and so on.

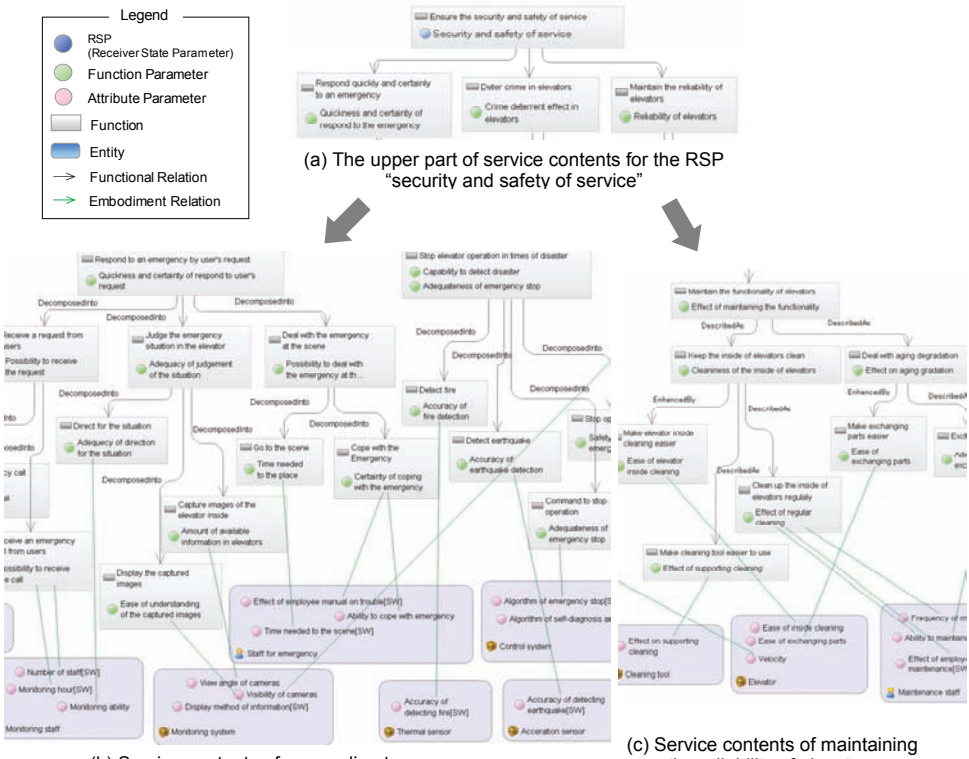
The function structure includes little information with regard to the service delivery process. This is mainly because the view model is the graph structure of the functions that contribute statically to an RSP; their activating processes are not considered in time and space.

4.3 Step 3) Construct service encounters

In the following step 3-5, service delivery process are described on the process layer according to service contents depicted in the step 2. In this step, service interactions between provider and customer are constructed in the extended service blueprint. Some of the humanware/hardware entities in view models, such as staff and machines, are correlated with BPMN pools in the corresponding activity/behavior blueprint.

4.4 Step 4) Deploy value-added processes

The middle section of Figure 3 and Figure 4 presents the relationships between functions and the service activities/product behaviors in a service blueprint. Each of the lowest-level functions can be deployed into a chain of value-added process; the process can comprise service activities, product behaviors, and receiver actions. Such relationships represent the behavioral aspects of the lowest-level functions. Therefore, they are subjective and exhibit a many-to-many correspondence, according to the discussions on function and behavior in conventional design studies [21]. In the case where a mapped process includes customer actions, the corresponding function needs customer participation as a co-producer of the service.



(a) The upper part of service contents for the RSP "security and safety of service"

(b) Service contents of responding to emergency

(c) Service contents of maintaining the reliability of elevators

Figure 5: An example view model of elevator service regarding the RSP "security and safety" (partial)

4.5 Step 5) Construct service delivery process

After laying out processes, all processes on the service blueprint are organized to ensure the totality of the delivery process. Examples of operation to organize processes on the service blueprint are as follows: classifying into visible/invisible process; adding/deleting process, aggregating similar processes, and dividing into plural processes. Process on the service blueprint can not be always related to functions on the function layer (e.g. support process). Such process is understood as non-value added process, while it involves executing the service. Finally, sequence flow, message flow, and other BPMN flow figures are added. Such figures include branch on condition, exception handling, and so on.

Figure 6 shows the part of the extended service blueprint after finishing step 3-5. This blueprint mainly shows the activities of the monitoring staff to respond an emergency request from the elevator user via intercom installed in elevator. The portions describing the processes of the monitoring staff and the monitoring system are split up into 2 sections. Processes in the upper section are visible to the user, while processes in the lower section are invisible.

BPMN group objects denoted by the broken lines in Figure 6 represent the relationship among functions and service activities (Figure 6(a)(b)(c)). The function of judging an emergency situation in elevators, which contributes to responding to the emergency, can be implemented by collaboration among the user, the monitoring staff, and the monitoring system. Deployed processes for the function are parallel processes and include a conditional branch of directions about the emergency.

As shown in Figure 6, human processes and physical processes are unified explicitly and effectively by using extended service blueprint.

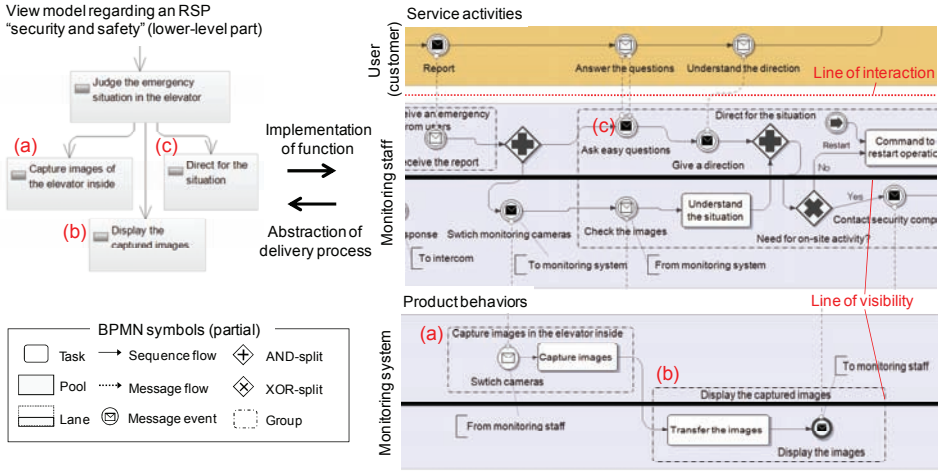


Figure 6: Representation of service contents and service delivery process (partial)

4.6 Step 6) Describe all of entities needed in the service

Entities such as resource, processing object, and product of activities are arranged on the attribute layer: entities not only from functional viewpoint but also from the viewpoint of physical environment surround customer. Hence, as with visibility of activity, entities on attribute layer can also have visibility to customer.

5 DISCUSSIONS

5.1 Relationship with Product design process

Our method emphasizes concurrent designs of product and service activity. The view model and extended service blueprint technique support the early stage of service development: function of service, product behavior, and human activity. By developing them iteratively, we can sequentially evaluate a service offering.

To clarify the relationship with product design process, let us compare design processes of product-oriented service offering. Figure 7(a) shows general design process according to traditional engineering methods, while Figure 7(b) shows the proposed design process according to the presented method in this paper. In the former process, product design is based first on the result of product planning. After that, product production and service activity design is done. In the latter process, product planning is replaced with service contents design, and the early stage of product design is done in service delivery process design. Design of service contents and their delivery process should be cooperative tasks among engineers and marketers to links the information between product specification and activity specification in the later design phase. The output of such cooperative tasks can be used for the following tasks: engineers do detailed design of products on traditional CAD tools, marketers do detailed service activity design, perform test marketing on target customers, and managers organize staff for service operation.

5.2 Evaluation of customer satisfaction

Let us discuss a method to estimate customer satisfaction after designing a new service with the presented method. Functional qualities for customer requirements can be specified by designing embodiment structures of the service: service delivery process and entities with their attributes. The papers [25] [26] demonstrate evaluation of customer satisfaction by introducing non-linear satisfaction mapping of function quality on parameters in the view models. In that evaluation, Kano model [27] and Prospect theory [28] are applied as basis of constructing such non-linear mappings. Kano model insist that satisfaction a quality level delivers has different inclinations by quality element. Prospect theory in behavioral economics also insists that cognitive benefit in human decision-making is

inconsistent with actual benefit. By measuring customer satisfaction for each RSP based on the satisfaction mappings of function quality, the designer can review how degree the service captures customer satisfaction.

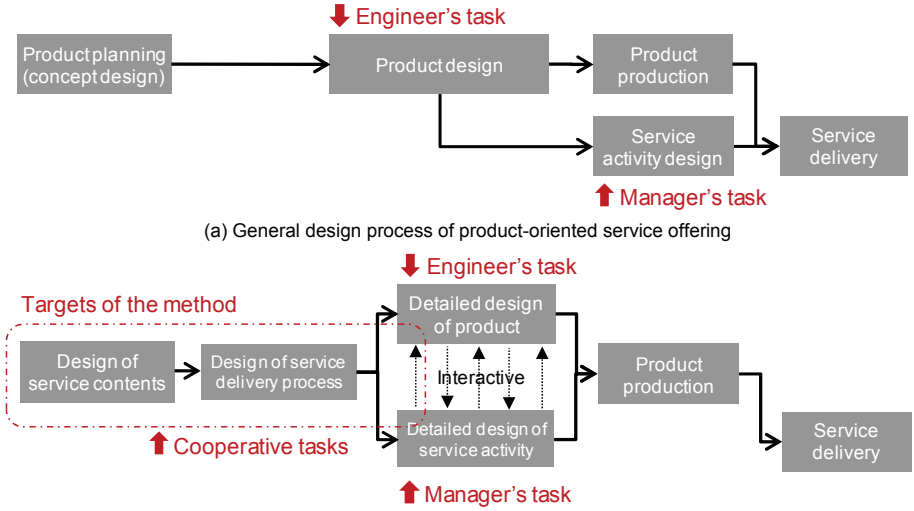


Figure 7: Design processes of product-oriented service offering

6 CONCLUSION

Services have increasingly become an important part of the traditional manufacturing industry. Although current physical product and human activity are designed separately, they are strongly related one another in service offering. In this paper, we introduced a functional representation of service contents for customer value. In addition, a method called "extended service blueprint" was proposed, which enables us to design service delivery process that consist of both human processes and physical processes during the early phase of design.

For engineering field, by incorporating information of service delivery process into conventional function model, the value of both physical products and human activities throughout product lifecycle can be well balanced. For marketing field, by incorporating functional quality in service delivery process, evaluation of customer satisfaction on services based on their contents can be performed. As a consequence, the maximization of customer value in service can be achieved by the proposed blueprint.

Future research will include the feasibility assessment on much complicated product–service combinations, and the development of a method to simulate services based on the extended service blueprint.

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