2012 International Conference on Education and Management Innovation
IPEDR vol.30 (2012) © (2012) IACSIT Press, Singapore

Providing Customized Products and Services Based on Service Science Paradigm

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Abstract. Services are growing in importance since all industries and their products require some financially linked aspect of service. Service science applies technical and managerial science effectively to provide customized services for improving productivity and service innovation for improved profitability. This study develops two new models that are used to identify the service innovative position of modern enterprises through the analysis of the scope of services, the degree of customization, data mining, and IT service systems requirements. The key to application of the systems engineering approach are the data mining techniques applied as a dynamic process to estimate the effectiveness of customized services. The model of the service science technology increases the competitive advantage and demonstrably increases business profits for companies.

Keywords: service science, customization, data mining, systems engineering

1. Introduction

Services dominate the economy in most developed nations nowadays [1]. The latest report of Central Intelligence Agency indicates that the worldwide percentages of GDP contribution (2010) are 5.7% in agriculture, 30.7% in industry, and 63.6% in services. On average, developed countries hold 70% to 80% of their GDP and employment in the service sector, 15% to 25% in the manufacturing sector, and about 5% in the agricultural sector [2]. Thus, the evolution to a service-led economy has become increasingly important for positioning countries [3]. Numerous enterprises measure customer values and utilize this information to retain customers and maximize their profit potential [4]. Only when enterprises understand the value of customers and the value offer by delivering customized services to different customers is effective customer relationship management achieved [5]. Instead of guessing the target customers' needs by the service providers, mathematics and information science are used for service science applications [1]. Data mining (DM) techniques are widely used to solve customer relationship management (CRM) problems [6].

Service science technology combines the concept that data mining is one of the most effective approaches to identify consumer behavior and provide better services. The research focuses of this paper are as follows. First, a model based on service science is developed to determine the innovative position of providers. Second, dynamic systems engineering with the data mining is applied to achieve service customization. Finally, customized marketing strategies are provided based on the analytical results. The research is organized as follows. In section 2, the related literature is reviewed. Two models and the systems engineering approach for service science are presented in section 3. Two case studies illustrate how decision

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makers apply these models to the service domain in section 4. Finally, the conclusion and expected outcomes are discussed in section 5.

2. Literature Review

This section reviews some fundamental concepts and related research in service science, data mining and systems engineering.

When referring to the scope of service science, three terms are frequently used: service, service systems, and service science. A service is defined as the application of competence and knowledge to create value between providers and receivers [7]. They share services through value co-creation [8]. Generally, service systems are dynamic configurations of resources that can create value with other service systems through shared information [7]. Combining the front and back office via the service system improves the quality of the service experience and creates maximum value when the service encounter takes place [9]. Since 2004, the IBM research division advocated Services Science, Management, and Engineering (SSME), as an interdisciplinary approach for service-oriented value creation. The goal of service science is to catalog and understand service systems and to apply service systems for practical business purposes.

CRM focuses managerial efforts to business processes and technologies that are designed to understand the customers of an enterprise [10]. An IBM executive said you cannot be an effective marketer today without possessing skills in data mining [11]. The concepts of CRM and document that data mining is widely used for solving customer service problems [12]. Data mining is the approach employed to discover hidden information behind the customer data and identify useful patterns and associations for decision makers [5, 11, 12]. In conclusion, the discovered knowledge is helpful for better decision making so that the business profits and competitive advantage can be improved.

Systems engineering is an engineering discipline for creating and executing an interdisciplinary process to ensure that the customer and stakeholder's needs are satisfied in a high quality, trustworthy, cost efficient and schedule compliant manner throughout a system's life cycle. Systems engineering is a quantitative approach, involving tradeoff, optimization, selection, and integration of the products of many engineering disciplines [13]. The process includes what needs are to be achieved, how well it must be achieved, how it is to be achieved, and the results of the analysis.

3. Methodology

This section includes the development of two models and procedures for extracting the customer demands from data. Based on the research motivations and objectives as described earlier, the transition model of service science orientation and the phases of service innovation are proposed. Further, a systems engineering approach for service science is built in the last subsection.

3.1. The transition of service science orientation

Three areas are arranged in Figure 1 including goods-dominant logic (G-D logic), goods-based service logic (G-based S logic), and service-dominant logic (S-D logic). The degree of differentiation is judged by value that is created between service providers and receivers. The higher the values created, the higher the revenues increased through service extension.

3.1.1 Goods-dominant logic (G-D logic)

In the past, the business activity focused on production and the main goal was to maximize the profit from the sale of output (value by transaction). Goods are manufactured efficiently without extended value and improved customization can be a represented and modelled in this area.

3.1.2 Goods-based service logic (G-based S logic)

The middle area puts emphases on value for use. Namely, providers manufacture and supply practical goods-based services to end users. Hence, providers try to get into target markets and understand customer needs before manufacture.

3.1.3 Service-dominant logic (S-D logic)

Over the past several years, new emerged logic focused on intangible resources, value in use [14], and relationships. S-D logic provides experiences via the service system. In order to maintain customers, a higher degree of customization is essential for service providers to increase revenues through service extension.

3.2. The phases of the service innovation

The phases of service innovation model are proposed in Figure 2. Based on the relationships, three phases of service innovation are organized into the models of Provider-Driven Services, Market-Driven Services, and Customer-Driven Services respectively. The differentiation is mainly judged by the role of the customer from passive to active.

3.2.1 Provider driven services

Based on the service science transition model, the bottom left area focuses on goods centered view. The transactions with economies of scale, selling mass quantity to customers to decrease average cost (and maximal profit), causes customer be ignored. Neither data mining techniques nor interactive service systems are used so the provider driven services rate the lowest service innovation.

3.2.2 Market driven services

The emphasis shifts from the supply of standard services and products offered to segmented and market-oriented services. Solutions are often created by packaging a number of standard elements to achieve economies of scope. Although market driven services involve the mid-range of service systems and data mining, it lacks immediate interactive dialogues between sellers and customers.

3.2.3 Customer driven services

Modern business practices show that a consumer becomes a prosumer that combines the roles of a producer and a consumer. Data mining techniques are used in database management that involves immediate interactive dialogue through IT service systems. In conclusion, the data mining techniques and IT service systems requirements are adopted to co-create value in the top right area of the figure 2.

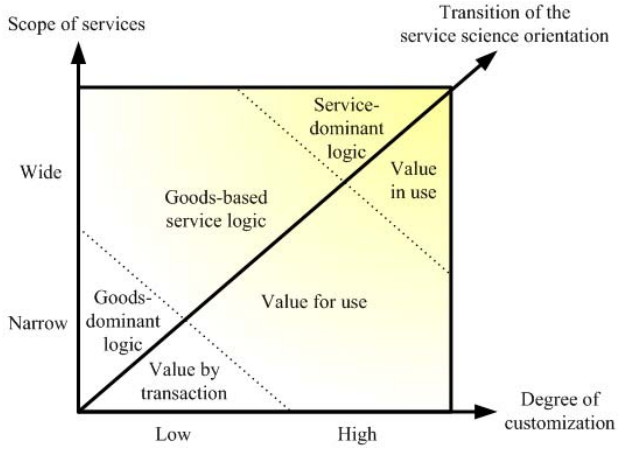

Fig. 1: Transition of service science orientation

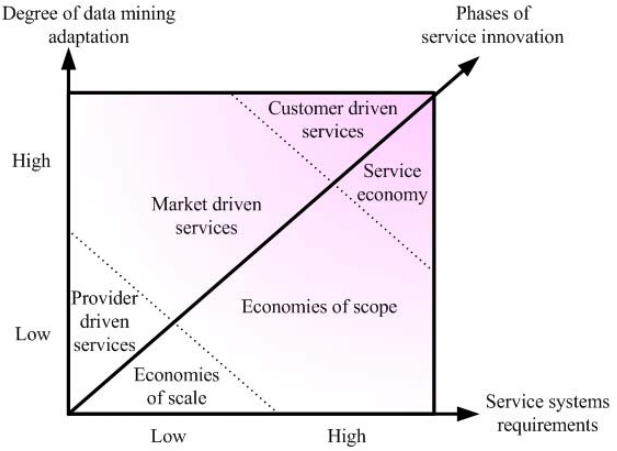

Fig. 2: The phases of service innovation

3.3. Systems engineering approach for service science

Referring to the definition of systems engineering, this section integrates the service science concept and data mining techniques. The proposed approach is depicted in Figure 3. Five steps include requirements definition, service systems integration, system model, customized services, and evaluate results and re-evaluation.

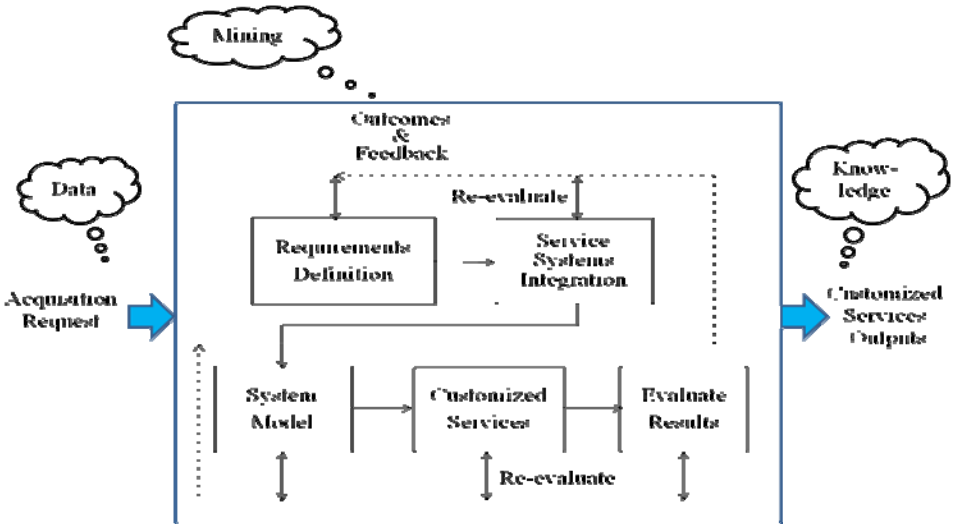

Fig. 3: Systems engineering approach for service science

4. Case Studies

Two related cases including Trappey et al. (2009) and (2010) are highlighted in this section to illustrate the proposed service science methodology [15, 16].

4.1. Case A: promoting customer preferences in a gourmet restaurant chain

Case A is a chain of upscale gourmet Japanese restaurants. The chain focuses on customers willing to spend over NT$1,000 to NT$2,000 per person per meal. Such high-end restaurant offer valued customers customized menus and services to satisfy their high expectation. Higher customization, combined with integrated service systems and data mining techniques, places the restaurant in the top-right area of the service orientation and innovation shown in Figure 1 and Figure 2. Customers are identified using an RFID-embedded premier (membership) card when entering the restaurant. The personal digital assistant (PDA) is used to bring up each customer's personal information, order and service preferences to better enable the service staff to interact with customers. For the first level of segmentation, customers are clustered based on frequency of visits and dining expenditures. A non-hierarchical K-means clustering approach is used. The data is mined periodically to provide customized coupons which encourage re-visits.

4.2. Case B: prioritization of automobile logistics services

Company B would like to offer customized services to its customers with a higher customization degree that combines improved IT systems and data mining techniques. The provider belongs to the market driven services of Figure 2. Company B must interact with more than 70% of the automobile sector including domestic car makers, car dealers, original equipment manufacturer (OEM) parts suppliers, original equipment service (OES) parts suppliers, and automobile maintenance and repair shops. A two stage clustering method, combining Ward's minimum variance method and the K-means algorithm to prioritize the logistic services to better satisfy groups of manufacturers with specific preferences in the automobile supply chain. The target segments are analyzed to determine the service preferences within these distinct groups. Given the complex relationships between the supply chain partners, establishing a smart service system for 3PL service providers is of vital importance to better satisfy customers with specific preferences.

5. Conclusion

This research contributes to the following aspects of service science. First, two conceptualized models are defined to help providers understand not only how they create service value but also determine their orientation and innovative service position. Second, through a dynamic systems engineering process, data mining techniques are applied for service customization. Through the use of the systems engineering approach, more accurate decisions are made based on these techniques.

The purpose of services may be value-in-use and may also be gained from a long relationship perspective. Regardless of the purpose for a particular service, offering the best service that satisfies customer's needs is essentials for CRM. Value co-creation is typically not subject to standardized approaches. Instead, services are customized based on consumer needs and the competitive environment in which providers offer services or products through service shape and promote the consumer repurchase.

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