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A DESIGN METHODOLOGY OF SERVICES

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1 Introduction

Service or product-service systems, as opposed to physical products, have been gaining interests of industry as well as of researchers. There are two reasons for this. First, due to increasing awareness of environmental problems, dematerialization is highlighted as a method to decouple economic growth from consumption of energy and material. It is expected to reduce environmental impacts caused by artifacts while maintaining economic performance. This is a focal shift to service and knowledge contents of products (i.e., artifacts) from products as material [1].

Second, in almost every product category, products are mature. It is increasingly becoming difficult to further differentiate products with only costs, functions, and physical performance. One of the few areas where we can find new gains resides within the product value chain. For instance, for products that require consumable supplies such as desktop printers, business of these supplies is not negligible and has become even bigger than the business of printers themselves.

Traditionally, service has been mainly discussed within marketing [2–4]. Shostack [2] even talks about “design of service” and “to engineering service. However, because service is not goods, it was inappropriately dealt with even in economics. Within engineering, service has been mostly neglected and this paper is an attempt to properly deal with service in an engineering context. In particular this paper focuses on service design and its methodologies, because in designing innovative products such as soft artifacts to generate more added values, considering only product life cycle is inappropriate [5, 6]. We need a much bigger framework to be innovative and that is service engineering.

Service is a chain of activities or actions and is not a physical existence [7, 8]. Because of this, service design contrasts with product design, for which there exist a variety of product design methodologies such as [9, 10], in many aspects. For instance, product design methodologies formulate design as a process from functional requirements through physical effects to embodied structure of technical systems. They assume underneath such concepts as function, behavior, and structure typically found in physical systems. However, obviously service does not contain these concepts, and consequently these product design methodologies cannot be applied to service design.

In this paper, first we briefly review our past research efforts about service definition and service modeling [5–8]. We will identify service elements that constitute service. Such service modeling is crucial also to develop, e.g., service CAD [11]. Based on the differences in these elements, we will categorize existing services. Next, we will present essential concepts of

service engineering that is required to intensify service contents. As many authors correctly point out [12–14], traditionally we have been focusing too much on products and neglecting systemic aspects that contain products, services, and processes. Servicification cannot be achieved without appropriate technological theories, tools, and methods to increase added value of service.

We then describe two different ways to design services, which are service design methodologies; one to give best-fit service, and the other to develop a new service. We point out that ownership plays a crucial role in designing service. Finally, we illustrate an example of new service design that involves a recovery system for post-consumer home appliances. This is becoming increasingly important due to environmental legislative measures such as EU's directive on WEEE (Waste Electrical and Electronic Equipment [15]).

2 Service

2.1 Definition of service

In this section, we overview the definition of service that has been proposed in our previous research [7, 8].

In our daily lives, we perform various activities, such as preparing food, going out for shopping, commuting to a work place, etc. To achieve the aims of these activities, we sometimes need help (activities) from a third party. For example, to go out for shopping, we may need a transportation service; otherwise, we need walk, ride a bicycle, or drive by ourselves. Here, we consider such activities of a third party as services. If we assume services are activities, it cannot be stored and is consumed and disappears instantly.

We may define service, which is generally perceived as an activity (see Figure 1): *Service is an activity that the service provider offers to the service receiver in a service environment and generates values for the service receivers.* We also define an *activity* that is a series of procedures that the service provider offers to the service receiver.

When a service is offered, the service receiver performs his/her own activities aiming at a certain aim. The service should create a benefit or convenience for the service receiver, typically by enabling the receiver to achieve the aim or by making his/her activities easier. The service may even change the state of the service receiver, which was the aim of the activity.

It is also important to notice that service requires information exchanges to invoke the service. For instance, the service provider has to clearly identify himself/herself and the service contents as well as the price. These must be agreed upon between the service provider and the service receiver before the service is performed. This is modeled as information exchange between the provider and the receiver. Doctors need to receive previous health records of patients to perform medical services, and patients would like to know about the doctors past performance to choose a good doctor. Note that this service information exchange takes place often before the service is performed and is different from the information that is part of service contents. This service information is a prerequisite to start or to invoke service, rather than part of service contents. Additionally, this exchange doesn't have to be bi-directional. Many service types can be executed without clearly identifying service receivers; in other words, they can stay anonymous. In typical public transportation, for example, you do not have to identify yourself.

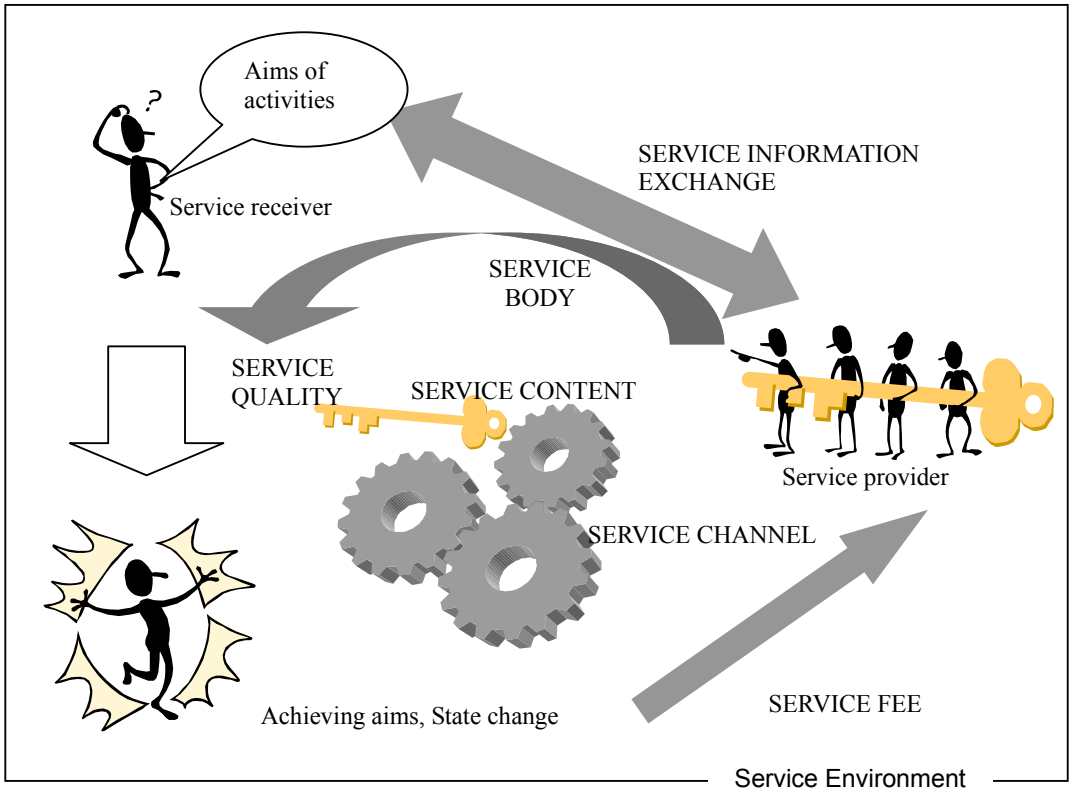

Figure 1. Service

The *service goal* is the aim of the receiver's activity or the state change of the receiver. In contrast, the *realized service* is what was realized by the service. The *service value* for the service receiver is the degree of the service receiver's satisfaction through the realized service. The *service quality* concerns with how the service satisfied the receiver.

This implies that the service value is dependent on subjective judgment of the service receiver. The same service can mean to someone a good service and to another a bad service. For instance, media such as TV broadcasting services provides the public with information through various channels. The viewer changes his/her state and become more knowledgeable. This is the service value of the media. However, if the news did not come at the appropriate time, the value of this service could be low or zero; the service qualities of media could be, therefore, costs, immediacy, accuracy, etc.

Depending on the service value, the service receiver pays a fee (not necessarily after the service took place). There are free services, although it is only free because, for instance, the service provider aims at obtaining certain information about the service receivers or is paid for other purposes by a third party. For example, purchase records of credit card holders could be a good source of marketing information. For this purpose, the service provider (credit card company) can even offer free cards. Watching commercial TV programs itself is free, but the costs are borne by sponsors. This indicates that commercial TV stations in fact offer two services (double structure); one to provide TV programs to viewers and one to distribute product information to the viewers. Similarly, customer loyalty management systems such as frequent flyers programs can provide customers with free benefits including free tickets. Of course, the real costs are included in the price, but at least for frequent flyer program members, the membership itself does not cost.

Figure 1 shows a more formal definition of service. In the *service environment*, the *service receiver* performs his/her own activities with an aim. The *service provider* provides the service receiver with *service contents* through a *service channel*. This provision of the service as an activity is the *service body*. The object of the service could be the service receiver himself/herself, the service receiver's own activity, or an object or activity associated with any other service. As a result of the service, the service receiver receives some convenience to achieve his/her own aim or changes his/her state. The difference between the service goal and the realized service creates the service value depending on which the receiver pays a price.

Before or during service, there can be service information flow between the service provider and the service receiver. This flow can be both bi-directional and mono-directional.

In general, artifacts play the role of the service channel as a device to deliver, amplify, or automate service. Because a service channel is an artifact, it consumes material, energy, and information. In addition, service contents can also be artifacts and involve material, energy, and information. Because of this, although service itself is an activity, it might be unavoidable to consume material, energy, and information and service cannot be free from environmental impacts.

This definition can be contrasted against, for instance, Andrade's definition of service elements, i.e., objects, procedures, and people [14].

Table 1. Service elements

Service environment	E
Service provider	P
Service receiver	R
Aim of the service receiver's activity	Ap
Service target	T
Service body (as an activity)	A
Service channel	Cp
Service content	Co
Service information	I
Service goal (achievement of an aim, state change)	G
Realized service (achievement of an aim, state change)	M
Service quality	$\underset{\sim}{Q}$
Service fee	F

2.2 Elements of service

Having defined service above, we can summarize elements of service as listed in Table 1.

Service goals represent the needs of the service receiver (or something insufficient for the service receiver to achieve his aim). As a result of service, the service receiver can easily achieve his/her aim (enabling service), receives help, support, or enhancement in achieving the aim (enhancement service), receives convenience of not doing the aimed activity by himself because the service provider acts as an agent of the service receiver (proxy service), or changes his/her state. The realized service can be evaluated for such factors as the degree of the aim achievement or of the state change. Service has quality. This may include such factors as capacity, efficiency, cost, time to execute the service, and accessibility (place and access point),

timeliness, frequency, punctuality, flexibility, customizability, convenience, easiness, safety, security, and comfort.

2.3 Categorization of service

From the definition of service shown in Figure 1, we may notice that there could be different types of services. For example, apparently TV broadcasting is different from elevator maintenance service, but how are they different? Focusing on the service elements depicted in Table 1, we might obtain the following five different categories of services.

Message Type Service (Table 2): For instance, a TV broadcasting service makes viewers happier and more informed by providing TV programs (i.e., information). These are state changes of the service receiver. The service channels are TV sets, equipment at the TV station, and wireless communication, and they function as devices to deliver and amplify the service. The service contents (message) are, of course, TV programs. In contrast, educators and consultants do not have clearly recognizable service channels, but they convey messages that contain knowledge and information and change the state of the service receiver.

Table 2. Message type services

Examples	**Broadcasting**	**Management consultant**	**Remote medical diagnosis**	**CRM (Customer Relation Management)**
Aim of the receiver's activity	Entertainment, Collecting information	Enterprise management	Medical treatment	Maintain good relationships with customers
Service target	Viewer, Listener	CEO	Patient	Customer
Service body	Broadcasting programs	Management advice	Diagnosis and subscription	Changes in the customer relationship
Service channel	TV station, TV sets, etc.	Consultant himself, Books	Internet	Communication channel
Role of service channel	Delivery, Amplification	Delivery	Delivery, Amplification	Delivery
Service contents	Information	Information	Information	Information (bi-directional)
Service Information	Program information	Consultant records, Company details	Doctor performance, Patient health records	Customer details
Service goal	State change (Acquiring knowledge and information)	State change (Acquiring knowledge and information)	Achieving aim (enabling, convenience)	State change (improved loyalty)

From the viewpoint of service contents, a remote medical diagnosis system can be classified as message type service. However, from the viewpoint of the service receiver (i.e., patients), it will increase opportunities to obtain medical care in isolated areas or during night. This could be convenience/enabling type service that is discussed below. From the viewpoint of the

service provider (i.e., doctors), this remote medical diagnosis system could be a service channel that automates delivery of medical care.

Massage Type Service (Table 3): This type of service looks similar to message type service, except that the service body has physical effects. A masseur gives massage service to make the receiver relaxed and to relieve him/her from pain. The service content is the motion of the masseur's hands and the service channel is his hands. Airlines perform transportation services by moving passengers from one place to another. The passenger's position (which is a state) changes. The service contents are flights performed by aircraft, airports, etc., and such service quality as transportation costs, safety, convenience, punctuality, frequency, and comfort, becomes important.

Table 3. Massage type services

Examples	**Massage treatment**	**Airlines**
Aim of the receiver's activity	Relief of pain	Traveling
Service target	Patient	Passenger
Service body	Massage	Flights
Service channel	Hands	Aircrafts, Airports
Role of service channel	Delivery	Delivery, Amplification
Service contents	Massaging	Transportation
Service Information	Symptoms	Customer's travel details
Service goal	State change (relief of pain)	State change (positional change), cost, safety, punctuality, convenience, comfort

Table 4. Proxy/Automation type services

Examples	**Tax consultant**	**Travel agent**
Aim of the receiver's activity	Tax declaration	Traveling
Service target	Tax payer	Traveler
Service body	Declaring tax	Reservation, Price negotiation
Service channel	Consultant himself	Communication methods, shops
Role of service channel	Delivery,	Delivery
Service contents	Information	Information
Service Information	Income details	Customer's travel details
Service goal	Achieving aim (Representation)	Achieving aim (Representation), convenience

Proxy/Automation Type Service (Table 4): Proxy service or automation of receiving and delivery of service could also be a service. In such cases, the main service goal is to help the service receiver achieve the aim or to increase the convenience for him/her through the service provider's activity that represents the service receiver. This type of service could also be offered to a service provider (of another service) by performing proxy service, or to a service receiver by receiving service on behalf of the receiver.

An example is a tax consultant who gives advices about tax and prepares tax declaration forms on behalf of the service receiver. A travel agency provides one-stop service for arranging travel tickets and information on behalf of the traveler. At the same time these services add values of

enabling something impossible for individuals without expertise, of cheaper costs, and of giving better guidance.

Convenience/Enabling Type Service (Table 5): This type of service makes the service receiver to easily achieve the aim or to complete the aim that is not possible. It can also offer convenience to the service receiver in achieving the aim. For instance, rental car business offers cars to travelers. This will improve the traveler's mobility during the stay at the destination, without long-distance drive between home and the destination. In this case, rental cars can be both the service contents and the service channel.

There are services that have the aspect of this service type and that of the proxy/automation type service. Automatic Teller Machines (ATMs) of banks automate cash withdrawal, but they improve convenience by enabling 24 hours services as well. Internet ticket sales systems of airlines, on one hand, automate ticket sales but, on the other, improve convenience of getting tickets while staying home or in office. This service creates extra convenience value added of "anywhere" and "anytime" by having increased accessibility over traditional ticketing offices.

Service Associated with Product Life Cycle (Table 6): This type of service carries out a variety of activities associated with product life cycle. For example, house owners have to clean and maintain their houses. However, they can ask experts to do so, who have expertise, skills, specialized knowledge, and specialized tools. Typical examples of this service type include house-cleaning services, maintenance services (of a wide variety of machines), and waste treatment services. The service targets are not the service receivers but the artifacts they own. For the service receivers, these services are necessary in purchasing, using, maintaining, and disposing artifacts.

Table 5. Convenience/Enabling type services

Examples	**Rental car**	**Bank**	**Internet-based airline ticket sales system**
Aim of the receiver's activity	Traveling	Obtaining cash	Reserving and purchasing tickets
Service target	Traveler	Depositor	Passenger
Service body	Offering a car	Cash withdrawal with ATM	Sales of tickets
Service channel	Cars, shops	IT systems, ATM	IT systems
Role of service channel	Delivery	Delivery, automation	Delivery, automation
Service contents	Material	Information, Material	Information,
Service Information	Requirements for the car, customer details	Customer details (cannot be disclosed)	Customer's travel details
Service goal	Achieving aim (Enabling), convenience, State change (positional change)	Achieving aim (Enabling), convenience,	Convenience, accessibility

Table 6. Service Associated with Product Life Cycle

Examples	**House cleaning**	**Elevator maintenance service**	**Waste treatment**
Aim of the receiver's activity	Cleaning the house	Offering vertical transportation	Waste removal, Space creation
Service target	Property of the receiver	Property of the receiver	Property of the receiver
Service body	House cleaning	Elevator maintenance	Appropriate processing of waste
Service channel	Tools, detergents	Maintenance engineers, Remote maintenance systems	Transportation methods, Treatment plants
Role of service channel	Delivery, Amplification	Delivery	Delivery
Service contents	Cleaning	Monitoring, Diagnosing, Inspection, Repairing	Treatment
Service Information	House details	Elevator details, Maintenance fees	Waste contents, Waste location, Fees and treatment methods
Service goal	Achieving aim (Representation, enhancement)	Achieving aim (Representation, enhancement), State change (Improved security and safety)	Achieving aim (Representation, enabling), convenience

3 Formalization of Service

Traditionally, engineering aimed at production and improvement of functions of artifacts looking at their physical structure, behavior, and states [16]. For instance, structural engineering was interested in "strength" of structures, discussed such behaviors of materials as deformation and destruction, and aimed to improve strength by changing structures taking states and performance of the materials.

Unfortunately, service is totally missing from this scope of traditional engineering. *Service engineering* is an engineering method to deal with service [5, 6]. However, since service is an activity that the service provider offers to the service receiver in a service environment and generates values for the service receivers, service engineering has to deal with activity and value. Service engineering, therefore, deals with not function, behavior, state, and structure of artifacts, but service as activities and is interested in improvement the value of service and reduction of its cost.

Let us try to formalize service using service elements identified in Section 2.1 (Table 1). First, service environment E is defined by:

$$E(P, R, Ch, Co). \quad (1)$$

Service is performed when service information I is disclosed and agreed upon by both the provider and the receiver. I may include promised service goal G. Thus,

$$G \subseteq I \tag{2}$$

Let V be the value added that service as a whole creates. It is measured by the degree of achievement of the service goal and the service quality. Therefore, we say:

$$V(E, M–G, Q). \tag{3}$$

While the service goal and realized service are determined by various elements, they are dominated by, among others, contribution of the service to the aim of the service receiver's activity. This means:

$$\begin{gathered} G(Ap, A, T), \\ M(Ap, A, T). \end{gathered} \tag{4}$$

Therefore, V, the value added that service as a whole creates, can be formalized by:

$$V(E(P, R, Ch, Co), M(Ap, A, T)– G(Ap, A, T), Q). \tag{5}$$

This formalization suggests that service engineering which aims at increase of V should look at increasing realized service M or service quality Q, when E is the same. M can be measured by the degree of the service receiver's aim or state change, while Q can be measured by various factors such as capacity, efficiency, cost, time, timeliness, frequency, punctuality, flexibility, customizability, convenience, security, safety, comfort, and accessibility.

4 Service Design Methodology

In this section, we discuss how to design services. Just like there are a number of "design methodologies" for products or technical systems [9, 10], we firmly believe that we can establish a service design methodology.

Just like product design, service design has some aspects. In the following, we will discuss these different aspects of service design methodology.

4.1 Increasing Value of Service

This is a design methodology to improve existing services, rather than to design a new service. The value added by created by service is signified by (5). Realized service M can be measured by the degree of the service receiver's aim or state change. So, one method to increase V is to increase $M–G$. Of course, if $M–G$ is too excessive, this means excessive (i.e., unnecessary) service. Rather, in the modern industrial context, perhaps the most effective method is to develop a service system that can fit best the customers' needs or even catch up with ever changing service goals in a timely manner. To do so, a flexible service control method is of interest.

Service quality Q can be measured by various factors such as capacity, efficiency, cost, time, timeliness, frequency, punctuality, flexibility, customizability, convenience, security, safety, comfort, and accessibility. For instance, home delivery services with such features as on-demand, door-to-door, and delivery time guarantee, have significantly better quality than

existing transport services (such as postal services).

Customization methods should look at customization of service delivery in addition to functional customization of products. This can be observed in so-called digital home appliances. These new generation home appliances target information service, control of the appliance from outside, and connection of appliances through network. If we recognize these digital home appliances as a service channel to provide information (i.e., service contents), increasing functionality of these appliances may not satisfy customers, because there are so many alternative methods to obtain information. Instead, we might increase service quality, rather than service contents, and one of the methods is to look at customization through programmability. This will also contribute to improved realized service.

4.2 Designing a new service

Designing a new service should mean to design a new service that did not exist in the past or to improve an existing service (e.g., to improve service costs). A design methodology for such a new service could be approached as follows, taking product design methodology as a prototype.

A design methodology typically begins with functional requirements and converts them in one way or another to physical embodiment structure as a design solution. For example, the famous design methodology of Pahl and Beitz [9] in principle recommends the following procedure; analysis of the problem, identifying required function, decomposition of required function into subfunctions, finding embodiment mechanisms of those subfunctions focusing on physical effects, and composing those embodiment mechanisms into a whole structure. In case of service design, unfortunately, we still don't know, for instance, how to describe service goals, how to decompose the total goal into subgoals, how to find a service mechanism to achieve a subgoal, etc.

While finding these could be a further research issue, even if we don't know these, we can still tackle the problem of establishing a service design methodology by looking at, for instance, computational design methodologies. To do so, here we try to formalize service design in a similar way as product design methodologies. Given certain conditions (such as service receiver), service design methodology should begin with "requirements" and arrive at a new service with its full details described. Table 7 depicts this typical service design problem in which service goal is the requirement, service environment, service provider, service receiver, aim of the service receiver's activity, and service target are given as conditions, and the rest are elements to be designed. Note that this discussion excludes the realized service element, because it can only be known through evaluation of actual service. Depending on the design case, the combination of given elements, requirement, and to-be-designed parameters can be different; this is also similar to product design.

Now, one design method could be a database approach or case-based reasoning approach in which we first categorize existing services in the way we illustrated in Section 2. This database (or case base) could be searched for solutions that arrive at the required goals or similar goals. If these (approximate) solutions are not satisfactory, they could be fixed to perform what is exactly required.

The other approach could be knowledge-based approach that uses service design rules. However, this approach obviously requires further research efforts, because we simply don't know composition of service design rules.

The both approaches require a verification method to see if service design candidate can perform service goal under given conditions. A simulation based evaluation method can be developed, which models a service environment and stakeholders and simulates all of their activities.

Table 7. A typical service design problem

Service environment	*E*	*Given*
Service provider	*P*	*Given*
Service receiver	*R*	*Given*
Aim of the service receiver's activity	*Ap*	*Given*
Service target	*T*	*Given*
Service body (as an activity)	*A*	*To be designed*
Service channel	*Cp*	*To be designed*
Service content	*Co*	*To be designed*
Service information	*I*	*To be designed*
Service goal (achievement of an aim, state change)	*G*	*Requirement*
Service quality	*Q*	*To be designed*
Service fee	*F*	*To be designed*

Given a service database organized according to Table 7, we can perform a service design. First, we need to understand service elements relevant to the service receiver's activity. This will generate information about the required service in the form of Table 7. At this stage, Table 7 describes a non-existing service in our service database. For example, we can think about a message type service that offers information which is not available now; we can also think about a proxy/automation type service that replaces some of the activities of the service receiver; or, another service possibility could be an enabling/convenience type service that makes the service receiver's activity easier or cheaper.

Then, we might be able to find out a similar (existing) service that can be slightly modified to exhibit required service performance. While there do not exist so many methods to do so at this moment, we can point out that changing ownership plays a crucial role in considering services.

Changing ownership is often discussed in the contexts of selling use or functions to increase service contents [17, 18]. This mode of servicification tries to replace sales of physical products with rental and lease services. The ownership of physical products may remain with the service provider (or manufacturer). In so doing, the focus of added-value generation shifts towards more effective use of physical products, hence less environmental impacts. An example is car-sharing with which less fuel consumption and air pollution can be achieved, while maintaining transportation demands with a little additional inconvenience (although we need to pay a special attention to rebound effects that energy saving by car sharing might be destroyed by other family members who drive the car leaving the car at home [13]).

Table 8 summarizes possibilities of servicification in the context of washing clothes. This table implies that ownership is a key for servicification. Washing clothes itself is a typical service associated with product life cycle. However, different patterns in ownerships of the clothes and the washing machine result in possibilities of different services.

This means that service candidates obtained by searching the service database can be modified by reorganizing their information according to Table 8. If the service target or service channel is an artifact, we may change the ownership of the artifact and come up with another scenario

that involves a new service.

Table 8. Servicification of washing clothes

Possession of clothes	*Reuse of clothes after washing*	*Purchase and owning of washing machine*	*Location*	*Washed by*	*Service Example*
Yes	Yes	Yes	Individual household	Owner of the clothes	Washing at home
		No	Individual household	Owner of the clothes	Purchasing washing functions (Pay per wash) Rental washing machines
			Centralized	Owner of the clothes	Coin-operated laundry
				Outsourcing	Laundry/Dry cleaning services
	No	N/A	N/A	N/A	Disposal clothes
No	Yes	Yes/No	Centralized	Outsourcing	Rental costumes Rental shirts Rental clothes in hospitals Rental uniforms

4.3 Example

Here we demonstrate how our service design methodology works. Let us consider a service design example of a recovery system for post-consumer home appliances.

Recent legislative measures, such as EU directive on WEEE (Waste Electrical and Electronic Equipment), post-consumer home appliances must be recovered and recycled under the responsibility of manufacturers or importers [15]. One of the problems here is the recovery of these products; to identify locations of these products is, for instance, critical to build a recovery network from individual users to recycling plants. Except for sales information, however, manufactures have little information about the locations of their products and the usage patterns that are also critical for better end-of-life treatments. For instance, less used equipment can be refurbished for second-hand market or its components can be reused for remanufacturing or as service components. It is also important to prevent consumers from just throwing away old appliances into not preferred end-of-life treatment (such as incineration). We need a mechanism or incentive for a consumer to put their appliances into a preferred route.

From the discussion about Table 8, it is clear that if the ownership of home appliances stays with the manufacturer, this recovery is not a big problem. However, we cannot change this factor for this case.

Then, from Table 6, we understand the service elements of waste treatment. Since the key to better recovery of post-consumer products is identification of location, we need to find a way to obtain this information with relatively small costs (for both the manufacture and the customer). Table 2 suggests that such information is often included in service information that is prerequisite for service to be performed but it is also often the case that this type of

information is hard to obtain due to sales practices or consumer information protection legislation.

One may find out that, Customer Relationship Management (CRM) can overcome this problem with some costs. For instance, we find out that introducing a customer loyalty management system (similar to an airline's frequent flyer program) to the waste treatment could be a solution. The customer loyalty management system can collect not only location data but also usage patterns, failure data, etc., if we combine it with a maintenance service system or consumable supply sales system. In this way, the identification of location can be solved in an integrated manner.

4 Conclusions

This paper proposed a service design methodology to intensify service contents of a product life cycle. First, we presented fundamental concepts and definition of service that led to structural schemes (such as Table 1) for better understanding of service. This is a slightly modified version of service definition presented in our preliminary work [7]. This work revealed that, in principle, our framework to capture service can cover a wide variety of services.

Based on this, the paper presented three different ways to design services. Among them, the most interesting is a method to develop a new service. This is a service design methodology which uses a database or case-based reasoning approach with a modification technique for candidate solutions. Finally, we illustrated an example of service design.

At this stage, this methodology is still very much conceptual. However, further work may lead to better formalization which may even allow computer-based implementation of service design. We also need more quantitative ways to evaluate service based on our formalization. These work may begin with collecting thorough information about existing services and categorizing them according to our formalization.

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