Service Systems Engineering

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Lead Authors: *Ricardo Pineda, Bud Lawson, Richard Turner*

The growth of services in the ever-evolving global economy has brought much needed attention to service science and service systems engineering (SSE). Research focuses on developing formal methodologies to understand enterprise-end-user (customer) interactions from both socio-economic and technological perspectives, and to enable value co-creation and productivity improvements. Service systems require trans-disciplinary collaborations between society, science, enterprises, and engineering. Service transactions are customized and personalized to meet a particular customer need. This requires a disciplined and systemic approach among stakeholders and resources to emphasize end-user satisfaction in the design and delivery of the service (Hipel et al. 2007; Tien and Berg 2003; Vargo and Akaka 2009; Maglio and Spohrer 2008; Maglio et al. 2010).

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Topics

Each part of the SEBoK is divided into knowledge areas (KAs), which are groupings of information with a related theme. The KAs in turn are divided into topics. This KA contains the following topics:

- Service Systems Background
- Fundamentals of Services
- Properties of Services
- Scope of Service Systems Engineering
- Value of Service Systems Engineering
- Service Systems Engineering Stages

Introduction

New Service Development (NSD) has usually been a proprietary process closely guarded by product businesses and service businesses for their competitive advantage. Traditional systems engineering practices have been primarily applied in aerospace and defense sectors while SSE practices have been applied by information and communications technologies (ICT) service providers (Booz, Allen, and Hamilton 1982; Johnson et al. 2000; Eppinger 2001; Freeman 2004; Whitten and Bentley 2007; AT&T SRP 2008; Lin and Hsieh 2011).

These early efforts were, and in some instances remain, very important for product and service businesses. However, the growth and ubiquity of the World Wide Web, advances in computer science and ICT, and business process management through "social networking," support the realization of closely interrelated service systems. Product business (manufacturing, agriculture, etc.) and service business distinctions are going away (Spohrer 2011).

These services, or service innovations, must take into account social aspects, governance processes, business processes, operational processes, as well as design and development processes. The customer, service provider, product provider, and intermediaries need to collaborate toward the optimization of customer experiences and customer provided value (through co-creation). The

interrelations among different stakeholders and resources require that methodologies, processes, and tools be dynamically tailored and delivered for either foreseen or newly discovered services to rapidly adapt to changing enterprise and end-user environments.

Even in the case of static, predetermined, interaction rules, the major problems faced in the definition, design, and implementation of services have been in understanding the integration needs among different systems, system entities, stakeholders, and in defining the information flows required for the governance, operations, administration, management and provisioning (OAM&P) of the service. (Maier 1998; Jamshidi 2008; Pineda 2010; Luzeaux and Ruault 2013). Thus, the 21st century technology-intensive services are “information-driven, customer centric, e-oriented, and productivity-focused" as discussed by Chesbrough (2011), Chang (2010), Tien and Berg (2003), and Hipel et al. (2007). A detailed discussion of these characteristics is given in the Value of Service Systems Engineering article within this KA.

Service Systems Engineering Knowledge Area Topics

This knowledge area (KA) describes best practices in SSE during the service design process and outlines current research on methods, processes, and tools. It does not attempt to describe the initial efforts and research in service science that were proposed and introduced by International Business Machines (IBM) (Maglio and Spohrer 2008), but it does recognize their leadership in championing these concepts in undergraduate and graduate curricula.

The rest of the KA is organized in the following way:

The Service Systems Background article presents some background on the transition from a manufacturing economy toward the service economy brought by the World Wide Web through co-creation of end-user value. It describes how this transformation is impacting industries, such as healthcare, agriculture, manufacturing, transportation, supply chain, environmental, etc. The article also describes the scope of the SSE discipline's contributions to meeting the needs of the service sector companies in strategic differentiation and operational excellence (Chang 2010) by pointing out some differences between product-oriented systems engineering and SSE.

The Fundamentals of Services and Properties of Services articles take the reader through a general discussion of services and current attempts to classify different types of services, in particular, attention is paid to the properties of service systems for the service sector, such us transportation, environmental and energy services, consulting services, healthcare, etc.

The Scope of Service Systems Engineering and Value of Service Systems Engineering articles cover the value of SSE, defining (or using when available) service architecture frameworks, and the stages of the service development process from concept to life cycle management.

The Service Systems Engineering Stages article summarizes the major SSE process activities that need to be carried out during the service design process and the needed output (work products) in each of the service design process stages.

Service Innovation and Value-Co-creation

Service innovation has several dimensions. Service innovation can come about through the creation of a service concept which is sufficiently different that it is not merely an improved service, but in reality is a new service concept. To maintain the rigor and value of innovation, it is necessary to distinguish between an improved service, which may generate some additional value, and a truly new and innovative service concept, which may generate a great deal of value. Dr. Noriaki Kano, a renowned quality management guru, has suggested that every service concept has its inherent attributes and we should strive to continuously improve upon these; but this is not innovation (Kano 1996).

To be innovative, the change in a value proposition cannot be incremental, but it must be enough to significantly impact customer and competitor behavior (e.g., new market creation). Value innovation involves a shift in perspective of customer needs that requires a rethinking of what service value proposition is delivered (Kano 1996).

Innovation can also come through a significant change in the way or the reason the customer is engaged or connected. In a service value chain the customer may well change from being just a receiver of service value to becoming a co-creator, or an active participant in the

design and delivery, i.e., service transaction of service value. At the retail level, when a customer designs the time, route, and price selection for a plane ticket purchased online, he is co-creating the service. Value innovation involves a shift in perspective of customer needs that requires a rethinking of how a service value proposition is delivered (Bettencourt 2010).

Finally, service innovation can come through significant changes in the way the enterprise is organized to create a service value proposition from concept through delivery. A considerable improvement in the enterprise structure and/or governance can be seen as innovation. Value innovation involves a shift in perspective of customer needs that requires a rethinking of how an enterprise organizes to support a service value proposition.

Continuous improvement can be reasonably planned and predicted while innovation and breakthroughs cannot. The most effective way to obtain innovation and breakthroughs is to encourage the culture, environment, and atmosphere that are conducive to innovation and breakthroughs. Innovative co-creation requires the integration of people, ideas, and technology for the purpose of creating value for themselves, their customers, companies, and society.

The lone inventor sees a problem and must work to create the solutions to all dimensions of the problem. Co-creators see the problem and realize that there may already be several creators, each already having a piece of the solution. Co-creation embraces the value of things "not invented here" because of the velocity they can bring to ideation and time to market. This service innovation process is facilitated by modern mass (and at the same time, personal) communication technology evident in social networking platforms.

Towards a Discipline of Service Systems Engineering

Mindful of the evolution taking place in the global economy and the world markets, it would be futile to attempt covering all the major advances and the boundless possibilities in the services sector for the rest of the century. The services sector covers wide areas of application studied in many different fields (e.g., business science, social science, cognitive science, political science, etc.). The field of service systems, a trans-disciplinary analysis and study of services, was

only introduced 10 to 15 years ago. As a consequence, much of the existing literature on services and service-innovation is scattered. The main objective of this KA is to document the systems engineering processes, methodologies, and existing tools as applied to the service design process, and to introduce critical SSE challenges and research areas.

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