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Drivers and Implications of Service Science[1]

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***Abstract*: This paper seeks to analyze the drivers, the objectives, and the implications of service science. Rising importance of service in world economy, growing demand for service innovation, and infusion of business, technology and people lay the foundation of service science. As a multidisciplinary field, service science brings together knowledge from diverse areas by melding technology with business processes and organization. Service science embraces new mindset: service dominant logic, which builds the philosophical foundation of service science. Service system is the theoretical foundation. To facilitate the service science education, research and application, joint efforts from business, industry, governments, and academia are challenged. A framework model of service science is built, to show the drivers, stakeholders and implications of service science.**

***Keywords*- Service Science; Service System; Service-Dominant Logic; Service Innovation**

I INTRODUCTION

World economy is shifting from product centric to service centric economy. Service contributes more than 70% in GDP in developed countries, and service has become a major source of job creation. The success of service economy determines the future productivity and employment growth [1].

Rapid development of service dominated economy is driven by service innovation. Innovation occurs increasingly at the intersection of multiple disciplines. Service is more and more infused and integrated with other disciplines, such as IT, management etc. For example, in transportation and logistics service, three kinds of ICT (Information Communication Technology) have been supporting the service, leading to service innovation and increase in productivity. 1) Stationary IT. 2) Mobile IT. 3） Embedded IT. Furthermore, rising investment in intangibles, growing emphasis on knowledge management, and outsourcing play major roles in the expansion of service economy [2].

World economy shows the trend of increase in scale and complexity, more service innovation is needed. Under this circumstance, IBM advocated service science, which is aimed to enable service innovation with new knowledge.

The paper is organized as follows: Firstly, the drivers of service sciences are defined. Then service system as the theoretical foundation and service dominant logic as philosophical foundation of service science are discussed. Finally, challenges facing service research and education are pointed out. This paper contributes by establishing a framework model, describing the drivers and implications of service science. Another feature of this paper is the explanation with service related cases, which show the essence of service science: service innovation driven by interdisciplinary interaction and infusion.

II SERVICE SCIENCE DRIVEN BY SERVICE DOMINATED ECONOMY

A. Service Dominated Economy

Enterprises are undergoing a servicisation process, whereby manufacturers move from product-oriented towards a service-led business model. Due to severe competition and product commoditization, companies (especially good-dominant ones) have difficulties to differentiate their products. With narrowing profit margins, companies have to develop service, which becomes revenue generating differentiator. For example, instead of selling jet engines, manufacturers develop service offerings in which customers are charged for propulsion usage. SaaS (Software as a Service) mechanism allows small and medium sized enterprise, which depends more on technology and web service infrastructure as markets increase in complexity, to lease IT service from a platform and don't have to invest in infrastructure, which helps them save much money. Goods-dominant firms operating in B2B markets are striving to become "solutions providers" by adding new services (revenue-generating offerings) to their portfolio of tangible goods. IBM and GM are two successful companies for their revenue generating service business.

Service science is driven by three factors: service innovation, service dominated economy, and the interaction of technology, business and people.

B. Service Science

SSME (Service Science, Management and Engineering) or Service Science is an emerging field, which was proposed by IBM firstly in 2004 [3]. Services science is a multidisciplinary field that brings together knowledge from diverse areas to improve the service industry's operations, performance, and innovation. In essence, it represents a melding of technology with an understanding of business processes and organization.

Service science as a new academic discipline is a bold advocating. But it has two strong drivers: one is service economy and the other is growing demand for service innovations [4]. Service centric economy driven by service innovation requires new type of engineer to be educated. The so called service scientists should focus on services rather than manufacturing, and be able to integrate three sciences—management, social, and engineering science—in the analysis of service systems.

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In SSME, service is defined as the application of competences (skills and knowledge) for the benefit of another party (or for oneself); science is a way to create knowledge, engineering is a way to use knowledge to create value, and management invests to improve the process of creating and capturing value [5]. Some researchers argued that service design should become a contributor to SSME, because service design applies design methods and principles to the design of services. So service science is also referred to as SSMED.

Service Science is aimed to discover the underlying logic of complex service systems and to establish a common language and shared frameworks for service innovation.

There have been three possible perspectives of service science:

- As a multidisciplinary 'superset' embracing all appropriate disciplines and functions.
- As a multidisciplinary 'subset' embracing select elements of the major disciplines and functions.
- As an interdisciplinary activity which attempts to create an appropriate set of new knowledge to bridge and integrate various areas based on trans-disciplinary and cross-disciplinary collaboration.

The last perspective is more practical. It focuses on infusion and integration of different disciplines. Service science includes curricula, training, and research programs that are designed to teach individuals to apply science, engineering, management and design disciplines that integrate cross-disciplinary elements, such as computer science, operations research, industrial engineering, business strategy, management sciences, social and legal sciences, and others in order to encourage innovation in how organizations create value for customers and stakeholders that could not be achieved through such disciplines working in isolation.

For a specific service task, service science focuses on how to design and operate services, how to gain knowledge for this task, and how to provide this knowledge to those who need to set up business service platforms. A good example of service science is the CAME (Computer-Aided Market Engineering) tool suite (meet2trade), developed by Karlsruhe University, which shows a service engineering approach to the development of electronic markets as a service offering [6]. The CAME tool suite provides a conceptual framework for designing e-markets, a process model to guide the design, and methods and tools supporting these design steps. These tasks are inherently interdisciplinary. The strategic task of defining the segment, in which the e-market is intended to operate, is primarily a management and marketing endeavor. The design of the market mechanisms that describe the flow of the negotiation process pertains to economics. CAME serves as an example of SSME approach and meet2trade shows an integrated outcome of SSME.

C. Framework Model of Service Science

A conceptual model, shown in Fig. 1, is established to describe the drivers and proposition of service science.

In the center of Figure 1 is service science, which is driven by three forces: service dominated economy, service innovation and infusion of business, technology and people. The three drivers of service science are interrelated. Growing need for service innovation is the key driver of service science. Service innovation is enabled by infusion of resources (technology, people, business and shared information) of service system. Service innovation is the main driving force of the service dominated economy.

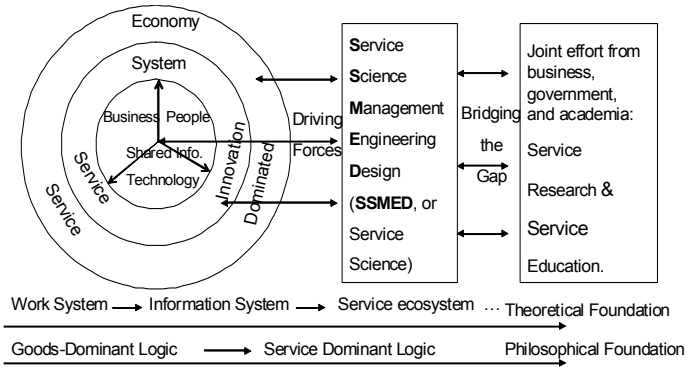

Figure 1. Framework model of drivers and implications of service science

Service science is dynamic and evolving. Its theoretical foundation is service system, which is evolving from information system and work system with the scale, complexity and innovation of the system getting increased. The mindset for service science is service- dominant logic (SDL), shifted from goods dominant logic (GDL).

Service science is aimed to educate or train T-shaped professionals as adaptive innovators, who are grounded in their home disciplines but have strong communication skills to interact with specialists from a wide range of disciplines.

The development of service science needs joint efforts from stakeholders, such as government, business and academia. Research and education are challenged to bridge the knowledge and skill gap, to promote service science, and to benefit the increasingly complex world economy.

III SERVICE SYSTEM: THEORETICAL FOUNDATION OF SERVICE SCIENCE

Spohrer proposed that service system (or service ecosystem) is the basic abstraction of service science [5]. Just like the industrial revolution was built on many powerful abstractions, such as mass, energy, work, and power) during the 19th century, the information revolution was built on many powerful abstractions (such as binary digit or bit, binary coding, and algorithmic complexity) during the 20th century.

A. Service System

Spohrer considered service system as a value co-creation configuration of people, technology, organizations, and shared information, and value propositions connecting internal and external service systems. Other researchers modified this definition by adding stakeholders in the service system, and underlined the dynamism of the service system. Stakeholder of service system consists of people (knowledge worker), technology, information, and resources. Two basic roles in service system are service customer and provider, who interact to create successful value propositions. Role-holders differ in specific service system. Glushko stresses the

interconnected provider-consumer relationships and the information flow through them in the service system [7].

Service system, as abstraction of service science, can help understand and build the foundation of service science. Characteristics of service systems are:

1) Customer-provider interactions that enable value co-creation
2) Solution for complex problem
3) Dynamic configurations of resources: people, technologies, organizations and information
4) Service is viewed abstractly as information exchange
5) Information-intensive and multi-channel;
6) Service activities: proposal, agreement, realization;
7) Increasing scale, complexity and connectedness, such as B2B, B2C, C2C, B2G, G2C, G2G service networks/system.

B. *Service*

Service is the basic component of service system, which is defined as relationship or experience, interaction, or value co-creation process between provider and customer [5]. The basic characteristics of service are intangibility, inseparability, heterogeneity, and perishability, which affect the development and delivery of services with respect to customer participation and service quality and experience.

C. *Service System Interaction*

Service system could be of different context, such as enterprise, industry/sector or country's economy. Service system interaction can be viewed from different perspectives.

1) *From resource perspective:* In service system, resources are applied (including competences, skills, and knowledge) to make change that have value for another system. Resources in service system belong to two distinct groups: operant resources and operand resources. A service system includes at least one operant resource. Operant resources can act on other resources to create change, value and effect. Operand resources are operated on. Determination of which resources are operand or operant depends on the context.
2) *From relationship perspective:* Service system is complex adaptive system, which is also a type of 'system of systems', containing internal smaller service systems as well as being contained in a larger service system. Service system interacts with other service systems via value propositions, forming stable relationships in extended value chains or service networks.
3) *From life cycle perspective:* (a) Problem definition; (b) Identification of stakeholders and their interaction; (c) Modeling the interaction of technology, business and knowledge worker in the system; (d) Extrapolate evolution of the system over time; (5) Envision new service systems that could be put in place to solve problem.
4) *From activity perspective:* Each service system engages in three main activities that make up as service interaction: (a) proposing a value co-creation interaction to another service system (proposal); (b) agreeing to a proposal (agreement); (c) realizing the proposal (realization).

Spohrer [5] proposed a normative ISPAR (Interact-Serve-Propose-Agree-Realize) model of service system interaction. Interaction episode is a series of activities jointly participated by two service systems.

IV SERVICE INNOVATION: AIM OF SERVICE SCIENCE

Service science focuses on service innovation, bringing together a number of different academic areas – from business models and processes, to a deep understanding of technology, to an equally deep understanding of people, cultures, and the ability to interact remotely in the global environment.

Within the last 20 decades, the mankind and world economy has gone through a series of innovation: from the industrial revolution in England in 1800s (Steam Engine), to the chemicals revolution in Germany in 1850s (Dyes & Metallurgy); to the electrical and information revolution in USA in 1900s (Telephone and Computers); to product quality in Japan in 1950s, to low cost services in India in 2000s (call centers), and to the low cost product in China in 2000. These innovations have driven the economic growth by providing lower cost and higher efficiency, enabled by workforce and technology. Based on the analysis of the innovation trend, the next focus of innovation could be industrialized services exports (IT Data Centers of Google)

Service innovation aims to improve existing service systems (incremental innovation), create new value propositions or create new service systems (radical innovation). Service innovation, normally driven by change in service elements, is the combination of technology innovation, business model innovation, social-organizational innovation and demand innovation. Service innovation can also be a result of novel combinations of existing service elements.

Innovation might come from technology, business or management, and the real innovation and insight requires combining these elements. Examples of service innovation include: On-line tax returns, e-commerce, helpdesk outsourcing, music download, loyalty programs, home medical test kits, mobile phones, money market funds, ATMs and ticket kiosks, bar code, credit cards, leasing

A relatively mature model for service innovation is the four dimensional, considering 1) new service concept: knowledge of the characteristics of existing and competing services (business intelligence); 2) new client interface: characteristics of actual and potential clients (market intelligence); 3) new service delivery system (capacities, skills & attitude of existing and competing service workers); 4) technological options as enabler of the service system. Bouwman et al. extended the service innovation perspective by developing a conceptual business model framework, the 'STOF model', covering the four interrelated perspectives: service, technology, organization and finance [8]. Based on this framework, a business model design method 'STOF method' is provided. This method offers new concepts and raises the business models to a new level of insight and

understanding. This structured approach is consistent with service science view and can be applied to analyze and design innovative service system model.

Service innovation is the objective of service science. But reach this aim, only the service system theory as theoretical foundation of service science is not enough, the new logic (SDL) help build the philosophical foundation of service science.

V SERVICE DOMINANT LOGIC (SDL): PHILOSOPHICAL FOUNDATION OF SERVICE SCIENCE

Worldview and mindset need to be renewed and geared to adapt to the new economic environment. Under these circumstances, a new logic called Service-Dominated Logic (SDL) is proposed firstly by Vargos and Lusch. SDL is different from the Good-Dominant Logic (GDL). Vargo et al. argued that a service science built on SDL is more likely to provide a more fertile knowledge base than is a services science built on the logic of a good [9].

Before SDL is formally proposed by Vargos, there have been scholars who have mused on it. In 1848, Bastiat proposed the great economic law: services are exchanged for services. Alderson (1957) wrote that what matters is not an interpretation of the utility created, but an interpretation of the whole process of creating utility. Kotler (1977) proposed the importance of physical products lie not so much in owning them as obtaining the services they render. Gummesson (1995) presented that customers do not buy goods or services; they buy offerings which render services, which create value. Gronroos (2000) put the focus of marketing on the consumers' value-creating processes, but not on products (goods).

A. Goods-Dominant Logic

According to GDL view, the purpose of economic exchange is to make and distribute things to be sold. A firm's production process embeds value or utility into a good, and the value of the good is represented by the market price or what the consumer is willing to pay. GDL is based on the concept that services are special forms of intangible goods and therefore GDL is concerned with the production of intangible units of output. In GDL, service is considered as a complement (and inferior) to goods.

GDL have evolved from Aristotle's "use-value" theory, to Adam Smith's view of productive activities with focus on the output of tangible resources, and further to the ''product'' embedded with ''utilities'' (exchange-value) as focus of neoclassical economics grounded in marginal utility theory. Thus, economic science became grounded on a foundation of goods-dominant logic and nominal exchange value.

B. Service -Dominant Logic

The SDL view is that all exchange is based on service, and that ''when goods are involved, they are tools for the delivery and application of resources''. In SDL, knowledge and skills are the key resources for competitive advantage [10].

Vargo and Lusch proposed ten foundational premises of SDL: 1) Service is the fundamental basis of exchange; 2) Indirect exchange masks the fundamental basis of exchange; 3) Goods are a distribution mechanism for service provision. 4) Operant resources are the fundamental source of competitive advantage; 5) All economies are service economies; 6) The customer is always a co-creator of value; 7) The enterprise can not deliver value, but only offer value propositions; 8) A service-centered view is inherently customer oriented and relational; 9) All social and economic actors are resource integrators; 10) Value is always uniquely and determined by the beneficiary.

C. Difference between GDL and SDL

GDL and SDL are two different paradigms for thinking about resources, exchange and human action. GDL is suitable for the production-based economic, with focus on value-in-exchange and embedded-value, while SDL fits the service dominated economy, embracing concepts of the value-in-use and co-creation of value. The main differences between them are explained as follows:

1) Resource

- GDL: Operand resources are primarily used;
- SDL: Operant resources (knowledge and skills) are primarily used; sometimes operant resources are transferred by embedding them in operand resources.

2) Exchange

- GDL: Focus on value-in-exchange; Economic exchange is fundamentally concerned with units of output (products).
- SDL: Focus on value-in-use or value-in-context; Markets, organizations, and society are fundamentally concerned with service exchange; Service is process-driven; Service is interpreted as mutual service provision process (service for service); Goods are still important; but service is dominant.

3) Value creation

- GDL: Value is created by the firm or producer, and products are embedded with value during the manufacturing (or agricultural, or extraction) process.
- SDL: Value creation is a collaborative process. Value is always co-created in customer-provider interactions with asset, information, work (actions) and risk sharing relationship. Firms propose value through market offerings, customers continue value-creation process through use;

4) Objective

- GDL: Increase wealth for the firm
- SDL: Increase in adaptability, survivability, and system wellbeing through service (applied knowledge and skill) of others

5) Role of provider and customer

- GDL: Provider produces and distributes value; Customer "uses up" or "destroys" value created by the provider;
- SDL: Provider propose, co-create value, and provide service; Customer co-create value through the integration of firm provided resources with other resources

6) The role of Goods and service

- GDL: Goods are units of output, operand resources that are embedded with value; Services are seen as units of output, but somewhat inferior to goods.
- SDL: Goods are vehicle for operant resources, enable access to benefits of firm competences; Service are seen as a process—doing something for (and in conjunction with) another party, sometimes with the aid of goods.

Service dominant logic serves as the philosophical foundation for service science. This new mindset sheds a new light for researchers and practitioners in this field.

VI Ongoing Joint Effort for Service Science

Service science seeks to strengthen industry-academic-government interactions, to develop innovative service dealing with the more complex service problem.

A. Research on Service Science

New knowledge such as models, methodologies, processes, and software tools for service science should be researched to create and deliver services more efficiently.

Till now, much work has been done. For example, IBM has developed Component Business Modeling approach and Service Oriented Architecture. Many service research centers have been set up, i.e. Center for Service Leadership from Arizona State University, University of Cambridge Institute for Manufacturing, and KIT Service Research Institute, etc. Many research initiatives about newly emerging service systems have been conducted.

More research should help exploit the power of infusion of technology with business and organization to design and provide new types of service offerings.

B. Education of Service Science to Bridge the Knowledge Gap

New service science talents should be educated to be able to study, manage, and engineer service systems, solving problems and exploiting opportunities to create service innovations. The gaps in knowledge and skills needed to deal with complex service systems indicate that we need to reassess our approach to research and education.

Within last few years, many universities have established service science related program, from bachelor level to master level, even Ph.D. level. Service science curricula are designed and embedded in business & management school and engineering school. Moreover, as a key stakeholder of service science, government should pay more attention and effort to promote service science by providing research and education funding. Collaboration with business and academia is imperative to implement efficient government service system.

VII Conclusions

This paper built a framework model to present the drivers and implications of service science. Focus of service science is to build knowledge through interdisciplinary collaboration, to promote service innovation. To make service science applicable, governments, business and educational institutes need to join together to advance knowledge and to develop valuable transdisciplinary services solution.

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