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A METHOD AND A COMPUTERIZED TOOL FOR SERVICE DESIGN

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1. Introduction

Service is getting more and more focus as the manufacturing industries are shifting from "product seller" toward "service provider." Especially in Japan, if the expenditure at households is classified into "goods" and "services," that for "services" accounts for 53% in the year 2003, which used to account for just 39% in the year 1993 [PMHAPT 2002]. However, very few researches on dealing with services from the viewpoint of engineering design have been achieved, while services have often been traditionally a target in the field of marketing and management (e.g., [Shostack 1981]). The authors are carrying out fundamental researches on "service engineering," which deals with services in an engineering manner [Tomiyama 2001]. One of the final goals is to develop a "service CAD," which supports engineers to design services. In service engineering, it is assumed that service design has its conceptual design stage, where realization means are found for the goals as in the traditional product design [Pahl 1996].
The authors have already proposed a methodology for modelling services [Shimomura 2002, Shimomura 2003]. On the other hand, a design process must be also described to develop a service CAD. Thus, this paper aims at proposing a service design method applicable to its conceptual design stage based on the model which is already proposed. In addition, a computerized tool for service modelling based on the adopted service model is proposed.
The rest of the paper consists of the followings. Chapter 2 explains the adopted service model and Chapter 3 explains the proposed service design method using the model described in Chapter 2. Chapter 4 explains the proposed computerized tool for service design. Chapter 5 describes discussions and Chapter 6 concludes the paper.

2. The Employed Service Model

2.1 The Definition of Service

A service is in general an activity that changes the state of a service receiver. A service is defined as an act by which a provider causes, usually with consideration, a receiver to change into the state which the receiver desires, where both contents and a channel are means to realize the service [Tomiyama 2001] (See Figure 1). A service receiver receives service contents from a service provider through a service channel. Service contents are material, energy, or information. A service channel is used to transfer, amplify, and control the service contents. Service contents sent by the service provider change the state of the service receiver. This change is the most important feature of services. The employed service model consists of three models; a flow model, a scope model, and a view model.

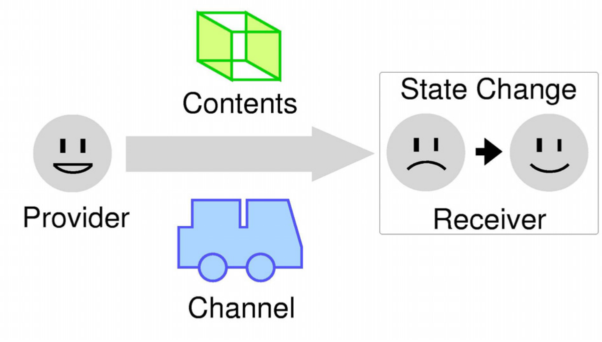

Figure 1. The Definition of Service

2.2 Receiver's State Parameter

A receiver's state is represented by a set of "receiver state parameters" (RSP). Since RSP can have quantitative values, including Boolean logic and multi-value logic, any comparison between two RSP values can be achieved. In addition, it is assumed that an RSP is observable and controllable. As the receiver's states change with supplies of contents, RSP can be described as functions of contents. Parameters expressing contents are called content parameters (CoP). In the same way, the parameters of channel, which influence RSP indirectly, are called channel parameters (ChP).

2.3 Flow Model

In general, services occur from quite a few agents' participation. In other words, many intermediate agents exist between a receiver and a provider. This is because it is in many cases necessary that intermediate agents amplify the service contents to increase satisfaction of a service receiver. This chain of agents is called a "flow model." A flow model in the case where a part maker achieves a service for a consumer driving a car is shown in the upper half of Figure 2.

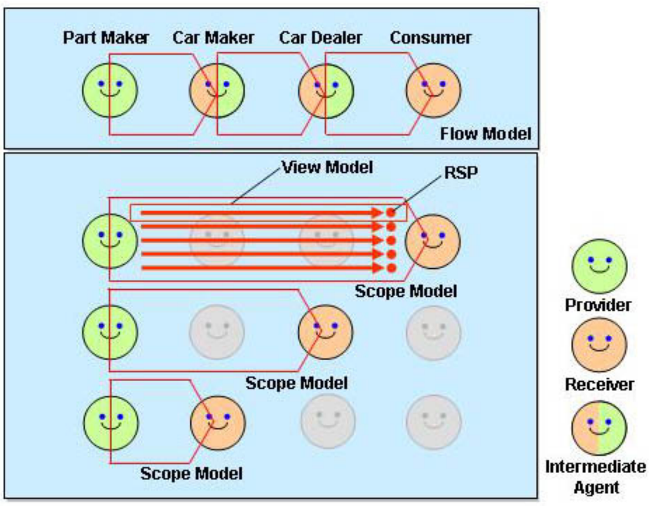

Figure 2. Relationships among Flow Model, Scope Model, View Model and RSP

2.4 Scope model

Intermediate agents in a flow model take roles of providers and receivers in general. Therefore, it is necessary to specify the target set of a provider and a receiver in the service to be analyzed or designed. A "scope model" gives a frame by which a provider and a receiver according to a needed analysis are recognized, and contains a set of "view models." See the lower half of Figure 2.

2.5 View Model

RSP values change according to how the receiver subjectively evaluates the received contents. A "view model" expresses the relationships among the elements of the service; i.e., the mutual relationships among the RSP, CoP, and ChP from the viewpoints of their functions. The model is expressed in a directed graph that consists of nodes representing parameters and arks representing their relationships. A channel and its contents are expressed by function names (FN) as lexical expressions and function parameters (FP). FP, influencing RSP directly, are recognized as CoP, and those connecting indirectly to RSP are ChP. The body of the function is expressed by function influence (FI). Figure 3 depicts one of the view models in the scope model between a coffee shop runner and their customers for a cafe service. This view model expresses one of the RSP, the workspace available, of the customers that want cafes to serve spaces for their own business activities, and the functions realizing the RSP.

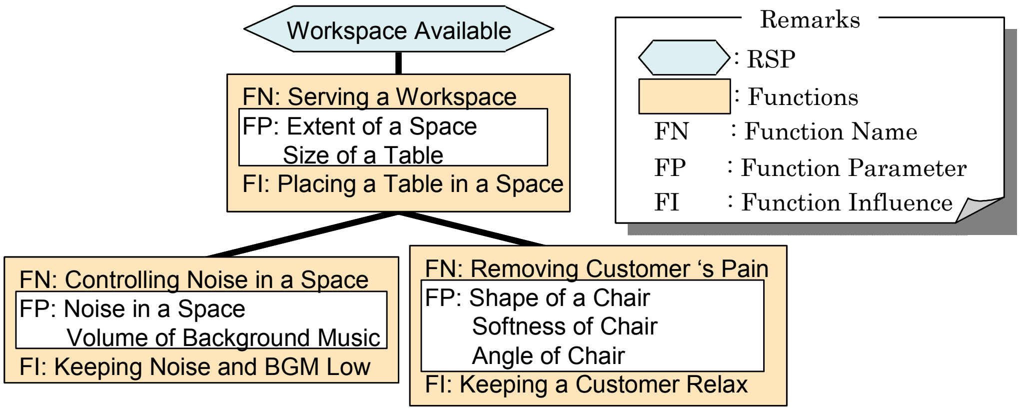

Figure 3. An Example of a View Model

3. The Proposed Method to Design Services

Figure 4 depicts the proposed design process. It is a provider to be that designs following this process. This designing provider is called "initial provider" (IP) of the service. The final target of the service is called "end receiver" (ER), while service receivers in general are symbolized SR. In Figure 4, the step of "constructing the ES (embodiment structure) and the flow model," which is described in more details on the right hand side, exists at two locations. At the first location, the SR (service receiver) points to the ER (end receiver), while it points to an intermediate agent at the second location. Each step of the whole process is explained below.

1) Describing a scenario of SR

A scenario which is the designer's expectation on how SR behave and make a state transition on receiving the service is described.

2) Extracting RSP of SR

RSP of SR are extracted based on the scenario identified in the step 1). If the step 2) is carried out after the step 5) "investigating whether newly recognized RSP exist", the RSP that are newly recognized in the ES (embodiment structure) are added. Those new RSP will represent in many cases costs to the SR. For instance, it is after the ES of a laundry shop for a clothes-washing service is identified that an RSP representing the transfer cost to a laundry is added.

3) Searching for ES for RSP of SR

A database is searched for the ES which realize the functions satisfying RSP of SR. For instance, the ES of a washing machine that realizes washing function to satisfy a change of RSP, cleanness of clothes, is found. It should be noted that the found ES need not be necessarily provided by IP, since there exist agents other than IP which can provide the ES.

4) Investigating whether the ES are possible

It is investigated whether the ES candidates are possible to be implemented or not.

5) Investigating whether newly recognized RSP exist

It is investigated whether newly recognized RSP exist or not among the state transitions generated by an ES candidate.

6) Selecting the best ES

The best ES is chosen from the candidates. To do so, satisfaction level of the whole ES for the whole set of RSP in the scope model needs to be calculated after satisfaction degree for each RSP is scored.

7) Searching for agents for the ES

The designers search a database for the agents that are able to provide the designated ES. For example, the agents that can provide a physical entity of a washing machine include not only a washing machine manufacturer but also a launderette owner. Using those agents, a flow model is constructed. It should be noted that a flow model without any intermediate agents is generated if the IP provides the whole ES.

8) Selecting the best flow model

The best flow model is chosen from the input candidates. When the candidates are evaluated, it is needed to obtain a score for each flow model. Possible evaluation indices include the value over the cost of the ER, and that of the IP.

9) Investigating whether intermediate agents are included

It is investigated whether the input flow model includes other agents than IP and ER.

10) Investigating the position of the intermediate agent

It is investigated whether the input intermediate agent has a position in the upper or lower stream of IP in the flow model. If the intermediate agent is placed in the lower stream, it is necessary to design a service which the IP provides and the intermediate agent receives. To do so, another step is needed for constructing an ES and a flow model for the structure between the IP and the intermediate agent. Without this, a service may not be accepted by an intermediate agent and as a result the service cannot be provided effectively to the ER. This necessity cannot be recognized when the service is designed only to satisfy the ER. For instance, when a washing machine manufacturer puts a retailer as an intermediate agent in their lower stream, it is required to have an appropriate ES and a flow model to satisfy the retailer.

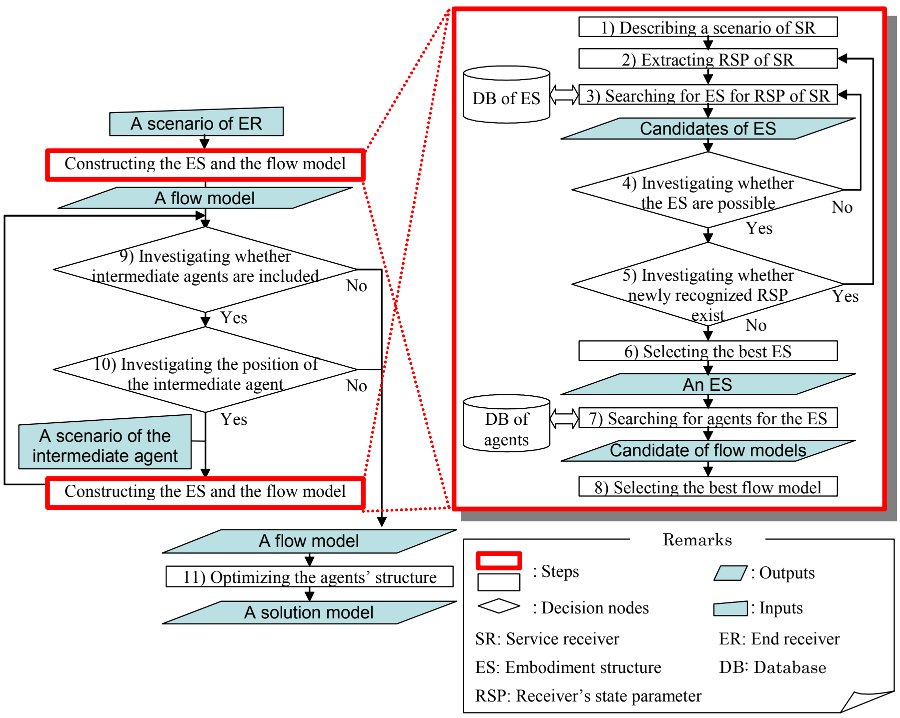

Figure 4. The Proposed Procedures to Design Services

11) Optimizing the agents' structure

The structure of all the agents in the flow model input is optimized. The purpose of the optimization is to determine the values for design parameters of IP. Possible evaluation indices include the value over the cost of the ER, and that of the IP.

4. The Proposed Computerized Tool for Service Design

A prototype system of a service CAD tool, which is called Service Explorer (SE), is being developed. Only the part of modelling a service has been implemented at present. The current version of SE was developed using Borland JBuilder8 with Java SDK version 1.4.1 and XML version 1.0 in the Microsoft Windows 2000 environment.

Figure 5 shows a screenshot of SE. This screenshot shows a scope model of a hotel service. Hexangular nodes denote RSP, while square nodes represent the functions with FN (function name), FP (function parameter), and FI (function influence). The RSP of "Comfort of the room" placed on the right hand side is connected to three functions, which are "Control the size of the room," "Control the shape of the room," and "Change the interior of the room."

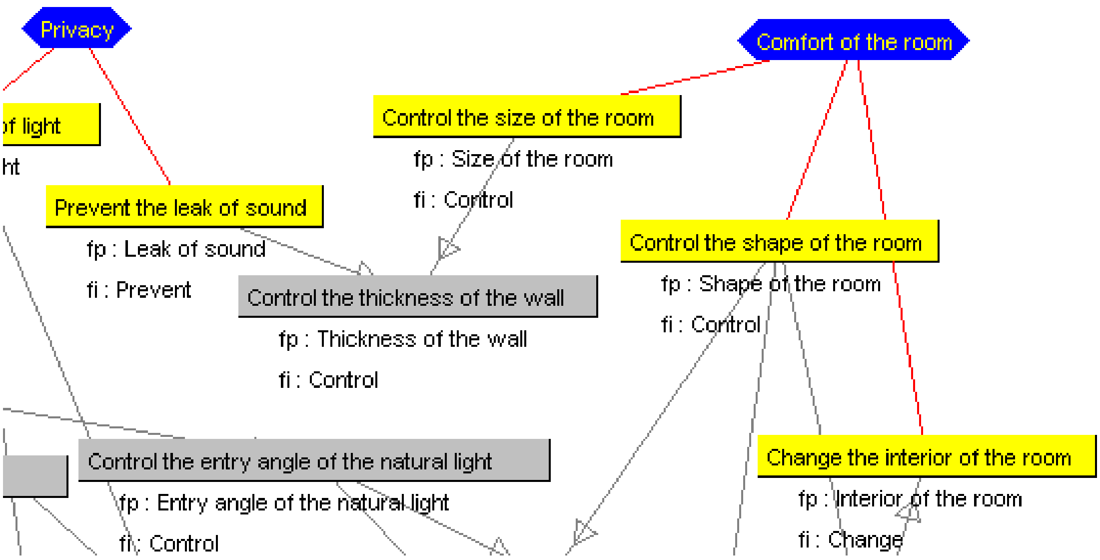

Figure 5. A Screen Shot of Service Explorer

5. Discussions

5.1 The Proposed Design Method

Using the service model that was already proposed, a procedure to design services was proposed in Chapter 3. The result shows potential to code the service design procedures in a service CAD. However, the followings in the proposed method need to be identified in more details.

a) How to evaluate services

It was revealed that evaluation procedures are needed in the steps of 6), 8), and 11). Evaluation to select one from multiple ES candidates in the step 6) requires to analyze and compare those candidates. On the other hand, evaluation in the step 11) is required to output the information used to determine the values of design parameters. This needs a synthetic viewpoint, since the evaluation is on the whole structure of the service. The third one in the step 8) requires both analytic and synthetic viewpoint, because it is for selecting one flow model, which consists of many agents.

b) How to describe databases

The proposed design process requires two types of databases. One is for ES (embodiment structure), while the other is for agents. The first one can be described only after how to describe the ES is identified. The second one needs description on the relationships between the agents and ES to provide.

5.2 Relationship with Product Design

The proposed service design method does not necessarily require designing products used for the service. The product design process lies in the downer stream of the proposed service design process. In other words, the output of the proposed process partially can be input to the design of a product associated with the designed service. In order to support the whole range of those service designs that need product designs, the service design method has to be extended.

5.3 The Proposed Tool

Adopting the existing service model, Chapter 4 proposed a tool for service design. A preliminary verification of the modelling function has been achieved. It is necessary to describe more service instances using SE, so that SE will be verified whether it has enough capability and usability to describe services. To do so, the service cases from the companies in industries participating in "service engineering forum," which the authors' group at the Univ. of Tokyo conduct, will be taken.

6. Conclusions

This paper proposed a method and a computerized tool to support design of services, and showed they have a potential to help service designers. Future works include identifying the two parts pointed out in 5.1, and verifying both the design process and the tool by applying them to services in real operation in industries. The activities in the service engineering forum run by the authors will be utilized for the verification.

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References

Pahl, G. and Beitz, W., "Engineering Design –A Systematic Approach," Springer, London, 1996.

PMHAPT (Japanese Ministry of Public Management, Home Affairs, Posts and Telecommunications), "Annual Report on the Family Income and Expenditure Survey," Japan Statistical Association, 2002.

Shimomura, Y., and Tomiyama, T., "Service Modeling for Service Engineering," Proceedings of The 5th International Conference on Design of Information Infrastructure Systems for Manufacturing, 2002, pp. 309-316.

Shimomura, Y., Watanabe, K., Arai, T., Sakao, T., and Tomiyama, T., "A Proposal for Service Modeling," Proceeding of the Third International Symposium on Environmentally Conscious Design and Inverse Manufacturing (EcoDesign 2003), IEEE Computer Society, 2003, pp.75-80.

Shostack, G.L., "How to Design a Service," Marketing of Services, Donnelly, J.H. and W.R. George (eds.), American Marketing Association, 1981, pp.221-229.

Tomiyama, T., "Service Engineering to Intensify Service Contents in Product Life Cycles," Proceedings of the Second International Symposium on Environmentally Conscious Design and Inverse Manufacturing (EcoDesign 2001), IEEE Computer Society, 2001, pp. 613-618.

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