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Americas Conference on Information Systems (AMCIS)

2009

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ABSTRACT

Services have been regarded as something intangible, perishable, and heterogeneous so that it is difficult to measure the quality and productivity of them. Services also have long been considered non-productive economic activities. However, considering the recent growth of service industry across the world, it is imperative to study the very nature of service and its systems in the knowledge-based economy from an integrated perspective to improve the quality of life and effective economic development. For this, we in this study will develop a systematic way of understanding the nature service in the knowledge-based economy from a systems' perspective and build an integrated theory of service systems which facilitates service innovation and improves service productivity. The proposed theory will provide the foundation for designing, producing, delivering, operating, maintaining, monitoring, and improving service systems, which in turn leads to service innovation and thus a sustainable economic growth with providing greater employment opportunities. This study will also provide researchers and companies with the basis for future study and guidelines to further service innovation.

KEY WORDS: Service, service systems, components, goals, interactions, service innovation, service quality, productivity

INTRODUCTION

Recent statistics about economic structure and its changes clearly show that the economy, *local, national, and global*, is changing to be more dependent on service (Glushko, 2008). This phenomenon of service reliance can be explained by two factors; one is the growth of service industry itself, and the other is the increasing reliance of other industries including manufacturing on service (Hidaka, 2006). The growth of service industry is driving the growth of whole economy and thus attracts a lot of labor to the industry. This trend is common to the countries across the world either developing countries such as China and India or developed countries such German, Japan, and the U.S.A. that have invested tens of million dollars in service R&D (Hidaka, 2006). The underlying reason of the service-based growth is believed that the contribution of services such as R&D, marketing, and finance in generating values for firms is greater than that of manufacturing (Sheehan, 2006). The change to service-based economy implies that to move toward advanced economy, countries need to transform the way of growth from input-led to productivity-led, where advanced service industry including knowledge service is necessary.

Recognizing the importance of improving service productivity and stimulating innovation for economic growth, previous studies address the issues including the importance of systems approach to service (Chesbrough, 2005; Monahan *et al*., 2006, Spohrer and Maglio, 2007), theoretical justification of service systems (Alter 2008; Basole and Rouse, 2008; Spohrer *et al.,* 2007; Tian, Ray, Lee, Cao, and Ding, 2008), and the emergence of service-dominant logic (Vargo and Lusch, 2007; 2008a, 2008b). The previous studies insist that the improvement in service productivity and innovation can reduce lead time for new product development and time-to-market and facilitate the application of new technologies to company processes, which leads to better performance. Even though the previous studies contribute to the literature by identifying the transformation of economy from product-based to service-based, they are mostly conceptual so that the practical value of service systems approach is still subject to verification, *theoretical and empirical*. Accordingly, we do not have solid tools and processes enough to measure service performance and design better service models that even incorporate both traditional products and services. Even more complicated is that it is really difficult to develop a universal theory and practical guidelines to be applied to explaining and predicting heterogeneous service provisions. This is primarily because a service system is a complex system that involves societal, technological, and economical aspects together (Kontogiorigis, 2006).

Despite the problems, it is imperative to study the very nature of service and its systems in the knowledge-based economy from an integrated perspective. We in this study will develop a systematic way of understanding the nature of service in the knowledge-based economy from a systems' perspective and build an integrated theory of service systems which facilitates service innovation and improves service productivity. The proposed theory will provide the foundation for designing, producing, delivering, operating, maintaining, monitoring, and improving service systems, which in turn leads to service innovation and thus a sustainable economic growth with providing greater employment opportunities.

In so doing, this study will provide researchers and companies with the basis for future study and guidelines to further service innovation. The current study will also help people understand the nature of service in knowledge-based economy and innovate service systems to achieve competitive advantage of the firm and eventually leads to the growth of national economy. In particular, given the fact that manufacturing industry is experiencing the low growth rate even without resulting in the increase in employment, the improvement in service productivity is urgent for the developed economy to keep a sustainable growth.

THE PROPOSED THEORY OF SERVICE SYSTEMS

In general, a system is defined as an arrangement of components which interact with each other within the boundary of the system to

achieve the objectives (Alter, 2008; Bertalanffy, 1968). The system can be closed to outside environments or open to interact with some entities in its environment to accept input and provide its output. A service system is a mechanism, i.e., an organically connected set of interacting components, which deals with the design, production, distribution and consumption of services in a particular situation. The service system consists of customers, services and products, suppliers, partners, and their relationships to resources and capabilities. It addresses the problems of service provision for which the components of the system interact with each other. Its goals include the maximization of service quality and service productivity, and service innovation. The theory of service systems we propose in this research study also identifies the components of service systems, the way of arranging the components, their interface, and the objectives. The major reason we rely on the systems perspective in proposing the theory of service systems is that individual services are quite heterogeneous, time perishable, intangible in their nature so that the very nature of service cannot be easily captured when we look at them as separate entities. Only through the lens of systems, we can recognize the big picture of service and its components and find the better way of improving and innovating it. For example, consider the MP3 player market where the first movers to this market iRiver and Samsung Electronics together have about 7% of the market share, while Apple, a follower, takes greater than 70% of it with their iPod and iTunes. How does this tragic result to the first movers happen? This is primarily because while the first movers have focused on the product or music listening service itself, Apple has taken into account the whole systems of music service including purchasing songs, managing the music files, selecting songs according to the need of the customer in a specific context, and listening to music so that it can maximize the customer experience and innovate the whole business of music service with their technology.

The Components of Service Systems

According to Alter (1999), the components of a work system include customer, product, business process, participants, information, and technology. The customer is defined as whoever receives and uses the outcome of the work system, product as what the work system produce including physical things, information, service, and the combination, business process as a set of work steps performed to generate outcomes, participants as whoever performs work steps in the business process, information as a combination of hard and soft data to be used to perform work, finally technology as a set of hardware, software, and other tools used by participants to perform their jobs. The definition of work system components is comprehensive, but cannot deliver the exact meaning of service, because it looks at the work systems from a production view point. From a customer point of view, products and/or services are the medium through which s/he fulfills the value to be intended to achieve. Participants and technology may be perceived as resources that support one's consumption activities. Therefore, from the customers' perspective, the six components Alter (1999) suggests can be collapsed to four components: *a set of customer activities* representing the target problems of customers that providers want to solve through products and services, *a set of participants*, inside and/or outside a company, whose job is the integration of a variety of resources to provide customers with solutions, *resources* including technology and skills to be used to generate and utilize the solutions, and *service processes* in which a set of participants perform tasks. In particular, when it comes to resources, customer capabilities need to be considered because during the process of value creation customers' participation is critical.

The proposed four components are expressed in a different way in the literature. The components, derived from the previous studies about service experience, include customer activity chain, experience network, and experience environment which determine customer experience (Prahalad and Ramaswamy, 2003) and from service dominant logic, consist of customer role, value network, and resources (Madhavaram and Hunt, 2008; Michel *et al*., 2008; Payne, Storbacka, and Frow, 2008) which involve the value creation process. Combining the two streams of research, we define the components of service systems as *value activity network, resource integrator network, and capability network* (Nam et al. 2008). Value activity network represents a variety of service related activities of customers, service providers, and their encounter which are non-sequential and randomly happening during the value creation process. The activities of customers and suppliers and those of their encounters as a whole constitute value activity network which indicates a set of solutions or services customers want to obtain to solve their problems. Resource integrator network represents various participants and their roles in the value creation process. It includes customer, service provider, customer communities, suppliers, and partners, as long as they are involved in the service provision. The primary role of the resource integrator network is in providing resources to support the value creation activities by organizing the resources each participant has. Finally, capability network involves the capabilities and resources that may exist within or outside the resource integrator network but are necessary to make the value creation process possible. The capability network consists of a variety of resources such as physical (operand) resources and skills and knowledge (operant resources) which are owned service providers and/or customers (Madhavaram and Hunt ,2008; Michel *et al*., 2008). As discussed above, recognizing the capabilities customers own is important to seamlessly create value through the service provision process.

Another important dimension of the system components we include in the theory of service systems is *service value creation process* which consists of strategy/design, production/delivery, maintenance/operation, and monitoring/enhancement (TSO, 2007). The inclusion of the value creation process is critical because service does not exist only in the form of production and delivery but rather throughout the whole processes of service value creation. In the past, among the processes, regarded as the most important was production and delivery process on which companies have focused their attention the most, when they wanted to improve service quality and productivity. However, a few companies such as IBM, GE, Rolls Royce (Howells, 2001) have developed new service models by reconfiguring business processes and capabilities with information technologies so that they could manage to convert previously reactive service provision processes to proactive services. In particular, the companies put a lot of efforts on transforming service design, maintenance and monitoring processes to create new services as well as to take preventive actions before problems happen. This trend is called servicization of product (Howells, 2001). The basic framework for research is shown in Figure 1. Service strategy/design determines target customers, revenue and cost structure, and distribution strategy. Production/delivery concerns service production and resource allocation, while operation/maintenance involves continuous service provision and monitoring/improvement captures customer feedback to enhance service quality. Each of the networks goes through each process during a service provision.

Interactions among the Components of Service Systems

Given the identification of components of the service system, the next step involves the specification of the interactions among the components (Alter, 2008). In particular, the interactions among value activity network, resource integrator network, and capability network throughout the service provision processes. Specifying the interactions is important for understanding how the systems work and how to innovate the service system. Specification of the interactions involves questions including what kind of knowledge and capability is required for both sides of participants, customers and providers, to create value, what is the integrated way of providing new and valuable service and solving service related problems, how to exchange intangible knowledge to deliver customer value, who is the key resource integrator in the value creation process.

[Figure 1] The Framework for Understanding Service Systems

The interactions among the components are quite complicated. Imagine in the service design process, customers are invited to provide their idea and expertise about a new service (value activity network). In this case, companies need to provide a good interface and communication tools with customers, to provide a better feedback to customers who suggest some ideas and expertise (value activity network form supplier side and resource integrator network). What if customers do not have enough knowledge to use the tools and interface? Companies need to provide some education to customers so that customer can have a priori knowledge about the systems of participation in the project (capability network). The same things happen throughout the service provision processes.

More complicated issues arise from resource integrator network. Within this network, there are a lot of participants involved with their own resources and capabilities. To provide better services, a nodal company (a company that deals with customers directly) as a core resource integrator generates a scheme to interact with each other, provides guidelines to serve customers, and share revenues from a specific service through translation (Latour, 2005). The interactions within the network increase exponentially as the number of participants increases so that sometimes the interactions cannot be controlled to give customers bad experiences with services.

Goals of Service Systems

The primary goal of service systems is to provide service users with high quality and innovative services in an interactive and productive way (Prahalad and Ramaswamy, 2003). The achievement of the goal in turn contributes to the growth of companies through services (Sawhney, Balasubramanian, and Krishnan, 2004). The goal of the service systems can be categorized into service quality perceived by customers, service productivity recognized by service providers, and service innovation for both customers and providers. The quality of the services provided by the systems can be evaluated by several methods including the quality of each cell in the framework (Figure 1) and overall user experience throughout the service provision. The quality of each cell in the framework (Figure 1) can be measured by the maturity of activities for service provision in each cell and across the cells. This approach to service quality encompasses a variety of factors such as service characteristics, service environment, service processes, service networks, and service people. These factors have been treated as separate concepts and investigated in a separate manner by previous studies (Cronin and Taylor 1992, 1994, Parasuraman, et al. 1988, Rust and Oliver 1994, Teas 1993, 1994, Van Dyke, Kappelman, and Prybutok 1997, Van Dyke, Prybutok, and Kappelman, 1999). In this study, however, all the factors consisting of the service system are the components of service quality. Overall user experience with the service can be evaluated by summing up the evaluation on the service processes and on the components' functions during the service provision.

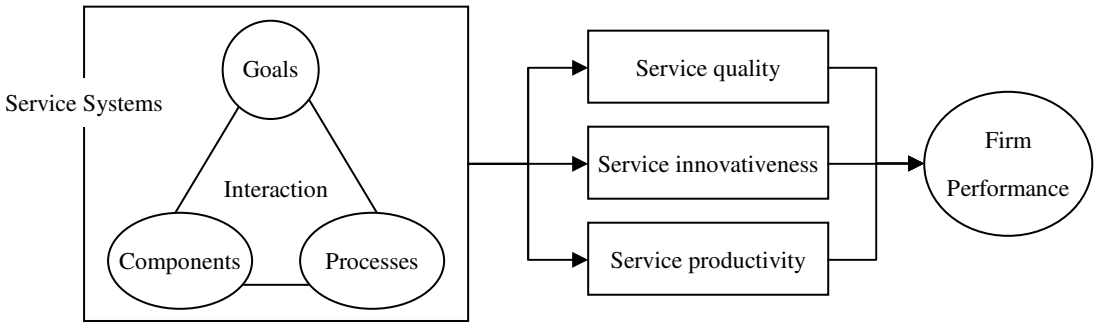
The productivity of the service provision can be evaluated by the efficiency of resource utilization. To provide services, companies rely on two types of resources, namely operant resources and operand resources (Vargo and Lusch, 2008a, 2008b). Operant resources are those that help service providers and customers with creating values by using other resources, while operand resources are those that require some others actions or operant resources to create value (Vargo and Lusch, 2008a, 2008b). For example, operant resources are competences, capabilities, and dynamic capabilities including skills and knowledge of individuals, organizational routines, cultures, and competences, and relationships with other organizations, whereas operand resources are tangible and physical resources such as raw materials and capital (Madhavaram and Hunt, 2008). Accordingly, there are different ways of evaluating the productivity of operant and operand resources. In particular, from the service systems perspective, operant resources of skills and knowledge are very important for maximizing customer experience because without them operand resources won't work very well. Moreover, service provision requires more tacit knowledge including skill, communication skills, etc. (Hertog, 2000). Therefore, measuring the productivity of operant resources in conjunction of operand resources is critical to understand the effect of knowledge and skills on service productivity and firm performance (Madhavaram and Hunt, 2008).

Finally, innovativeness of the services can be evaluated by investigating the amount of newly introduced changes in terms of the integration/disintegration of the roles of service users and the processes of service provision. For example, Michel, Brown, and Gallan

(2008) argue that to develop discontinuous innovation in service, the role of service users including buyer, payer, and user role need to be changes and the way of providing services changes by embedding knowledge/skills into objects, reconfiguring resource integrators, and establishing value constellation. Payne, Storbacka, and Frow (2008) insist that to improve co-creation of value, customer value creating process, supplier value creation process, and encounter process between customer and supplier need to be understood and innovated. We in this article focus on two dimensions of service innovation: how to innovate and where to innovate. 'How to innovate' dimension is categorized into embedding knowledge/skills into objects, reconfiguring resource integrators, and establishing value constellation (Michel, et al., 2008), while 'where to innovate dimension' includes the innovation in customer value creating process, supplier value creation process, and encounter process between customer and supplier (Payne, et al. 2008).

Service Systems and Firm Performance

The effectiveness of service systems in terms of the quality of services, innovativeness of services, and productivity of service systems is assumed to influence firm performance. The quality of services improves customers' experience with the services to increase customer satisfaction, which in turn enhance the return rate of customers and eventually firm performance. Innovativeness of services is likely to differentiate the service provision of a company from others so that the company attracts new types of customers to penetrate into new markets and retains current customers, which in turn contributes to the revenue of the company. Likewise, the productivity in utilizing resources, a company-owned or the network-owned, leads to faster service development and cost reduction which will contribute to the bottom line of a company. The positive relationship between service innovation and firm performance also has been investigated by a number of empirical studies. Deshpande et al. (1993) found that innovativeness was positively related to organizational performance in Japanese firms. Johnson and Baldwin (1996) also suggested the significant impact of innovation on a variety of business performance dimensions. In addition, service system innovation may result in not only the differentiation effect but also lead to cost reduction which in turn contributes to the productivity of the service provision. The relationship between service systems and firm performance can be depicted as figure 2.



[Figure 2] The Relationship between Service Systems and Firm Performance

DISCUSSIONS AND IMPLICATIONS

Services have been regarded as something intangible, perishable, and heterogeneous so that it is difficult to measure the quality and productivity of them (Quinn et al., 1987, Fitzsimmons, 2001). Services also have long been considered non-productive economic activities (Vargo and Lusch, 2008a, 2008b). However, considering the recent growth of service industry across the world, it is critical to understand the very nature of service and the way of innovating it to improve the quality of life and effective economic development. For this, we in this paper propose a theory of service systems consisting of components, interactions among the components and goals. This is primarily because the measurement and innovation of services become feasible when services are understood as a system that is comprised of components, the interactions among components, and goals.

In terms of the academic contribution, the proposed theory may provide the foundation for designing, producing, delivering, operating, maintaining, monitoring, and improving service systems. The current study will be the basis for service quality, productivity, and innovation studies by providing scholars with the components and the nature of their interactions such that the researchers can easily position their research studies within the literature.

Future research is desired to address the following issues to advance the understanding of the service from a systems perspective. The first issue relates to analyzing what composes each component and what is the best way to organize them. For example, to understand value activity network, researchers need to analyze and design user requirement and preferences, user activities, user-provider encounter activities, provider activities, and find out the best way of mapping user-provider activities. With regard to resource integrator network, researchers may want to analyze and design the role and responsibility of resource integrator, the role and capability of core resource integrator, the gap between the role and process of resource integrators, technology configuration to support value activity network and capability network, an integrated service process between resource integrators, and the best way to configure an integrated service process using Service Oriented Architecture and Business Process Management. Regarding capability network, researchers need to find out the best way of evaluating operant resources and operand resources and analyzing and designing the interaction pattern between capability and synergy effect.

The second issue involves analyzing and designing service processes. For example, to understand what is the best way of designing services, researchers need to analyze and evaluate the service portfolio and strategy, service revenue models, the relevance of service models, the relationship of leadership with performance, and service design process. Regarding service production and delivery

process, researchers are desired to analyze and design service production and delivery network, customer interface for service production and delivery, and optimize service production and delivery process, service production and delivery structure, service production and delivery process outsourcing, and find the best way of technology acceptance and diffusion in service production and delivery. With regard to service operation and maintenance process, future studies need to address the issues like service operation and maintenance network performance, customer interface for service operation and maintenance, optimization of service operation and maintenance process and structure, and service operation and maintenance process outsourcing. Finally, concerning service monitoring and improvement process, future studies are desired to find the best way of modeling service monitoring and improvement process, optimizing service monitoring and improvement process, diffusing technology in service monitoring and improvement, and analyze the impact of service monitoring and improvement process on other processes and firm performance.

The third issue concerns the analysis of the interaction among the components. As mentioned in the previous sections, the interactions among the components are very complicated. For example, the interaction between customers and service providers is quite nonlinear and complex to make the support for customer activities difficult. In addition, the complexity of the interactions causes problems with regard to resource acquisition and allocation. Hence, in designing the service-based business model, understanding the interaction among components and processes is critical. Future research needs to address the following questions: what are the nature and patterns of the interactions? How do the interactions affect the configuration of the networks and firm performance? In what condition, do the interactions affect the effect of the network configuration on firm performance?

We also expect that the proposed theory of the service system sheds some light on the way of innovating services and products in a much more safe fashion. The theory can be used by industries to improve productivity and service quality, reduce time-to-market and cycle time, and increase customer satisfaction, value creation, and innovative business activities. For example, based on the proposed theory, when companies change their perspective from product to service, they may come up with a variety of new business models to capitalize on their core technology and products as the medium of service delivery. The service based business models will give chances to innovate their existing business models to preemptively occupy newly developed markets. Companies can also measure the maturity of their service processes regarding the components to find out which process needs to be eliminated, reduced, raised, and created. These positive effects will lead to more service innovation and thus sustainable economic growth at country level with providing greater employment opportunities. Moreover, companies can transform their service activities into knowledge to gain market competitiveness, which in turn leads to more capital investments.

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