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IT SERVICE QUALITY MANAGEMENT MODEL BASED ON SERVICE SCIENCE, MANAGEMENT AND ENGINEERING

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ABSTRACT

The goal of Service Science, Management and Engineering (SSME) is to improve service systems through service innovation. However, current SSME infrastructure lacks a comprehensive quality management framework and the SSME research on people is limited. Users' service expectation has increased a lot along with the development of ICT. Single organization usually cannot fulfill user's needs comprehensively. This study first analyzes the shortcomings of current system development and quality evaluation methodologies, and points out that these methods cannot meet the requirement of cross-organizational services; then, by considering the idea of Mashup and quality management model in service ecosystem, this study proposes a theoretical architecture of service system, and a preliminary quality management model under SSME context

Keywords: *Service System, SSME, Quality Management, Mashup*

1. INTRODUCTION

Service Science, Management and Engineering (SSME) proposed by IBM is an emerging, multidiscipline area that integrates a variety of technical, business and social issues under a general concept of Services [1]. The goal of SSME is to improve service systems through service innovation. Service quality (especially user satisfaction) is regarded as a main research object in SSME. However, current SSME infrastructure lacks a comprehensive quality management framework, for example, quality management model and its related evaluation metrics. Moreover, although people is one of the core components in service systems, current SSME research on people is still much less than expected [2]. Therefore, there is an urgent need to address these issues and build a comprehensive quality management framework for SSME.

Based on existing work on service ecosystems [3], this study tries to consider user needs and intends to propose a refined service quality management model under IT service context (since SSME contains more IT service background). The rest of this paper is organized as follows: studies on service quality are reviewed in Section 2. Refined architecture of service system is descripted in Section 3. And quality management framework for SSME is described in Section 4. Finally, conclusion is drawn in Section 5.

2. SERVICE QUALITY

Service quality is generally found to have strong impact on business performance, customer satisfaction, loyalty and profitability [4], and it has attracted much attention from all areas related to service marketing, such as information system, and computer science.

Service quality is defined as the discrepancy between user's perceptions and expectations of the service (gap 1 shown in Figure 1) [5]. As it is shown in Figure 1, word of mouth communications, personal needs, past experiences and external communications are prime determinants of user's expectation about the service [6]. Users can get information from other users about their experience of using the service, and such kind of information will affect user's expectations of the service. Past experience on similar or related services can help users to adjust their expectations. And external communications, such as vendor communications (e.g. vendors' advertisements, sales calls) and service provider communications (e.g. negotiation during system development) also play an important role to form user expectations. Finally, among all these determinants, personal needs are a nature trigger for exceptions [7].

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Along with the shifts in ICT (e.g. smart devices, SOA infrastructure) and marketing models (e.g. user generated content in web2.0 era), the user's expectation level or satisfaction threshold towards the services also increases [8, 9]. Personal needs towards IT services have become much more diverse, and require much higher service quality, for example, cross-organizational services, such as a highly customized web page which shows news, emails and goods integratively.

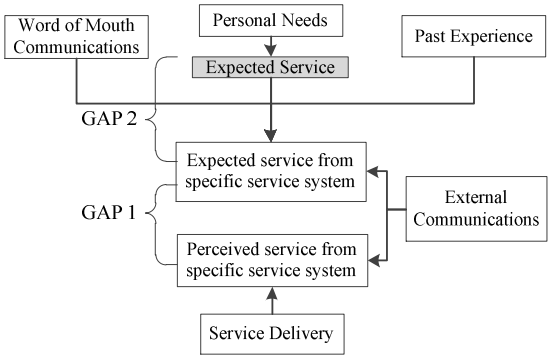

Figure 1. Determinants of user's expectations. (Modified from [6])

However, in current system development process, the analysis of customer requirement has at least two problems, first, systems analyzers often narrow customer needs down into organization scope because of the system boundary, and neglect some important user needs which locate outside of the organization scope; and second, the system development process usually consider human interaction aspect far too little, resulting a gap exists between fulfilling organizational needs and satisfying human users (e.g. a system with complete functions but very hard to use) [10]. Take ticket services at metro station for example, people have to buy ticket from ticket vending machine (TVM) before they plan to take subway. They usually have multiply needs when consume subway services, such as getting ticket, knowing weather outside, the locations of washroom, ATMs and IC card recharge outlets. However, the TVM cannot offer any service except the ticket, since the functions of the TVM system are limited in system analysis & design process, as mentioned previously. Therefore, user's needs cannot be fulfilled comprehensively (gap 2 shown in Figure 1). Moreover, when the TVM system is hard to use or the service provided by TVM is unstable, service dissatisfaction might be caused (gap 1 in Figure 1). Studies on service quality generally focus more on gap 1 shown in Figure 1, where almost none of them have addressed the issue of gap 2 shown in Figure 1.

How to evaluate service quality is a major issue in quality management. Current methods can be classified into system perspective and user perspective. Evaluation from system perspective generally uses the Quality of Service (QoS) metrics[11], such as response time, throughput, availability, accessibility, interoperability analysis and cost of service[12]. These metrics reflect the ability of the system to provide a service at an assured level, and they can be stored at the service broker database for service selection or ranking[12]. Evaluation from user perspective often uses the SERVQUAL (or e-SQ in IT service [13]) metrics (e.g. reliability, assurance, tangibles, empathy and responsiveness) [14], which measures the perceived quality of a service. However, similar to the issues in system development process, these two kinds of measurement are both confined in single organization scope, therefore they lack the evaluation of fulfillment of user needs and the connectivity/stability of external services.

3. SERVICE SYSTEM CONSIDER USER NEED

According to SSME white paper [15], service systems are complex adaptive systems. Such kind of complexity usually comes from the ongoing interactions (adjustments and negotiations) among all sub-systems and external systems due to the requirements and changes of user needs.

The architecture of service system illustrated in service ecosystem [16] contains four entities, namely service customer, service broker, service mediator and service provider. A service broker brings service consumers to service providers, and it is responsible for delivering services in accordance with the constraints from service providers (e.g. authentication, payment). Moreover, service broker can impose additional constraints on service delivery (e.g. incentive mechanisms). Service mediator aims at solving the issue of service heterogeneity, it translates different service formats and other routine functions to let service broker focuses on core competencies. The core advantage of this architecture is that service provider might not need to be responsible for the delivery of service (e.g. full channel, all service combinations) [3]. However, this architecture only emphasizes on segmenting the responsibilities of different service roles, and making the flow of service delivery more flexible, therefore, it lacks the ability to detect, analyze and store user needs and customize user service.

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Therefore, in order to better satisfy users, the architecture of service system requires a new component (including service needs analyzer, knowledge repository and Mashup engine) to handle the diverse user needs according to the principles of SSME (see Figure 2). In classic service systems, service broker is usually confined in single organizational scope [17] and it cannot well understand user needs (especially cross-organizational needs), while service needs analyzer is responsible for guiding users to identify their actual needs regardless the organizational boundary. And the knowledge repository is independent of specific service organizations, it stores user's preferences and context data (e.g. time, location), which can be used for further prediction. The Mashup engine is a light weight service broker. It selects and combines service brokers (or service providers) from different organizations according to the analysis of user needs.

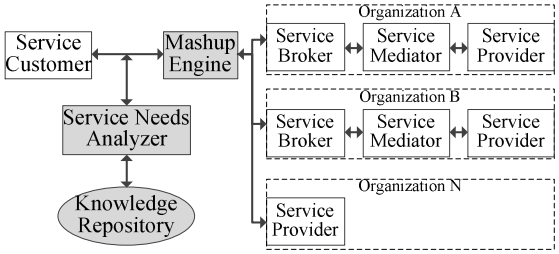

Figure 2 Top-level architecture of a service system

4. QUALITY MANAGEMENT

A four-layer quality management model for service ecosystem has been proposed by researchers [3]. In this model, service can be managed in four interrelated layers, namely perceived quality management, service level management, fault management and dynamic provisioning. However, by considering the characteristics of SSME and the issues mentioned above, this study intends to propose a refined model, which includes a new layer named knowledge management layer (see Figure 3).

1	Perceived Quality Management based on User Needs
2	Service Layer Management
3	Fault Management
4	Knowledge Management
5	Dynamic Provisioning

Figure 3. Five layers of quality management process. Adapted from [3]

The first layer: perceived quality management based on user needs. This layer is concerned with the evaluation of user's subjective perceptions of service quality, and it usually consists of three steps: (1) planning. The service providers need to define what service quality is, how it can be measured and who the users of their service are; (2) measurement. The actual measurement of service quality is conducted in this step. While implementing mature service evaluation metrics (e.g. SERVQUAL, e-SQ), the service providers also need to consider some other quality perspectives, such as fulfillment of user needs (service comprehensiveness) [18] and quality of user interface (e.g. usability, content/functionality, aesthetics, customization and engagement)[19]. A collection of metrics for evaluation of user perceived quality is shown in Table 1; and (3) feedback. All negative perceptions of service quality have to be delivered to the background and mapped into specific services. However, since each user's complaint is linked to a unique service status (e.g. delivery channel, calling of sub-services), it is important to store service status data for further analysis.

Table 1 Measurement of user perceived quality in IT service context

	Name	Description
Perceived Quality of User Interface	Ease of use	How easy the service is for users to use [20, 21]
	Aesthetics	The organization and presentation of content and the proper use of color, graphics, images, animations, size, etc.[20, 21]
	Customization	The extent to which the service interface can be tailored to meet user's preferences[13].
	Information Availability	The extent of completeness of information to facilitate user to use the service[22]
Perceived Quality of Service System	Reliability	The ability to perform the promised service accurately and consistently [13, 20].
	Efficiency	The speed of service delivery [13, 20].
	Support	The technical help, guidelines and personal advice available to users [20].
	Communication	Keeping users properly informed and communicating with users in understandable language [20].
	Security	Service provider can keep user away from danger, risk, or doubt during the service process [13, 20]
	Incentive	Encouragement given by service providers to users[20]
Other	Comprehensiveness	The ability to fulfill user's multiply needs at one-stop.

After the user's evaluation on service quality, three circumstances should be distinguished: (1)

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problem caused by calling external services, which may leads to the revision of service selection criteria; (2) problem caused by calling internal services, and system testing should be started; and (3) problem caused by service design, which may leads to re-analysis of user needs and change of service concept [3].

The second layer: service layer management. This layer focuses more on the technical aspects of services which have been signed to users. Through a continuous cycle of agreeing, monitoring, reporting, encouraging and making suggestions, a good service performance can be achieved [3]. The QoS metrics can be used to evaluate the quality of internal services. Moreover, Mashup service also needs evaluation. Current indices on measuring Mashup service are availability (e.g. connection timeout, read timeout, response time), error rates (e.g. connection error, malformed responses), popularity, user rating and comments, etc.[23]. A collection of quality evaluation metrics for service layer management is shown in Table 2.

Table 2 Measurement of service performance in service layer management

	Name	Description
Classic QoS Metrics	Response Time	the time between sending request and receiving response [12]
	Throughput	the maximum handled requests at a given time unit [12]
	Availability	a ratio of the time period when a service is available [12]
	Accessibility	the degree to which the service s operating normally and can process requests without delay [12]
	Interoperability	The compliance to given standards [12]
	Cost	the cost per request [12]
Mashup Service Quality	Availability of external service	The extent to which an external service is operable, including connection timeouts, read timeout, response time, etc.[23]
	Modularization	Efficient combination of references from original providers[23]
	Accessibility	Efficient functionality of disparate data[23]
	Security	Efficient security policies and right management[23]
	Popularity	The number of consumptions and ratings[23]

The third layer: fault management. This layer can be divided into incident management, problem management, and service recovery processes. The aim of incident management is to restore normal service operation when there are deviations from expected operation of the service. When the cause of the incidents cannot be identified, the problem management process can minimize the negative impact and ensure stable operation. Once a failure has occurred, the service recovery process can recovery this failure and resume the service operation so as to relieve user dissatisfaction [3].

The forth layer: knowledge management. In order to increase user satisfaction and customize services, the knowledge management component need to accomplish three tasks, first, record user's needs, service selection and follow-up operations, second, user modeling and generating mining rules, and third, recommend customized information and predicted services to user.

The fifth layer: dynamic provisioning. Since the status of service resources is dynamic, for example, a service provider might remove or modify its services without giving notice to others[24], or a new sub-service becomes available that should be used instead, there is a need to locate, bind and use appropriate sub-services at run-time and allocate other resources on-demand to keep the quality of service.

The mapping from five-layer quality management model to service life cycle model [25] is shown in Figure 4. Since the perceived quality management mainly measures the gap between user needs (expected service) and user perceived service, it can only exist in the processes where the service is available to users. Therefore, this layer spans the provisioning, deployment, executing and monitoring phases. The service level management focuses on the performance of service from system perspective. Therefore, it spans all phases in the service life cycle model. Fault only occurs when the service runs, the management of faults thus exists in all service life cycle except the first two phases (analysis and design, constructing and testing). The management of knowledge should exist in every service life cycle except the withdraw phase. User's needs and preferences acquired from the first two phases (analysis and design, construction and testing) will become basic service knowledge stored in knowledge repository. Along with the service usage, this kind of knowledge will be updated and used for advanced services (e.g. recommendation, customization). Finally, the same to perceived quality management, dynamic provision of service resources only takes place when the service is produced.

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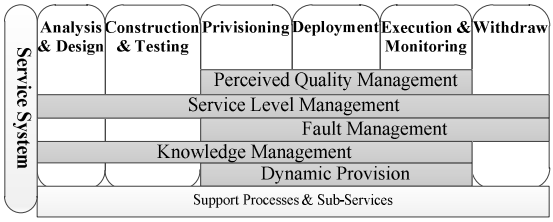

Figure 4. Quality management in service life cycle.

5. DISCUSSION AND CONCLUSION

The idea of SSME requires the service quality to be shifted to a fresh new level. Take IT service for example, along with the development of modern information technology, the user expectations on service also increases rapidly. In many cases, users' service needs cannot be fulfilled by services from single organizations; rather, they need combination of services from a variety of providers. However, current service technologies and implementations (e.g. SOA) still mostly exist within single organization scope, and lack the ability to provide cross-organizational services [17].

The contributions of this study are, first, it discusses about the shortcomings of current system development and quality evaluation methodologies, points out that these methods are all limited in single origination boundary and they cannot fundamentally fulfill user needs; second, this study incorporates the idea of Mashup and proposes a theoretical architecture of service system; third, a preliminary quality management model under IT context is discussed. However, the study of quality management in SSME service is still at early stage and needs more attention.

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