A Framework that Situates Technology Research within the Field of Service Science

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Abstract Service science strives to bring together many disciplines (including computer science, cognitive science, economics, organizational behavior, human resources management, marketing, operations research, and others) in an attempt to study service systems in the following ways: understanding what service systems are and how they evolve; studying how to invest in order to improve management practices in service systems; determining how to create new technologies that increase the scaling of service systems; and, establishing a basis for assessing and relating relevant interdisciplinary knowledge within this emerging field. Academic and industry researchers from separate and currently mostly isolated disciplines are each approaching the field of service science from their own perspectives. This chapter presents a framework that technology researchers can use to understand and articulate how their research relates to the field of service science. The result will better enable technology researchers to relate to and engage with other researchers in the interdisciplinary field of service science.

Keywords: framework, service science, service systems, research

1. Introduction and Motivation

Service is defined as the application of competence and knowledge to create value. Value is realized through interactions and co-creation among *service systems*. Service systems vary in scope (from individuals to businesses, organizations, governments, and nations) and involve people, information, organizations, and technology adapting dynamically and connecting internally and externally to other service systems through value propositions. *Service science* strives to bring together many disciplines (computer science, information systems and technology, cognitive science, economics, organizational behavior, human resources management, marketing, operations research, and others) in an attempt to study and understand service systems (Maglio and Spohrer 2008).

Researchers in a variety of fields of study, eager to contribute to the emerging field of service science, are striving to determine how their research fits within this developing space. In this chapter, we present a framework to help researchers in computing and technology fields relate their research to service science. The motivation behind this framework originally came from a workshop on service science, management, and engineering (SSME) where individuals from diverse backgrounds (computer science, marketing, social science, psychology, and cognitive science) tried to discuss their research in the context of service science. They struggled to find

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a common definition of *service* and had difficulty clearly articulating how their work relates to the emerging field of service science (SSME Workshop 2008). The work being presented and discussed at the workshop was clearly important with the potential to contribute significantly to the service science field and there was much discussion about how each of the different research activities presented might do so. The need for mechanisms to reconcile terminology and relate concepts became quite evident during the discussion.

While it is important to create these kinds of mechanisms for each of the fields of study related to service science, in this chapter, we focus on the general technology area including information systems (IS), information technology (IT), and computer science (CS). A recent article on service-oriented technology and management poses several questions that indicate a desire to better integrate and relate work going on in service-oriented computing and service-oriented architectures to service science (Demirkan et. al. 2008). Several open problems are given including understanding the relationship between the business view of service and the corresponding technology elements (Demirkan et. al. 2008). There is clearly a need and desire to understand how technology research fields relate to and can contribute to service science research.

One way to help satisfy this need is to introduce mechanisms and frameworks that enable researchers to situate their own work within this emerging field. In this chapter, we present a framework that provides a practical method for positioning past and future IS, IT, and CS research within the service science research domain. The main goal of the framework is to enable researchers in these fields to understand how their research relates to and can contribute to the field of service science. The ability to relate research to service science in this way will enable better collaboration and interdisciplinary activities in service science involving IS, IT, and CS researchers.

Section 2 presents related work on frameworks and research landscapes. In Section 3, we present our framework by describing the service science concepts used to define it. In Section 4, we demonstrate the effectiveness of the framework by using it to situate current information systems research activities relative to the field of service science. In Section 5, we conclude with suggestions for future research and further developments of our framework.

2. Related Work

The approach of using frameworks, models, and landscapes to bring understanding to and engagement in research activities has been used in other areas (Grover and Davenport 2001; Brooke 2002; Roth and Menor 2003; Sanders 2006; Kontogiannis et. al. 2007). In most cases, the goals are to look back at the evolution and growth of a particular research area and identify future topics of research. In (Sanders 2006), a landscape for talking about and reflecting on the state of research in the area of *design* is presented in response to the recognition that design research was going through a great transformation. The stated goal of the landscape was to provide a view of the existing design research space in order to support conversation and to provoke future thinking and action (Sanders 2006). In (Kontogiannis et. al. 2007), a research landscape for service-oriented systems is proposed. They put forward a

classification of research issues pertaining to the business, engineering, and operational aspects of service-oriented systems in order to better channel research efforts and enable building on the research of each other. A key reason noted for the proposed classification and landscape is a recent growth spurt in research in service-oriented systems which has resulted in substantial research and significant progress albeit with efforts emerging in several directions and with little coordination.

We are witnessing similar issues in the field of service science with many research efforts in diverse areas progressing along their own paths with little to minimal coordination or formal link to service science research. As the field of service science matures, we see transformations taking place that increasingly require common frameworks on which to base discussions and collaborations.

In (Alter 2009) a service science domain framework is presented that attempts to reconcile many concepts from service science. The complex framework consists of four concentric layers (action, architectural, economic exchange, and industry and society) and is oriented around two axes which create four quadrants within the inner two layers of the framework. Its goals include locating topics from different disciplines relative to the framework, showing synergies between quadrants and links within layers of the framework and locating specific topics in the framework such as service-dominant logic (Vargo and Lusch 2004) and various aspects of software-as-a-service (Dubey and Wagner 2007).

The framework we present in this chapter is simpler and more clearly defined and based on service science concepts. It is proposed specifically to enable researchers in IS, IT, and CS research areas to relate their research to service science, and is straightforward to use for that purpose as demonstrated in Section 4.

3. A Framework for Relating Technology Research to Service Science

In this section, we describe the framework based on underlying research and concepts in service science. The methodology we used to define this framework is somewhat unique and it, itself, exemplifies service exchange and interactions among people. A review of service science foundational papers was conducted which resulted in an original version of the framework. This original version was validated and evolved through a series of presentations and interactions. It was first presented, discussed and critiqued at a software engineering research workshop (Lyons 2008a) and an information systems special interest group meeting on service (Lyons 2008c). These discussions brought feedback on the framework from computer scientists, business school academics, researchers in information schools, and people in the IT industry. Further interaction and discussion brought feedback through the use of social computing media (Lyons 2008b) and on-line communities, in face-to-face discussions, and through evaluations and critiques of the framework in a graduate-level introductory service science course (Lyons 2009). The resulting framework which incorporates this feedback from interdisciplinary researchers and practitioners is presented next along with an examination of how foundational service science papers inform its definition.

Recall that the main goal of the framework is to enable researchers from IS, IT, and CS disciplines to situate their research relative to service science foundations. In this section, we show how the framework is defined based on these foundations. According to Maglio and Spohrer (2008):

> Service science combines organization and human understanding with business and technological understanding to categorize and explain the many types of service systems that exist as well as how service systems interact and evolve to cocreate value.

From this fundamental definition, we consider two key aspects of service science: the combination of knowledge from a number of different areas; and, the use of that knowledge to study service systems and the ways in which they interact and evolve to create value. Relating any field of research to service science then requires relating the research to the different knowledge areas and relating the research to service systems and how they interact and evolve to create value.

Therefore, our framework consists of two dimensions: the vertical dimension identifies the knowledge areas or kinds of understanding (business, human/organizational/work practice, technological) used in the research being positioned on the framework; and, the horizontal dimension indicates how the service systems being studied evolve and interact. Figure 1 shows the dimensions of our framework.

We now present a review of some foundational papers in service science and show how the concepts within them support this choice of axes for the framework. We begin with the vertical axis that identifies knowledge and understandings used to study service systems. The University of Cambridge report (IfM and IBM 2008) defines service innovation as a combination of the following: technology innovation; business model innovation; social-organisational innovation; and, demand innovation. Business model innovation and demand innovation can be combined under a broader category of business innovation. These three types of innovation map to the three kinds of understanding on the vertical axis of our framework: technology innovation relates to technological understanding; social-organizational innovation relates to organzational and work practices understanding; and, business model innovation and demand innovation relate to business understanding.

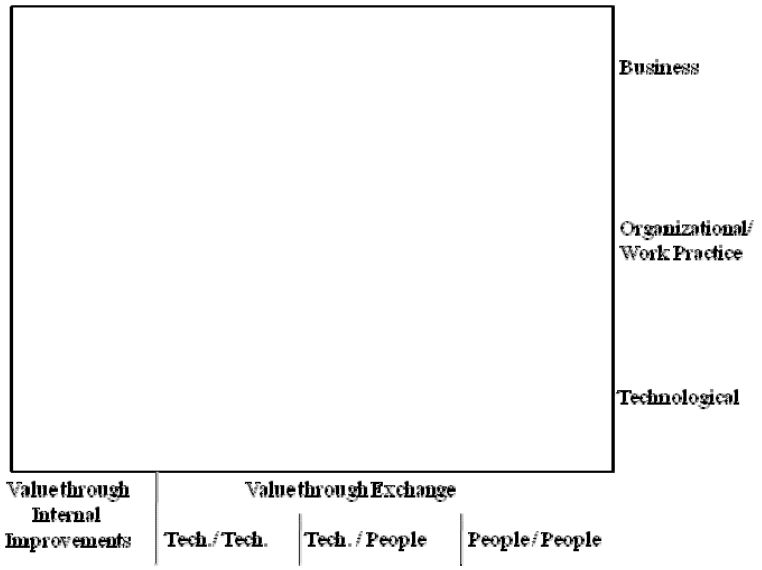

Fig. 1. The Framework: The vertical axis identifies kinds of understandings used and the horizontal axis identifies how the service systems being studied evolve or interact

de Jong and Vermeulen (2003) identify the following dimensions of service innovation: innovation in the service concept; innovation in the customer interface; innovation in the delivery system; and, innovation in technological options. Innovation in the service concept relates to business understanding in our framework. Innovation in the customer interface is covered by the horizontal dimension of our framework which is described later in this section. Innovation in the delivery system refers to internal work practices and organizational arrangements that are managed in order for service workers to do their work (de Jong & Vermeulen 2003). This innovation concept relates to organizational and work practices understanding in our framework. Service innovation in technological options relates directly to technological understanding in our framework.

Demirkan and Goul (2006) describe a service-oriented enterprise as having several layers: low-level technology and infrastructure layers; the business processes and workflows layer; and, the business strategy layer. These layers map to the technological, organizational / work practice, and business understandings in our framework, respectively.

Spohrer and Maglio (2008) plot topics from academic courses and programs over the last 100 years along three axes (technology, human or social-organizational, and business), arguing that progress towards a greater balance among these three areas is in reaction to the shift to a service economy. These three axes map to the three understandings in our framework. Table 1 summarizes the foundational papers and corresponding concepts as they relate to the three areas on the vertical axis of our framework.

Table 1. Foundational concepts as they relate to the vertical axis of our framework

Foundational Paper and Corresponding Concept	Types of Understanding Used to Study Service Systems: The Vertical Axis		
	Technological	Organizational and Work Practices	Business
Maglio & Spohrer 2008	Technological understanding	Organization and human understanding	Business understanding
IfM & IBM 2008	Technology innovation	Social-organizational innovation	Business model innovation and demand innovation
de Jong & Vermeulen 2003	Innovation in technological options	Innovation in the delivery system	Innovation in the service concept
Demirkan & Goul 2008	IT infrastructure and architecture	Business processes and workflows	Business strategy
Spohrer & Maglio 2008	Technology axis	Human or social-organizational axis	Business axis

For the horizontal dimension of our framework, we refer back to the definition of service science provided in (Maglio and Spohrer 2008) which states that service science combines various kinds of knowledge to understand service systems and how they interact and evolve. The horizontal axis of our framework identifies how the research being situated addresses the study of service systems by differentiating between research into internal improvements in service systems and research into different kinds of service system interactions.

An important way in which service systems evolve is through internal improvements. In addition to research that addresses improvements in service system interactions, we also consider research that studies back stage improvements (Teboul 2006). Research that studies service system evolution through internal improvements (back stage) in service systems is located on the far left side of our framework.

We now consider how to define the rest of the horizontal axis such that it deals with service system interactions. Value creation takes place through exchange among interacting service systems (Spohrer et. al. 2008). In other terminology, value is being co-produced by two or more actors for and with each other and also with other actors (Ramírez 1999). In their revised foundational premises for service-dominant logic, Vargo and Lusch (2008) refer to value creation through resource integration and suggest that individuals and organizations are resource integrators. In all cases, service system interaction involves at least two actors or resource-integrators, one applying competence and another integrating the applied competences with other resources to determine benefit (Spohrer et. al. 2008).

The resources identified in (Maglio and Spohrer 2008; Spohrer et. al. 2008) are people, technology, information, and organizations. If we consider that organizations contain people and technology and information is shared through people and technology, we can focus on exchange and resource integration between the people and technology resources in service systems.

In order for value to be realized and competences to be applied, two of these resources must exchange something through an interaction. The exchange can take

place between two technology resources using automated processes or web services. The exchange can occur when a human resource interacts with or exchanges information through technology, such as in an online banking service. Finally, the exchange can take place through people-to-people interactions such as that which takes place in a hotel service.

An important contribution of our framework is the way in which it reconciles the use of the term *service* in technology literature with service science terminology. In (Glushko 2008) a call is made to unify or define boundaries between these two notions of service, stating that an inability to do so will stand in the way of progress toward a service science. In our framework, we consider that service systems interact through resources which can be technological or human. Therefore, in the context of our framework, research on web services (Alonso et. al. 2004) and some aspects of service-oriented computing (Demirkan et. al. 2008) address technology-to-technology interactions in service systems.

We now present a review of some foundational service science papers and show how the concepts presented in each support the choice of the horizontal axis for our framework. Wemmerlöv (1989) defines three basic types of contacts necessary for exchange between a service system and a customer in a proposed taxonomy for service processes: (1) direct customer contact in which the customer is physically present during the service process; (2) indirect customer contact in which the contact is mediated in some way by a human or another media form; and, (3) no contact in which the service process does not interact with the customer as in the purchasing activities in a restaurant kitchen, for example. The direct customer contact category (1) is further subdivided into: (1.1) that with no service worker interactions; and (1.2) that with service worker interactions. The subcategory (1.2) maps to the people-to-people interactions specified in our framework and both subcategory (1.1) and category (2) map to our framework's people-to-technology interactions. Examples of interactions of type (1.2) provided in (Wemmerlöv 1989) are giving a lecture or serving food in a restaurant (people-to-people interactions). Examples of people-to-technology interactions of type (1.1) and (2) provided in (Wemmerlöv 1989) include ordering groceries on-line and withdrawing cash from an automatic bank teller.

We note that, in 1989, Wemmerlöv (1989) considered technology as a vehicle for identifying service processes that are rigid (involved with routine technology) and fluid (non-routine technology) and not as an interaction medium; therefore, the technology-to-technology component (necessary to characterize research in service system interactions today) is new in our framework. We also note that Wemmerlöv's category (3) (no customer contact) maps to service system internal improvements in our framework. Example service processes that exhibit no customer contact given in (Wemmerlöv 1989) are processing of information/images or check processing. Further examples of service research that maps to the internal improvements section of our framework include research in service operations as surveyed by Chase and Apte (2007).

Glushko and Tabas (2008) state that,

A key tenet in the service system perspective is that it emphasizes what is common to person-to-person services, self-service, and services where the provider and consumer are both automated processes rather than focusing on their differences.

The second dimension of the framework presented in this chapter is defined to ensure that this tenet is maintained by equally representing the different kinds of service interactions (person-to-person, person-to-technology – self-service, and technology-to-technology – service through two automated processes) in the framework. Table 2 summarizes the foundational papers and corresponding concepts as they relate to the horizontal axis of our framework.

Table 2. Foundational concepts as they relate to the horizontal axis of our framework

Foundational Paper and Corresponding Concept	Service System Evolution and Interaction: The Horizontal Axis			
	Internal Improvements	Technology-to-Technology	Technology-to-People	People-to-People
Wemmerlöv 1989	(3) No contact	-	(1.1) Direct customer contact with no service worker present (2) Indirect customer contact	(1.2) Direct customer contact with service worker present
Teboul 2006	Backstage	Backstage/ Frontstage	Frontstage	Frontstage
Glushko 2008	-	Service architecture	-	Person-to-person services
Glushko & Tabas 2008	Backstage	Provider and customer are both automated processes	Self-service	Person-to-person services
Chase & Apte 2007	Service operations research	-	-	-
de Jong & Vermeulen 2003	-	Innovation at the customer interface	Innovation at the customer interface	Innovation at the customer interface

4. Using the Framework to Relate IS Research to Service Science

There are several ways to demonstrate the effectiveness of our proposed framework. In this section, we consider its usefulness as a means for defining an information systems research program in service science. We do this by describing our own research program and some current research collaborations in terms of the framework. We situate our research primarily in the right side of the framework spanning the vertical axis; that is, in terms of service science, the goal of our research is to bring understanding and innovation in technology, work practices, and business in order to study service system interaction through the exchange or sharing of information and knowledge between people and between people and technology. In this

section, three research projects are described and situated within our framework. The positioning of the three research projects relative to service science is shown in the framework in Figure 2.

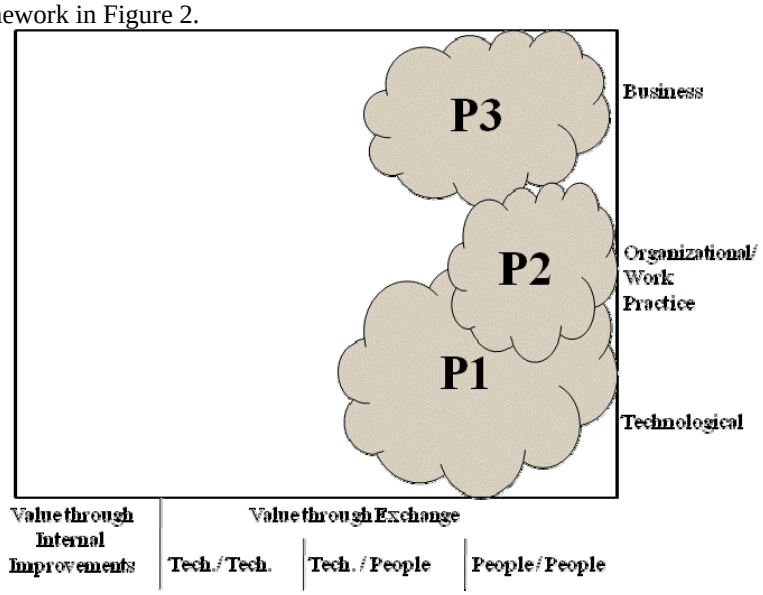

Fig. 2. Three information systems research projects relative to service science research

Project P1: The first project to be described fits in the bottom right corner of the framework. It is based on a method presented by Flor and Maglio (2004) for identifying which aspects of an *offline* service business (ie, one that does not use technology to mediate interactions with customers) to move *online* (Flor and Maglio 2004). Their method is based on the assumption that successful businesses have well-honed offline practices that can be translated to online practices. They use media-constellation diagrams to model activities in the service processes in terms of movement of information across media and apply their method in a hair salon business.

The goal of our project is to extend their method to identify opportunities to inject social computing practices in a service business. We have applied this enhanced modeling technique to a library service offering which provides access to selected tables of contents of periodicals and access to selected articles from the periodicals. We have studied the current offline processes in this offering through observation and interviews with stakeholders and have used our extension of the Flor and Maglio (2004) modeling technique to identify online social computing practices that will enable sharing of information (eg., tables of contents) to people through technology and sharing of information (eg., tags, tables of contents subscription information) among people (Lyons and Marks, 2009).

By situating Project P1 on the service science research framework, we can see how it relates to service science research: Project P1 brings understanding in work practices and technology to study how to incorporate technology into a service offering to facilitate both people-to-people and people-to-technology interactions.

Project P2: The second project fits in the middle (vertically) and right (horizontally) part of the framework. Its overall goal is to study the use of social computing tools in the enterprise. In this research, we used the network structure of an internal enterprise blog space (where nodes are bloggers and edges are comments made by one blogger on another bloggers' blog) to determine the number of bloggers, number of posts, number of comments, tags, geographic distribution of bloggers, and their position within the corporate hierarchy (Kolari et. al 2007).

We discovered a few interesting characteristics of the structure of this internal blog space: conversations are not limited to peers and employees; conversations span geographic boundaries (primarily among English speaking countries); blog comments are highly reciprocal (people comment on each others' blogs); in-degree approximates authority; and, out-degree approximates connectors. The results point to several interesting questions: can this information be used to identify experts; are blogs enabling a flatter organization; how does employee hierarchy relate to the implicit interconnections created through blogs; how can conversations across geographies be encouraged; and, how can these networks be used to enhance innovation or productivity?

In order to situate Project P2 on the service science research framework, we must think about the service system of an internal blog community and how value is created within it through interaction and resource integration. We define the service system as the organization itself and the blog space as a technological structure that facilitates value creation through people-to-people interaction. In this way, we view the employees as internal customers of the organization that delivers various employee service offerings. Note that some time ago, the notion of internal service marketing was put forward as a future topic of research in service marketing (Fisk et. al. 1993). Our research aims to understand how the blog space and structure of interactions enabled through it affect work and work practices within organizations (Kolari et. al. 2007); therefore, we place this work in the middle right part of the framework (see Figure 2). By situating Project P2 on the service science research framework, we are able to articulate how it relates to service science research and better understand the service system involved.

Project P3: Finally, we present research within our research program that fits in the top right corner of the framework. In this work, we study business models for web-based service offerings (such as software-as-a-service, social computing tools, and virtual worlds) (Lyons et. al. 2009). We looked at the kinds of new business models that are emerging and the impact they are having on the ways in which service offerings are paid for, delivered, and used. Specifically, we considered how the typical roles of provider / customer are changing in the context of emerging online service offerings and in light of a move from a goods-dominant to a service-dominant world (Vargo and Lusch 2004). In these emerging business models, additional third-party entities are key stakeholders and we see co-creation of value among many actors in the online service offerings. In this research, we analyzed three types of online offerings and their corresponding business models. We defined four classes of offering: (1) computational processing and database service offerings, provided as old-style utilities; (2) content providers from the old media (gathered by news teams and shared through newswires) and new media (gathered from the Inter-

net or created by online communities); (3) transactional service offerings for physical products and packaged software information, or media products; and (4) brokerage or affiliate models that help bring partners together to make their own transactions or barter. For each class of offering, we described how value is exchanged in a variety of specific instances. As the ability to design new web-based service offerings grows, we will continue to see a need for innovations in service business models such as those surveyed in this work.

By situating Project P3 on the service science research framework, we see how it relates to service science research: Project P3 describes innovations in service business models and shows how they are being used to create value through exchange among people and between people and technology. This research collaboration includes business school researchers, computer science and information school researchers and benefits from bringing together the complementary expertise in service marketing, information systems, and computer science.

In this section, we demonstrated how the proposed research framework for service science research can be used to help define an ongoing information systems research program in service science. We feel that having a framework within which to discuss the relationship of our research to the emerging field of service science is beneficial in two main ways: it enables us to better associate our different research activities to the field of service science; and, it is useful in helping define collaboration opportunities with complementary research programs and projects in service science.

5. Conclusions and Future Work

In this chapter, we proposed a research framework for relating IS, IT, and CS research relative to the field of service science. We discussed the methodology by which the framework was defined and demonstrated the effectiveness of the framework by using it to situate and relate information systems research projects within the field of service science. The implications of our study for researchers include having a common reference point for research discussions and collaborations. Specifically, our framework is a practical tool that helps researchers in IS, IT, and CS reconcile terminology and relate their work to service science research. Researchers can use the framework to define collaborative efforts that span the service science spectrum or focus on specific areas that are under studied. Implications for practitioners include being able to map investments relative to the breadth of service science research in order to identify areas of future focus.

Future work involves extending the framework, conducting further testing and evaluation of the framework, and reconciling it with other related frameworks such as that presented in (Alter 2009). The framework was originally conceived to help situate and relate research from a variety of disciplines to the field of service science but is currently focused on situating technology-related research within the field of service science. Future work will extend and adjust the framework to situate research from other relevant fields: cognitive science, economics, organizational behavior, human resources, marketing, operations research, and others.

There are many ways in which the framework can be further evaluated and tested including using it to situate a variety of IS, IT, and CS research projects, using it to define research collaborations, and determining ways to measure the effectiveness of the framework. Finally, there are many academic programs and courses being developed in service science and it would be useful to map the curricula in those programs within the framework to determine the usefulness of the framework in guiding the design of future such programs.

As the field of service science continues to grow and evolve, the framework should be evaluated and updated to ensure it develops to meet the needs of the service science research and academic communities.

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