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## **SEE: Extending the Service Engineering Methodology for Experience Innovation**

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**SEE: EXTENDING SERVICE ENGINEERING  
METHODOLOGY FOR ACHIEVING EXPERIENCE INNOVATION**  
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**ABSTRACT**

This study is concerned with improving the Service Engineering methodology for experience-oriented service systems. It critiques the Service Engineering methodology based on the motivating example of automotive navigation service system design, and it describes the Service Experience Engineering (SEE) methodology, which extends Service Engineering by making three improvements, namely the use of formal models of experiences, service-experience requirement analysis, and the simulation of service experiences. The example presented here demonstrates that SEE can help capture context-wide service-experience requirements and translate them into functional requirements. This study further indicates that a methodology for engineering service experiences is possible and promising.

*Keywords:* Service engineering, service design, methodology, experience innovation.

**INTRODUCTION**

Services have been generally developed based on the assumptions that customer value systems have been fully understood and are easily translated into system requirements. This assumption is problematic for two reasons. First, this assumption suffers a manager level bias. As noted by James Allen, et. al. [4], traditional market research frequently leads firms to view customers as statistics. Meaning managers become so focused on data that they stop hearing the real voices of their customers. Second, customers themselves do not explicitly understand their hidden needs, and it is difficult for them to express their ideas [14][24]. Furthermore, developing new services in the current increasingly competitive business environment is quite challenging since companies often need to surpass customer expectations. Therefore a service design/engineering methodology, that provides appropriate support for engineering service experiences and thus enables the overall service experience to exceed customer expectations, is significant and useful.

Methodologies for experience innovation have not yet emerged, although general concepts regarding experience innovation have been discussed in [21]. Since we lack the experience innovation capabilities to facilitate the development of experience-oriented service systems, systems still need to be tested to determine whether the experiences are acceptable to customers. Service Engineering established by Fraunhofer IAO may be the most developed service innovation methodology [5], and they managed to establish a ServLab [2] for testing new services. This study improves the Service Engineering methodology to permit enhanced engineering of customer experiences. The required improvements are discussed based on a motivating example, involving an automotive navigation service system.

The remainder of this study is organized into the following sections. Section 2 introduces the navigation service system. Section 3 then reviews the Service Engineering methodology. Next, section 4 describes SEE, and the ways in which it extends Service Engineering. Section 5 then provides example artifacts of the extended models based on the motivating example. Subsequently, section 6 discusses related works and section 7 presents conclusion.

**MOTIVATING EXAMPLE: AN AUTOMATIVE NAVIGATION SERVICE**

Imagine an automobile with a GPS navigation system. The navigation system is equipped with an embedded cell-phone for call center services. This setup enables the driver to request the call center to create a navigation path for him/her. This service is particularly useful for drivers that require a customized navigation path but are unable to set it up themselves for fear of distracting them from other tasks, particularly, drivers who cannot take a break from driving. While the call center records confirm the demands of customers' frequent requests on customized navigation path, the reason for requesting alternative navigation paths is unknown to the call center. Another application of an automotive navigation service incorporating a call center is providing security management. For example, whenever a car is moved without a standard unlocking procedure, a message will be issued to the owner via SMS, and the call center can then help track down the suspected stolen car.

Since the navigation service provider is planning to develop new services over the current navigation service platform, it is important that they create new "experiences" for existing customers. Following the Service Engineering approach, ideas are gathered and discussed during the idea management phase. However, service developers soon found it very difficult to innovate new experiences owing to them lacking an understanding of how to define experiences for customers. Furthermore, service developers need to ensure that that Service Engineering methodology ensures the engineering of the experience requirements.

The navigation service company, Yulong, is one of the largest car manufacturers and telematics service providers in Taiwan,

and is attempting to differentiate its services from those of competitors. Yulong has established a user experience team to implement the company vision. The best means of identifying hidden customer needs and transforming those needs into technological-functional service requirements is considered the key capability that this company needs to develop.

## SERVICE ENGINEERING

### *Definition of Services*

The literature contains numerous definitions of service [11][7][12]. In national economic statistics, the service sector is frequently defined as all sectors other than agriculture or manufacturing. The North American Product Classification System (NAPCS) [15] defines service as follows:

A service is a change in the condition of a person, or a good belonging to some economic entity, brought about as the result of the activity of some other economic entity, with the approval of the first person or economic entity.

Fitzsimmons et al. [7] provided a simpler definition: A service is a time-perishable, intangible experience performed for a customer acting as a co-producer. According to this definition, a service is actually an “experience”. In fact, “selling experience” is one of the optimum strategies for fighting low-cost rivals [10]. In the digital economy, a new service definition can focus on the technical nature of modern services, such as cyber-infrastructure-based service enterprises [9]. Cyber-infrastructure-based services enable standardization and mass customization, and are thus more complex than traditional services. A systematic approach for new service development is therefore required to ensure new service quality and service innovation efficiency. Bullinger et al. [5] used the attributes of contact intensity (CI) and variety (VI) to further define four types of services:

- Type A services (low CI and low VI) are characterized by low contact intensity and low variety, making them especially suitable for highly standardized delivery,
- Type B Services (low CI and high VI) have low contact intensity and high variety, and the focus from the perspective of the developer is on systematic variant creation,
- Type C Services (high CI and low VI) have high contact intensity and low variety. Such services essentially comprise a single, clearly defined standard service, which may be customized by the customer up to a certain point,
- Type D Services (high CI and high VI) have high contact intensity and high variety, and their performance typically requires considerable customization.

Currently, Type A services are the main targets for service engineering, and are detailed below.

### *The Service Engineering Methodology*

Fraunhofer IAO first initiated research activities focused on Service Engineering (SE) in 1995, and subsequently initiated several related projects: Holistic service engineering, Computer aided service engineering (CASET), customer oriented service development. Their partners for R& D projects include AUDI, C& E, Fein, Dekra, DIW, ETAS, IWKA, Oce, R+V and Zwick. The ServLab has recently been established for service simulation and testing.

According to the Fraunhofer IAO experiences, several methods from traditional product development are used for services with relatively low contact intensity, namely, Type A services. These methods include quality function deployment (QFD), structured analysis and design technique (SADT), failure mode and effects analysis (FMEA) as well as service blueprinting and other process modelling methods. For Type D services, social and behavioral science methods are encountered. This study thus concludes that the contact intensity criterion appears to be the main determinant of preferred engineering methods in practice.

Besides methods used to devise new services, the development process (the order in which activities occur within the development) is also important. Because companies regularly developing new services are compelled to seek ways of avoiding redundant work, preventing repetitions of past mistakes and enabling the reuse of existing know-how. Therefore, the companies frequently attempt to standardize individual development steps to a certain degree. This standardization in no way implies that development processes are constrained within a rigid straitjacket [5]; on the contrary, it means that these processes stop being arbitrary. Instead defined guidelines exist according to the services being developed. Both linear processes (waterfall models) and iterative processes (spiral or prototyping models) are accepted as options for new service development.

Simply put, the Service Engineering methodology proposes a set of methods (QFD, SADT, FMEA, service blueprinting, conjoint analysis, product modeling, process modeling, role concepts, target costing and pricing) and a set of process models (waterfall, spiral and prototyping) for service developers. The overall service development process is further subdivided into six broad phases: brainstorming and idea appraisal, requirement analysis, conceptualization, implementation, market launch and support. A New Service Development Manual, detailing all phases, has been provided in the form of a guide book. Service developers are then free to apply process and engineering methods that best suit their projects. The next section discusses the requirement analysis in detail.

### ***Requirements Analysis of SE***

According to the SE manual, the requirement analysis phase comprises the following processes: strategic requirements, functional requirements, organizational requirements, general market requirements, customer analysis, competitor analysis, partner involvement, binding requirement profile, project planning, and review. The instruments used during the customer analysis process include: customer survey, customer focus groups, case studies undertaken for selected customers, survey of front-line employees, assessment of information from the perspective of sales, and assessment of complaints.

This study includes a special focus on requirement analysis, which involves formal analysis of *service experience requirements* (SER). Unfortunately, requirements analysis in SE involves no defined experience-related requirements and no defined process for eliciting SERs. To improve requirements analysis of SE, this study add three instruments: customer needs discovery, service experience modeling and simulation, for SER generation. QFD is then used to convert SERs into functional requirements. The details are described in the next section.

## **SERVICE EXPERIENCE ENGINEERING**

### ***Definitions of Experiences***

In the requirements engineering field, customer experience requirements (CERs) are defined as customer perceived attributes of the interaction with the service provider that contribute to satisfaction and adoption of the service [18]. The term experience requirement includes both the outcome and process attributes of the interaction between customer and service provider. Restated, CERs include: outcome-oriented performance requirements and process-oriented emotional requirements (such as autonomy and pleasurability). Generally, the emphasis of CER elicitation gradually shifts from interaction system requirements, viewed from a system internal perspective, to user experience requirements, viewed from the customer perspective [22]. Some studies [17] have advocated the inclusion of experience goals and emotional requirements in CER.

In the Marketing field, the role of experiences in service provision is becoming increasingly important. Since the differentiation of goods and services has become increasingly difficult, enhancing the customer experience has become the new source of differentiation and value creation [19]. Experiences are defined by questions involving the following: how the service made customers feel and their emotional associations. Since service experiences are co-production values resulting from interaction between customers and service providers, they are considered unique and context-specific.

This study defines service experience requirements (SERs) as follows: given a specific context, the performance requirements and emotional requirements of a service described so as to enable service designers to translate them into system functional requirements. The next section defines a more rigorous service experience model based on this definition.

### ***Discovery of Customer Needs***

There are numerous methods of identifying customer needs, including expert reviews, user testing, focus group interviews and surveys. Recently, new methods adopted from social sciences have been applied to discovering customer needs, including ethnographic methods [16] and naturalistic inquiry [20]. These qualitative methods of data collection contribute to enhanced understanding of customer goals and needs. However, these methods suffer from difficulty in generalizing the drawn conclusions from a small sample of customers. Fortunately, quantitative marketing methods [6] may resolve this problem, although the method of questionnaire administration does not permit elicitation of rich information as is the case for qualitative methods.

To effectively analyse hidden customer needs, it is recommended that certain qualitative methods should first be applied to discover hidden needs, especially emotional needs. Second, needs are categorized using psychological models such as Maslow's Hierarchy of Needs [13] and efforts are made to ensure that both performance and emotional needs are identified. Finally, the model is generalized using quantitative methods. For qualitative research, the 51 methods of IDEO cards [1] can provide a good reference. It is recommended that customer research be conducted by a mixed team of designers, engineers, social scientists, and even customers.

### ***Service Experience Modeling & Simulations***

A state machine [8] may be the best reference model for modeling a service experience, since events result in experiences and states can be used to represent needs satisfaction. A service experience system can also be considered a real-time system, in which all service activities are performed concurrently and in a timely manner, thus optimizing the customer experience. Formal techniques exist for modeling real-time systems, such as: Real Time Logics, Duration Calculus, Process Algebras and Formal languages [8]. Nevertheless, many of the techniques do not include visual system representations, and are focused on formally verifying a system rather than modeling appropriate system behavior. This study suggests that service experience modeling be achieved via Petri Nets. Although cognitive problems exist when using Petri Nets to understand complex structures and processes, this study argues that a useful experience model should remain simple for the sake of model generalization (using quantitative methods).

In the last section, customer needs are classified according to Maslow's Hierarchy. By turning each category into a state

indicating the satisfaction of needs (see Fig.3), all service activities that help achieve the state can be represented by transitions. In Fig.4, the experience model is further refined into a Petri Net. Strict and precise timing constraints are modeled in Petri Nets. These timing constraints help in identifying possible system bottlenecks during the analysis stage, and may be useful in fault identification. Other analysis can be performed to formally verify these models and also to improve upon them. Models like TCPN (Timing Constraint Petri Nets) can be used for schedulability analysis [23]. Using state machines and Petri Nets, Service Experience Model (SEM) and Service Experience Requirements (SER) are defined as follows:

Given a specific context, customer service experience models (SEM) are described using a state machine including states indicating different levels of needs. Common customer states transit to higher level states when all needs of the current level are satisfied. Customers perceive a good service experience when all needs are fulfilled in a timely manner such that the customer feels that: whenever there is a need, there is a satisfaction. This state machine can be further refined to a Petri Net, with transitions representing service activities that trigger token firing. The resulting Petri Net is considered a service experience requirement (SER).

Notably, each customer might have different service needs, and different (timing) wishes regarding needs fulfillment. Therefore, service experience is optimized when all needs are addressed according to the distinct preferences of each customer, i.e., when a tailored service is provided.

### Service Design & Implementation

Following the principles of Service Engineering, the requirement analysis phase is completed by converting SERs into functional and organizational requirements via QFD. During the next phase, the conceptualization phase, these requirements are further refined into: service definition, organizational concept (process description, roles and resources, trainings), and marketing concept (product policy, price policy, place policy, and promotion policy). Next, during the implementation phase, the service system is implemented and tested internally. The new service is officially offered to customers during the market launch phase. Feedbacks are continually monitored for further development or replacement of services in the support phase.

## EXAMPLE

### Background

This section describes a real world example and an ongoing project involving the innovation of a new car navigation service. The development project will continue for two years. The first year involves the brainstorming, requirement analysis and conceptualization phases. Emphasizing the differences between SE and SEE, the work done during the requirement analysis phase is presented in detail below.

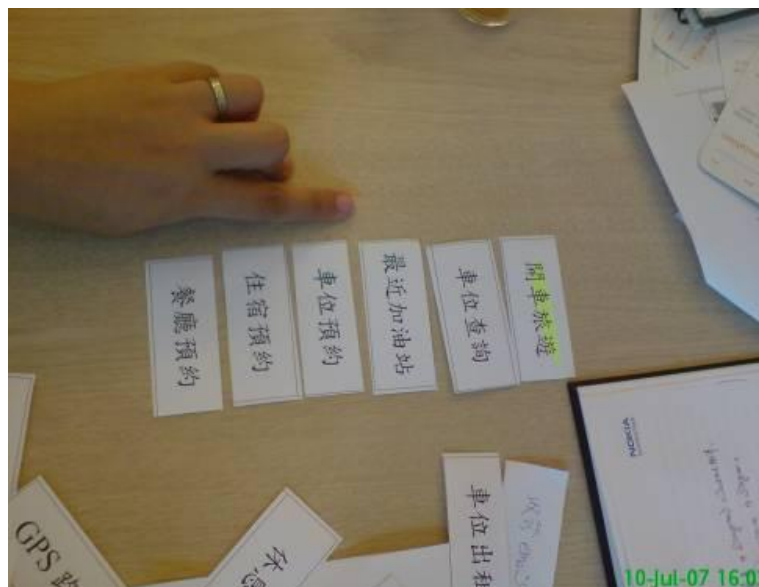


Figure 1: Customer doing card sorting

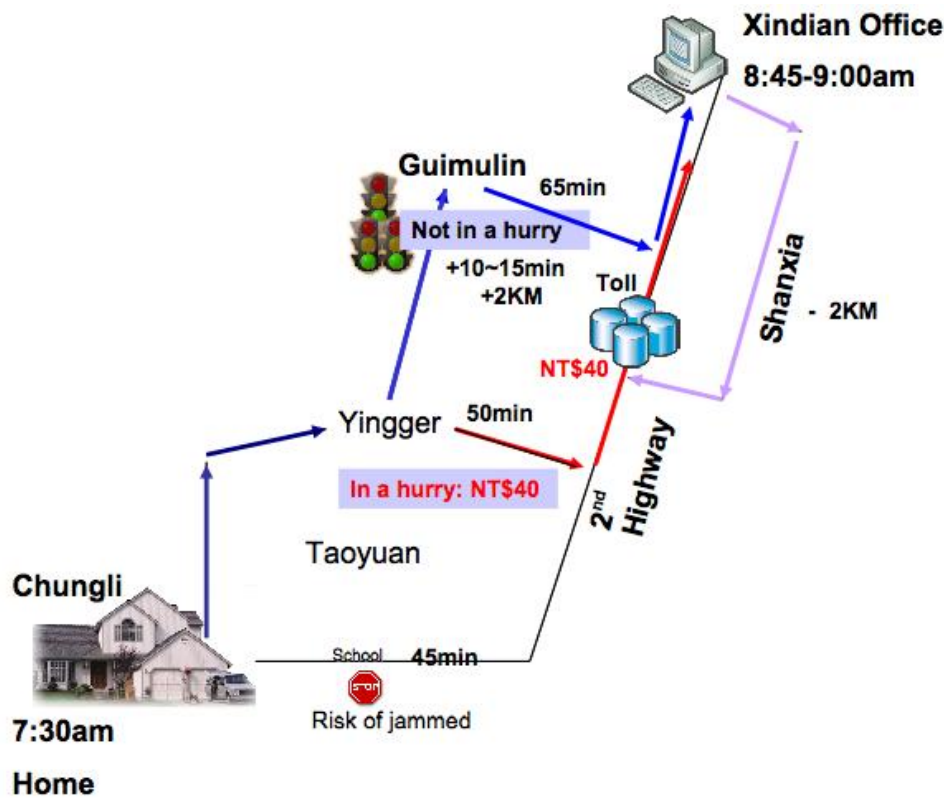


Figure 2: Customer's commuting experience

### Customer Needs

To understand the service needs of drivers using car navigation systems, nine methods from IDEO are used to conduct a study of our customers, including: Behavioral Archaeology, Social Network Mapping, Draw the Experience, Card Sort, Error Analysis, Scenario Testing, Survey and Questionnaires, Character Profile, and "A Day in the Life". Figure 1 displays a customer performing card sorting, and Fig. 2 shows the customer drawing of his own driving experiences. A total of eight customers participated in this investigation, and 20 customers participated in the investigation of "A Day in the Life". The resulting service needs are classified using Maslow's Hierarchy of Needs, as shown in the following list and Fig. 3.

- To Move (smoothly)
  1. Auto map update
  2. Routing by number of lanes
  3. Routing by number of traffic lights
  4. Toll-free routing
- To be Safe
  1. Car-only routing
  2. Routing to avoid schools during peak traffic times
  3. Routing to avoid funeral parlors
  4. Routing to include branded gas stations
- To Share (love and joy)
  1. In-car Karaoke
- To have an Assistant
  1. Dynamic routing assistant
- To Guide others
  1. Share one's driving experiences to other drivers

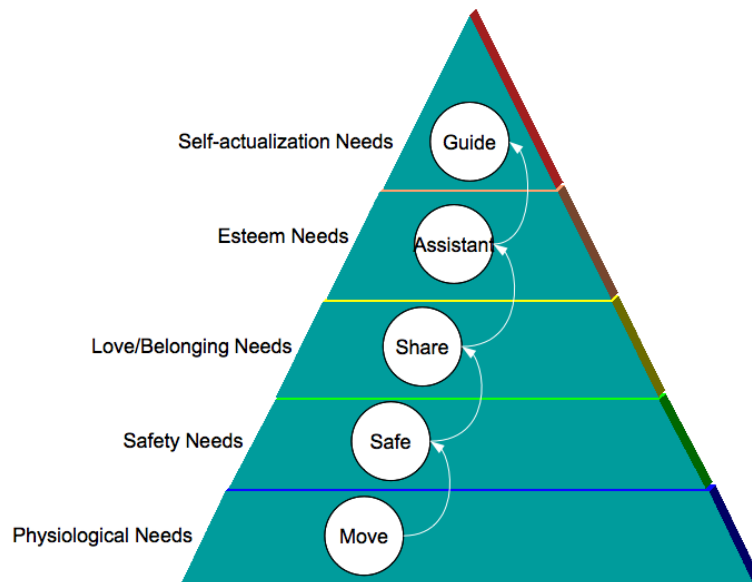


Figure 3: Customer experience state machine

**Service Experience Models & Requirements**

Figure 4 shows the customer experience model expanded from the original state diagram (Fig. 3). For simplicity, only three experience states: move, share and assistant (with names in brackets), are preserved in this diagram. In the initial state "Start", the driver starts the car. Once the navigation map is updated, the "Move" state begins. Based on the user preferences, the navigation system calculates a "smooth" and safe route for the driver, and the system switches to a "Safe" state. If the driver turns on the function of navigation assistance, the system switches to the "Assistant" state. In the "Assistant" state, the call center watches over the movement of the car. If the driver presses the assistance button, he can request immediate help from the call center to provide customized navigation. Otherwise, the call center monitors the navigation system and provides assistance if the driver continues to diverge from the correct route.

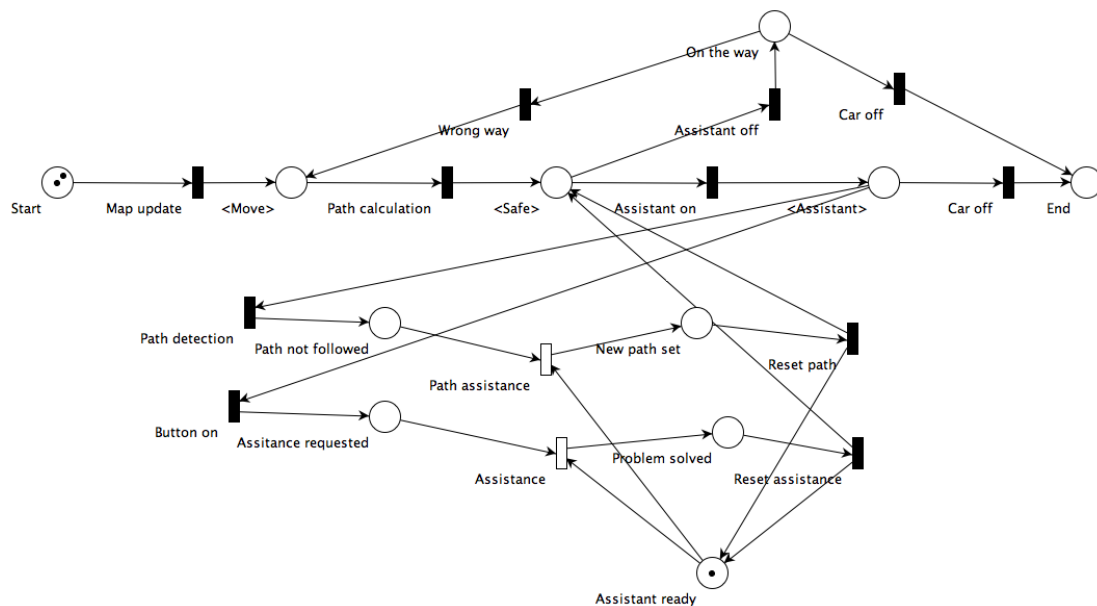


Figure 4: Customer experience Petri Net

Since this model is created using Petri Net, it can be simulated to provide preliminary analysis. Furthermore, the model becomes a useful input when implementing the system. The customer experience model can be built into the in-car navigation system, enabling the system to keep track of driving experience of the driver.

**Functional And Organizational Requirements**

According to the principles of service engineering, the SERs are analyzed using con-joint analysis and QFD. Figure 5 shows the result of QFD. The functional and organization requirements include: providing update service, enriching map details, enriching location database, routing algorithm, customer service staff training, human-assisted planning system, and expanding customer service staff.

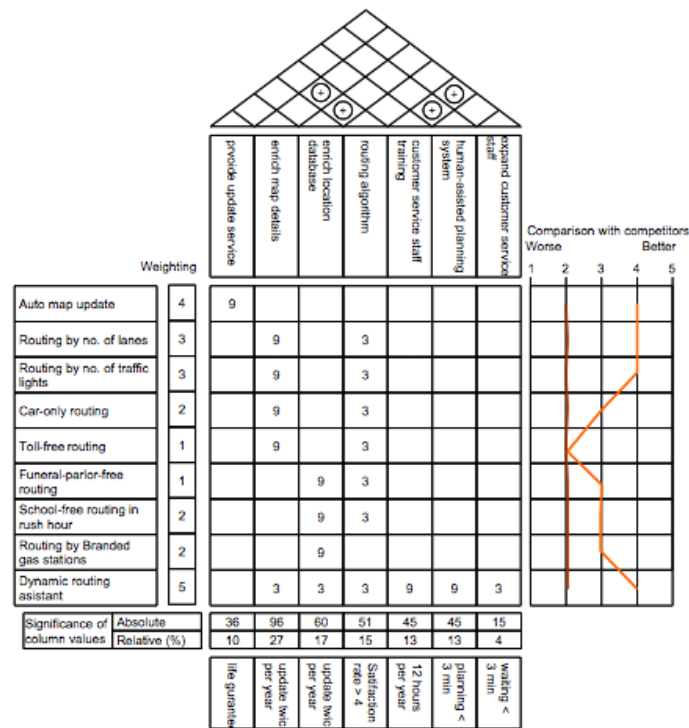


Figure 5: Quality Function Deployment

**RELATED WORK**

This project combines service engineering methodology with experience engineering to establish an extended methodology named Service Experience Engineering (SEE), which permits experience identification, modeling and simulation. This study argues that SEE helps service designers to develop new services that meet hidden customer needs and create unexpected experiences.

CorSE [3] is a similar project that focuses on extending Service Engineering to facilitate customer integration. However, methods for experience innovation are not available. We believe that service providers should be proactive in innovating experiences. Given a specific service context, service experience innovation is defined as the activity of finding hidden customer needs and designing the new value delivery system, such that all hidden needs are satisfied and the overall service experience exceeds expectations. This definition differs from that of Prahalad et al. [21], which emphasizes on personalized interaction and value co-creation.

To obtain hidden customer needs, IDEO methods are used to investigate customer behavior. The discovered hidden needs are then classified according to Maslow’s hierarchy of needs. Using state machines, the manner and timing of the satisfaction of a need are formally modeled. Offering the right services and correctly timing service deliveries improved the service experience. This study referred to the state machine as an experience model, and also context-wide service experience requirements (SERs), which differ from CERs. While CERs are mainly considered system-dependent, SERs are customer-oriented, context-specific and system-independent. The SERs are later transformed into functional requirements using QFD.

**CONCLUSIONS AND FUTURE WORK**

This paper notes the importance of experience innovation and the weaknesses of Service Engineering. Specifically, this study proposes an SEE method to overcome the difficulty of experience innovation. SEE includes three parts: model of customer experience, analysis of hidden service needs, and simulation of customer experience. An example of a car navigation service is used to demonstrate SEE. The example revealed that SEE helps innovators to systematically identify customer needs and thus improve customer experiences. The resulting new services become more competitive as a result of enhanced customer experiences and service optimization. The objective of this study is to establish a methodology for service experience innovation, and creates an associated discipline. Further work is underway to clarify the quantitative benefits of SEE.

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