Service Science, Management, and Engineering (SSME) Research Workshop

1. Motivation

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 2005 was derived from the service sector. However, according to [1], "[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.

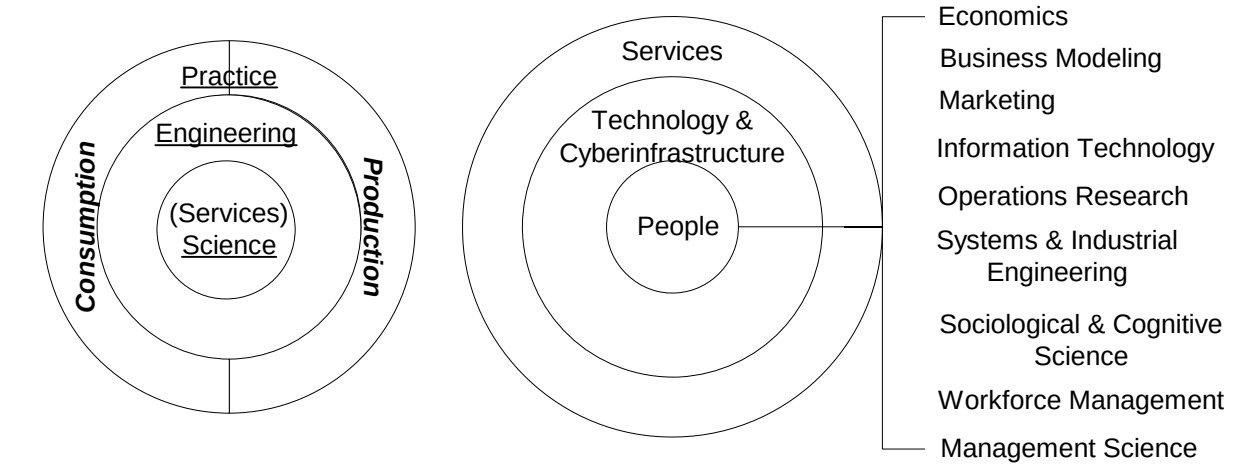
According to the NAE project report [2], the service industry employs a large and growing share of national workforce (about 80% in 2005), and is the primary users of information technology. Even in most manufacturing industries, the service functions (e.g., sales, logistics, distribution, and customer 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 services 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 by "(1) adapting and applying systems and industrial-engineering concepts, methodologies, and quality-control processes to service functions and businesses; (2) integrating technological research with research in social sciences, management, and public policy; and (3) educating and training engineering and science graduates to deal with management, policy, and social issues."

Service is typically considered as an application of specialized knowledge, skills, and experiences, performed for the benefit of another [1, 3]. Service is perishable, heterogeneous, and intangible, commonly provided for either individuals or businesses to create desirable value to satisfy their needs [4, 5]. Although a significant portion of the services provided by the services industry is consumed by individuals, such as medical, education, insurance, legal, financial, and retailing services, recently business services that serve different business units or organizations are growing quite rapidly [4]. For example, technical support, enterprise resource planning, call center operations, sales management, IT implementation, logistics, and business investment and transformation consulting are well recognized as a business service [6].

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** at a pace never before seen in history [7]. It is obviously a trend that leading and competitive services are all remarkably delineated with information-driven, customer-centric, e-oriented, and satisfaction-focused characteristics.

A variety of 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., UPS, Wal-Mart, etc.) are also transforming themselves into service-value networks. 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.

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 [1, 4]. To address the needs, Figure 1 proposes perspectives of uncharted services 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 performance [1, 8, 9].



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

(b) Service Systems: From Need to Delivery

Figure 1: Services Science: Service and Service Systems

It is well recognized that automation, outsourcing, customization, offshore sourcing, business process transformation, and self services became another business wave in today's evolving global services-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, services science and engineering is still substantially uncharted territory [1, 9, 10]. Little is really known about how services sciences, management, and engineering are systematically applied for the delivery of a services-led value chain from end to end (Figure 1).

"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." [7] 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.

The major goal of this funding is to create and support an effective venue for a group of leading scholars from academics and industries to study the gap from a research perspective, aimed at exchanging points of view from these pioneers so as to gain better insights of services science in general. By exploring the current US services industrial needs, research areas will be classified and corresponding priorities identified, which will be potentially used as a reference for NSF to create next research agenda in the Service Enterprise Engineering program.

2. Towards the Science of Service 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." [11]

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 [11].

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) [1, 4, 8].

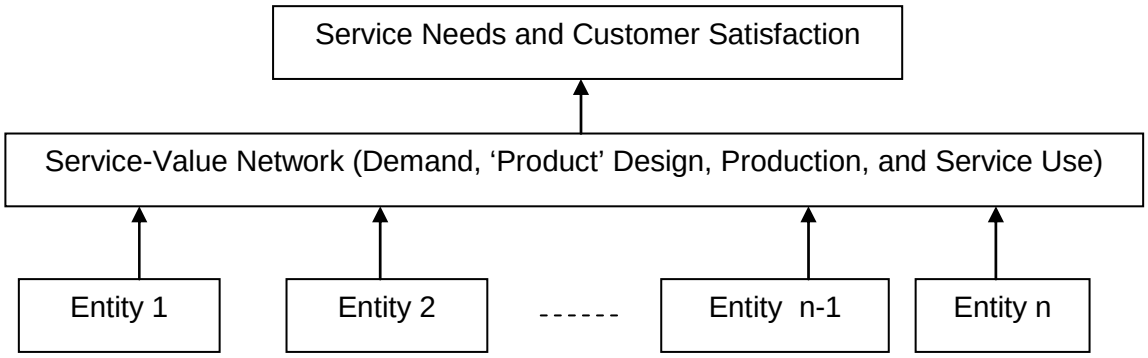


Figure 2: Schematic View of a Service-Value Network [6]

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 to deliver their ***service-oriented*** solutions. 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 [12].

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 is critical for service businesses 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.” [13]

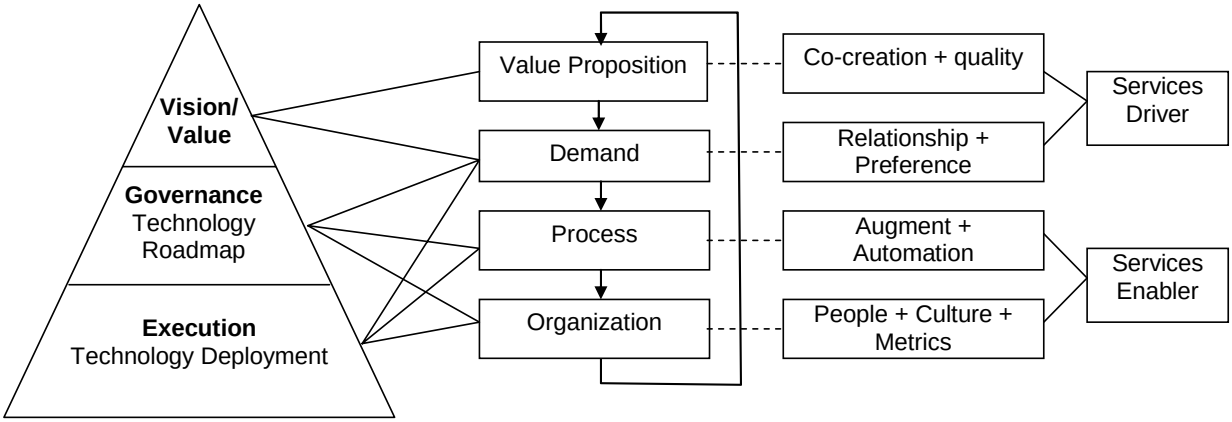
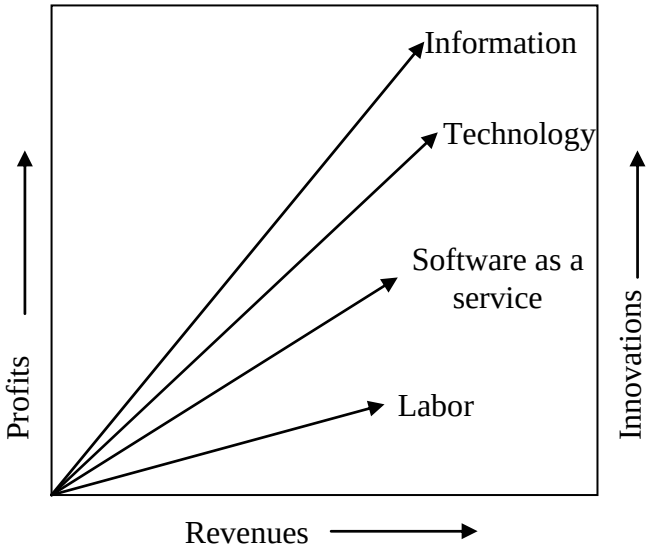


Figure 3: Service Innovations Framework [6, 10, 13]

When a service system integrates different types of resources, it generates different scales of revenues and profits (Figure 4). James Spohrer, Director of IBM Services Research, has his insightful view of the need for more exploratory research of service innovations and modeling, especially in the area transforming businesses for better competencies. He states, “Increasingly over the past ten years, the new frontier of service research and teaching has shifted more and more towards business-to-business process transformation models. Process reengineering, IT productivity paradox, and other case studies highlight the need to constantly redesign work to improve productivity through multiple types of innovation in demand, business value, process, and organization.”



Figures4: Outcomes Scale of Service Systems with Different Configurations [1]

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 their future ***service-led*** economic growth [1, 2, 4, 9, 14, 15]. There lacks a widely accepted definition of service and furthermore the theory and principles towards engineering, operating, and managing service systems. Jim Spohrer presents seven 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 [14].

Specifically, Dietrich and Harrison [4] compare services to manufacturing and supply chain systems. They articulate 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. In a broader view, services can not be in inventory, and are typically intangible, perishable, difficult to port, hard to measure, and co-production with customers. Thus, service systems innovating and enabling services should be highly adaptable and sustainable to the service environment (when, where and who to deliver and whom to be served, etc).

In summary, to help service providers maximize the profit across the whole **service-value network** (Figure 2) with a competent configuration (Figure 4) by employing materialized and concrete service innovation framework (Figure 3), **Services Science** (Figure 1) should be comprehensively studied, aimed at scientifically facilitating crafting and measuring service productivity, quality, compliance, operations, and innovations. Jim Spohrer proposes that a general theory of service should broadly consist of three bodies of knowledge [14]:

1. *Service Systems and Their Services: Understand the origins of new service systems and new services. Understand what is and is not a service system, and what services are produced and consumed by instances and classes of services systems, both externally and internally. The role of people, technology, shared information, as well as the role of customer input in production processes and the application of competences to benefit others must be defined as well.*
2. *Service System Improvements: Understand the ways a service system improves or can be improved over time through investments, including improving efficiency (improved plans, methods, and techniques for a service system), effectiveness (improved measures, goals, purpose, and key performance indicators for a service system), and sustainability (improved value proposition results, robustness and versatility with more old and new service systems).*

3. *Service System Scaling: Understand the ways improvements (new competencies) in one service system can be spread (scale out and scale up) to other service systems, both within and between types of service systems (family, firm, city, nation, etc). This leads to the coevolution of intra-entity services and extra-entity services, as service systems obtain greater competencies for the production and consumption of more sophisticated services. Because of the nature of customer input (and often customer transformation) in the production process, scaling the distribution of competences is a challenge in service systems. Unless the new competence can be reduced to a simple list of instructions that the receiving service system can implement through self-service, a more complex transformation service is required to spread the competence.*

3. This NSF SSME Workshop and Expected Outcomes

3.1. SSME Workshop

As discussed earlier, **Services Science** is the key to creating optimal **service-value networks** and measuring service productivity, quality, compliance, operations, and innovations to gain competitive advantages. In [9], Qiu *et al.* summarize that the success of establishing service systems capable of delivering competitive and satisfactory services substantially relies on thorough consideration of the following factors:

1. Service demand/marketing: varieties, market acceptance, penetration, and potentials, competitiveness and economic benefits -- not just revenue (cost, price, inventory, etc.), but also beneficial opportunities in the long run.
2. Service environmental settings
    a. Service consumer's environmental setting: value proposition, customs, languages, cultures, and regional regulations, etc.
    b. Service provider's environmental setting: workforce management, labor relationships, human behavior, skills/training, knowledge transfer, etc.
    c. Human interfaces and interactions (psychological and physiological).
3. Adaptable and sustainable service engineering process: operations function and value, hybrid designed (artificially) and evolved (naturally) to meet the diverse needs of service environmental settings.
4. 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 and information to the right user at the right time.
5. Effective management and efficient organization: planning, design, execution, and reengineering of the defined complex and adaptable services systems.

Given that this emerging inter-disciplinary area is too complicated and generally uncharted, this workshop essentially aims at creating and supporting an effective venue for a group of leading scholars from academics and industries to exchange points of view of **Services Science** so as to gain better insights of services science, management, and engineering in general. By exploring the current US services

industrial needs, research areas will be classified and corresponding priorities identified, which could be potentially used as a reference for NSF Service Enterprise Engineering and service enterprises to create their next research agenda. In addition, we will communicate with other worldwide leading scholars by delivering keynotes, participating in panel sessions, and presenting our research work at SOLI'2007.

3.2. Expected Outcomes

This workshop will solicit presentations from professors and professionals in exchanging different research perspectives of focused area. ***With the good understanding of that services can not be in inventory, and are typically intangible, perishable, difficult to port, hard to measure, and co-production with customers***, tentatively, research perspectives in the following service research areas will be solicited:

- Service Dynamics and Strategy
- Complex Adaptive Service Systems
- Service Marketing
- Capacity and Demand Management
- Quality, Risk, and Management
- Service Engineering
- Service Operations and Productivity
- Service Innovations
- Customization vs. Standardization
- Workforce Management
- Service Pricing
- Business Transformation
- Information and Knowledge Systems
- Focused Service Sectors (e.g., healthcare, technical consulting, personal training)

Accordingly, three sessions (Industry Perspective, Academia Perspective, and Roundtable Discussion) will be organized at the workshop.

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