Service Science: Scientific Study of Service Systems

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Service cannot be held, and is typically intangible**,** perishable, difficult to port, hard to measure, and co-produced with customers. This paper introduces a new thinking of design and deployment of competent and competitive service systems by taking account of these service's unique characteristics. It aims to help promote and advance Service Science that ultimately will empower enterprise service systems and make them highly adaptable and sustainable to the global, changing, and dynamic service environment (when, where and who to deliver and whom to be served, etc.) to meet the severe competition challenges.

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1. Service and Service-led Economy

Based on the Bureau of Labor Statistics, except those in the goods-producing sectors—agriculture, mining, construction, and manufacturing, the service sector encompasses all other industries including transportation, logistics, communication, wholesale and retail, trade, education, finance, insurance, real estate, healthcare, criminal justice, postal operations, government, and a variety of public utilities. The service industry has grown to dominate developed economies. In the US 80% of GDP in 2007 was derived from the service sector, whereas in China a rapidly growing service sector represents about 35% of the economy. Although Chinese service industry has now contributed only 1/3 of the economy, Chinese service industry has grown in the fastest pace in the world during last quarter century. Moreover, Chinese government aggressively responds to the service innovation opportunity by including a focus on incubating "Modern Services" in China's 2006-2010 Five-year Plan.

In contrast to the fast service economy development, the advancement in service education and research is far left behind. According to Spohrer et al. (2007), "[t]he service sector accounts for most of the world's economic activity, but it's the least-studied part of the economy." In 2003, US National Academy of Engineering (NAE) reported this important finding when "The Impact of Academic Research on Industrial Performance" project was completed. According to the NAE project report [9], the service industry employs a large and growing share of national workforce (about 80% in the US in 2006), and is the primary users of information technology (IT). Even in most manufacturing industries, the service functions (e.g., sales, logistics, distribution, and customer service) focusing on increasing customer values have become leading sources for improved business competitiveness. Although it is well understood that the rate of innovations and level of productivity in the service infrastructure (e.g., finance, transportation, communication, and healthcare) have an enormous impact on the productivity and performance of all other segments of the economy, the research and education in both academics and industries are not focused on or organized to meet the needs of service businesses. It was suggested that universities and industries should immediately and appropriately address the challenges in service education and research (NAE 2003).

Service is typically considered as an application of specialized knowledge, skills, and experiences, performed for the benefit of another (Lusch and Vargo 2006, Spohrer *et al* 2007). Service is perishable, heterogeneous, and intangible, commonly provided for either individuals or businesses to create desirable value to satisfy their needs (Dietrich and Harrison 2006, Sampson and Froehle 2006). Although a significant portion of the services provided by the service industry is consumed by individuals, such as medical, education, insurance, legal, financial, transportation, and retailing services, recently business services that serve different business units or organizations are growing substantially rapidly (Dietrich and Harrison 2006). For example, technical support, enterprise resource planning, call center operations, sales management, IT implementation, e-logistics, and business investment and transformation consulting are well recognized as a highly profitable business service (Qiu 2006).

Driven by today's new business environment that includes advanced telecommunications, accelerated business globalization, increased automation, and rapid technology innovations, emphasis in the service sector has evolved from a traditional labor-based business to sources of innovations, collaboration, and value co-creation, driving the emergence of service-value networks (i.e., service systems) at a pace never before seen in history (Spohrere and

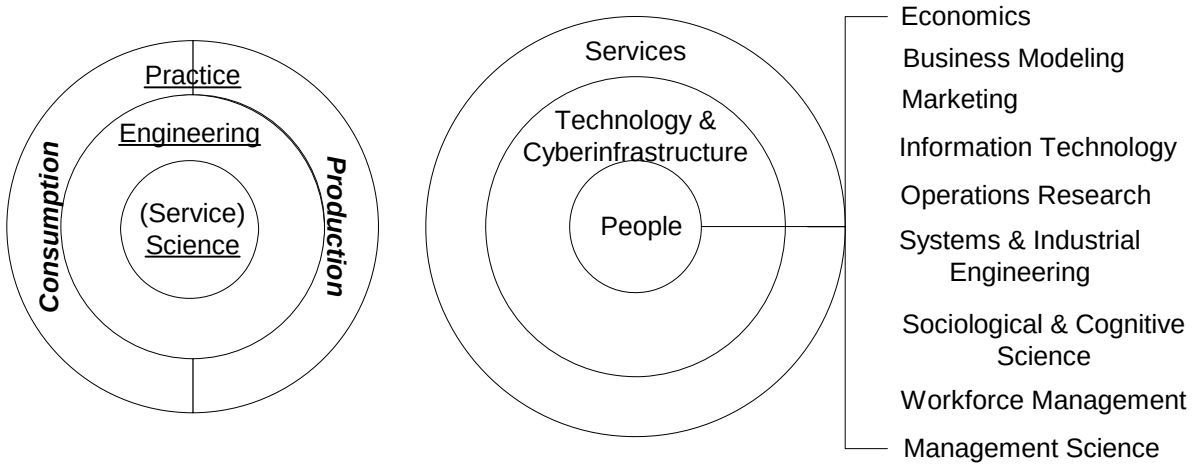
Riechen 2006). It is obviously a trend that leading and competitive services provided by service systems are all remarkably delineated with information-driven, customer-centric, e-oriented, and satisfaction-focused characteristics.

A variety of high-tech services enabled through service-value networks in the high value areas have been emerging recently, such as online information and knowledge service, IT outsourcing to post-sales training, on demand innovations consulting (e.g., work helping customers reengineer products, automate business processes, improve goods and services delivery efficiency, and design and deploy supportive IT systems). In evidence, IBM Global Consulting, Accentric, Google, eBay, Amazon, YouTube, Yahoo, and online distance education well represent these emerging services. Note that traditional services providers (e.g., Airlines, UPS, Wal-Mart, McDonalds, travel agencies, etc.) are also transforming themselves into service-value networks to gain competitive advantages. It is well understood that the quality of their provided services largely depends on very large–scale public information infrastructures and complex services systems in order to satisfy the diverse needs of worldwide customers.

Even in manufacturing, for farsighted manufacturers in the developed economy, as their product technologies might quickly lose their competitiveness, they recognize that only their services components would distinguish themselves from their competitors. Therefore, enterprises are keen on building highly profitable service-oriented businesses by taking advantage of their own unique engineering and service expertise, aimed at shifting gears towards creating superior outcomes to best meet their customer needs in order to stay competitive (Qiu 2006, Rangaswamy and Pal 2005). General Electric, IBM, and many worldwide bellwethers are great examples in repositioning themselves towards the service-oriented businesses (Hidaka 2006).

However, there lack of full-fledged sciences that could systematically guide the plan, design, marketing, engineering, and delivery of services to meet the needs of today's changing, complicated, and dynamic global service-led economy (Dietrich and Harrison 2006, Spohrer *et al* 2007) . To address the needs, Figure 1 proposes perspectives of uncharted service science by illustrating that: (a) the development of service-oriented science and engineering is the key to the success of the conduct of competitive service practices (i.e., production/consumption), and (b) service systems must be people-centric, IT-powered, and market-driven, consisting of people, technology, infrastructures, and processes of service management and engineering (Lovelock and Wirtz 2006, Spohrer *et al* 2007).

Figure 1 Service Science: Service and Service Systems



(a) Service Production and Consumption: Science, Engineering, and Practice

(b) Service Systems: From Need to Delivery

It is well recognized that automation, outsourcing, customization, offshore sourcing, business process transformation, e-business, and self services became another business wave in today's evolving global service-led economy. Although this new wave seems to be repeating the trends afflicting US manufacturing in the 1970's, it gets more complicated while demanding higher efficiency and better cost-effectiveness across the service-value networks. Moreover, compared to industry's knowledge of mature manufacturing business practices, service science, management, and engineering is still substantially uncharted territory (IBM 2004, Spohrer *et al* 2007). Little is really known about how service science, management, and engineering can be systematically applied for

the efficient and cost-effectively delivery of an adaptable and sustainable service-oriented value chain from end to end.

"The opportunity to innovate in services, to realize business and societal value from knowledge about service, to research, develop, and deliver new information services and business services, has never been greater. The challenges are both the multidisciplinary nature of service innovation, which combines business, technology, social-organizational, and demand innovation as well as the lack of formal representations of service systems." (Spohrer and Riechen 2006) Furthermore, Jim Spohrer (2006) articulates many reasons contributing to the slow progress of service research. Two main reasons are (1) diversity of service industries and service activities and (2) the interdisciplinary nature. Apparently, the economy focus shift has created a research and education gap due to the complexity of inter-disciplinary issues across services business strategy and modeling, operations research, information technology, industrial engineering, management science, sociological and cognitive science, workforce management, and legal science, etc.

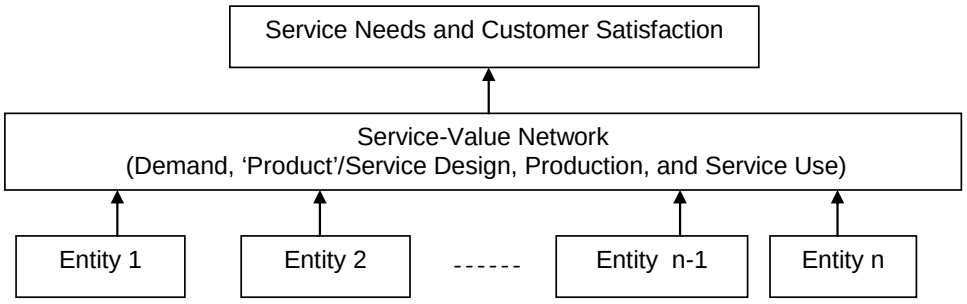
By reviewing certain state-of-the-art research in service, this paper presents one point of view towards the science of service and service systems. Hopefully, the articulated concerns in this paper would help draw much more attention from scholars, managers, engineers, practitioners, and policy makers around the world. Ultimately the theory and principles towards engineering, operating, managing, and evolving service systems would then be comprehensively explored and developed, resulting in the fast fulfillment of the education and research gap in service identified by NAE (2003) to meet the challenges in the service-led economy.

2. Towards Service Science, Engineering, and Practice

By end of the day, the value of delivered individual or business services lies in its ability to satisfy an end user's need, which is not simply and strictly seen in the technical characteristics of the services and the physical attributes of the associated products in the services. It is not a secret; that the quality services essentially lead to high customer satisfaction. Satisfaction characterized as a superior outcome then further drives customer decisions. It well concurs with Prof. Roland Rust's remark, "[today's] business reality is that goods are commodities; the service sells the product." Apparently, the service-oriented total solutions measured by performances for the customer's final benefit rather than the functionality of physical goods become the prime competition in the global service-led marketplaces (Rust 2004).

The competency of service providers to deliver superior outcome to the end user inevitably relies on the capability of engineering, performing, and managing quality of services throughout the entire service-value network. As seen in Figure 2, no matter what service is provided for whom, an entity of individuals or businesses, whether the need is fully met and the customer completely satisfied relies on the efficient and effective operations of the service-value network, i.e. an integrated heterogeneous service system. Entities in the service-value network are service providers and clients; they could be individuals or businesses (e.g., companies, institutions, governmental agencies). It is widely recognized that competitive service systems are value co-production configurations of people, technology, internal and external service systems connected by value propositions, shared interest and information (languages, customs, regulations, and metrics) (Dietrich and Harrison 2006, IBM 2006, Spohrer *et al* 2007).

Figure 2 Schematic View of a Service-Value Network (Qiu 2006)

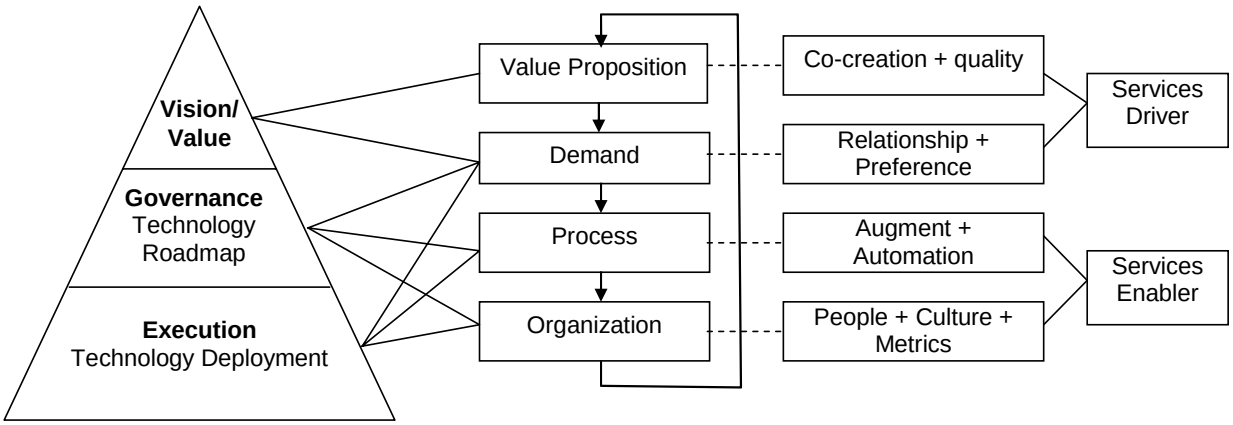


With the help of on-going "industrialization" of the information technologies, enterprises must aggregate products and services into total solutions by implementing integrated and complete value chains, which optimally deliver their services through the exchange of intangible resources, the co-creation of value, and relationships. The essential goal of applying total solutions to service-value networks is to enable the discovery, design, deployment, execution, operation, monitoring, optimization, analysis, transformation and creation of coordinated business

processes across the whole value network. Ultimately, the profit across the whole service-value network can be maximized as it becomes the top business objective in today's global business environment (Karmarkar 2004).

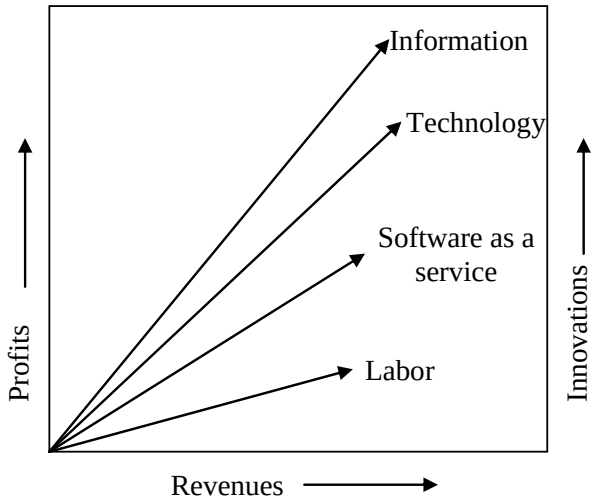
Innovations are the key to stay a step or two ahead of competitors. New service delivery models are essentially derived by working closely with customers to co-create innovative and unique solutions best meeting customer inevitably changing needs. According to Rangaswamy and Pal, a service innovation framework (IBM 2004) is critical for service business operations and management to stay 'outperform' (Figure 3). "The framework can guide the creation of customer value and demand, and the processes and organizations that deliver services successfully - all of it catalyzed by emerging technologies." (Rangaswamy and Pal 2005)

Figure 3 Service Innovations Framework (Rangaswamy and Pal 2005, Qiu 2006)



Consequently, enterprises nowadays have to rethink their operational and organizational structures by overcoming a variety of social and cultural barriers, so as to ensure the prompt and cost-effective delivery of innovative and satisfactory service for customers throughout the geographically dispersed value network. Challenges appear in many aspects from business strategy, marketing, modeling, innovations, design, engineering, to operations and management. When a service system integrates different types of resources, it generates different scales of revenues and profits, most importantly different competitiveness staying in the marketplace (Figure 4). It is essential to develop the science capable of helping enterprises invest effectively to realize a competitive configuration of service systems under circumstance and realize more predicable outcomes.

Figures 4 Outcomes Scale of Service Systems with Different Configurations (Spohrer *et al* 2007)



In summary, to help service providers maximize the profit across the whole service-value network (Figure 2) with a competent while competitive configuration (Figure 4) by employing materialized and concrete service

innovation framework (Figure 3), Services Science (Figure 1) should be comprehensively studied and developed. Surely a well defined and developed Service Science will scientifically facilitate crafting and measuring service productivity, quality, compliance, operations, and innovations throughout the lifecycle of services across the service-value networks.

3. THE HOT-SPOTS IN SERVICE RESEARCH

As stated earlier, in spite of the dominative role of services in today's economic activities, research on understanding how enterprises could invest effectively to create service innovations and realize more predicable outcomes has made a little and slow progress, which could be a big obstacle for the developed countries to develop and sustain their future service-led economic growth (Dietrich and Harrison 2006, Hidaka 2006, Lovelock and Wirtz 2006, NAE 2003, Spohrer 2006, Spohrer *et al* 2007). Ironically, there is even a lack of a widely accepted definition of service, not to mention the unified theory and principles towards engineering, operating, and managing service systems.

Note that today's service concept evolves beyond the traditional non-agricultural and/or non-manufacturing performance for the consumer's benefits. For example, many new emerging high value areas, such as IT outsourcing to post-sales training, on demand innovations consulting (including knowledge services helping customers improve their products, business processes, goods and delivery, and IT systems), are well recognized as a service (Fitzgerald 2005, Rosmarin 2006). Although little progress has been made yet in service and service systems as a whole, research work in pieces has been separately done in many disciplines for years.

By exploring the marketing shift from the exchange of tangible resources, embedded value, and transactions based "goods" to the exchange of intangible resources, the cocreation of value, and relationships based "service", Vargo and Lusch (2004) argue for the necessity of evolving a service-dominant logic in marketing to replace the goods-dominant logic. They emphasize that general concepts, worldview, and small set of fundamental propositions, along with their empirical support, about the service should be established. They have comprehensively reviewed literature in the relevant areas and present the foundational premises of the emerging service paradigm: "(1) skills and knowledge are the fundamental unit of exchange, (2) indirect exchange masks the fundamental unit of exchange, (3) goods are distribution mechanisms for service provision, (4) knowledge is the fundamental source of competitive advantage, (5) all economies are services economies, (6) the customer is always a coproducer, (7) the enterprise can only make value propositions, and (8) a service-centered view is inherently customer oriented and relational."

Vargo and Lusch articulate that the essential concept of "service" should be defined as the application of competences for the benefit of another entity and the term "service" focusing on a process rather than "services" implying "intangible goods" should be used given that the service value is always co-created during its production. Through further identifying intangibility, heterogeneity, simultaneity, perishability, customer participation, and co-production as key commonalities across disparate services businesses, Sampson and Froehle (2006) present the need for a Unifying Services Theory (UST). They particularly argue that the presence of customer dynamic inputs is necessary and sufficient to define a service engineering process, which is why service processes are typically harder to manage than goods production processes. Their investigation focus on revealing some principles common to a wide range of services and providing a common ground for further theoretical exploration of capacity and demand management, service quality, service strategy, and so forth.

As stated earlier, service systems produce and consume services. As competitive service systems must be people-centric, IT-powered, and market-driven, consisting of people, technology, infrastructures, and processes of service management and engineering, Jim Spohrer proposes that a general theory of service should broadly consist of three bodies of knowledge (Spohrer 2006), including (1) the fundamental understanding of service systems and their services: the origins of new service systems and new services, interactions, the role of people, technology, shared information, as well as the role of customer inputs in production processes; (2) how to improve service systems: the ways a service system improves or evolves over time through further investments, including improving efficiency (improved plans, methods, and techniques), effectiveness (improved measures, goals, purpose, and key performance indicators), and sustainability (improved value proposition results, robustness and versatility); and (3) how to scale service system: the ways improvements (new competencies) in one service system can be spread (scale out and scale up) to other service systems to create a synergistic effect .

By comparing services to manufacturing and supply chain systems, Dietrich and Harrison (2006) state that in general it lacks sufficient modeling of services due to the fact that service research is confronting more challenging issues. Compared to physical goods in manufacturing and supply chain systems, resources, largely people, can not

be held and are more complex to model as people participating in service production and consumption have physiological and psychological issues, cognitive capability, and sociological constraints. They propose a variety of research issues to which operation researchers potentially can contribute.

In a broader view, service can not be in inventory, and are typically intangible, perishable, difficult to port, hard to measure, and co-production with customers. Thus, competent and competitive service systems should be highly adaptable and sustainable to the service environment (when, where and who to deliver and whom to be served, etc). Service systems then should be well defined and developed through well understanding of the following:

- Service demand/marketing: need, perception, value, and satisfaction spanning from varieties, market acceptance, penetration, and potentials, competitiveness and economic benefits, to beneficial opportunities in the long run.
- Service environmental settings
  - Service consumer's environmental setting: value proposition, customs, languages, cultures, and regional regulations, etc.
  - Service provider's environmental setting: workforce management, labor relationships, human behavior, skills/training, knowledge transfer, etc.
  - Human interfaces and interactions (psychological and physiological).
- Adaptable and sustainable service engineering process: resource alignment (e.g., workforce management), operations function and value, hybrid designed (artificially) and evolved (naturally) to meet the diverse needs of service environmental settings (co-production).
- Large–scale information infrastructure: a complex and integrated system that can evolve over time to optimally support the defined service engineering processes, aimed at the delivery of needed data, information, and knowledge to the right user at the right time.
- Effective management and efficient organization: planning, design, execution, and reengineering of the defined complex and adaptable services systems.

Despite the recognition of the importance of service research, the shift to focus on disparate and global-scale services in the information era has created a research gap due to the overwhelming complexity of inter-disciplinary issues across service marketing, service-oriented business modeling, information technologies, and workforce management. Filling the gap is essential. "We can move the field forward not only by understanding and serving the customer but by designing efficient systems of service delivery; training and motivating service providers; using new service technologies; and understanding how service affects the marketplace, the economy, and government policy." (Rust 2004) Surely as stated earlier a better defined and more advanced Service Science would facilitate crafting and measuring service productivity, quality, compliance, operations, and innovations throughout the lifecycle of services across the service-value networks.

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