Workshop to Develop a Research Agenda for Service Innovation

Overview: We propose a workshop to bring together thought leaders from a variety of areas to a two-day meeting in Washington DC to outline a specific agenda for scientific and engineering research in important service-related problems, particularly related to problems in service innovation. The workshop will aim to develop a research agenda for service innovation by (a) laying out the societal context for service research, (b) identifying technology needs for service innovation, and (c) developing basic science and engineering questions to be addressed.

The *California Center for Service Scienc*e at the University of California, led by Dr. Paul Maglio at UC Merced, will partner with Dr. Stephen Kwan of San José University and Dr. Jim Spohrer of IBM to co-organize the meeting. Participants will be drawn primarily from US academic institutions, companies, and government, with some attendees from international institutions. Participants will be selected to cover a broad range of topics, expertise, and experience across a variety of service areas, including information technology, marketing, operations, optimization, computer science, and social sciences. The workshop will be structured to facilitate conversation and interaction among participants. The first day will begin with a 90-minute session in which each participant will have exactly two minutes to present a single slide describing a fundamental research challenge in the broad area of service. This session will be followed by structured and facilitated conversations among participants aiming to form appropriate teams, leverage complementary skills and insights, develop substantive and lasting research relationships, and build effective cross-disciplinary research ideas. The second day will end with teams presenting their consolidated research agenda items for service innovation.

Intellectual Merit: Systematic search for service innovation requires new theories and new methods aimed at problems unique to complex service systems. Service science is an emerging discipline aimed squarely at these problems. It may involve methods and approaches from a range of existing disciplines, but often requires more than the application of individual methods from a single discipline. Effective understanding of and innovation in service systems often require combining multiple methods – to consider how interactions of people, technology, organizations, and information create value in various contexts and under various conditions – drawing from industrial engineering and operations research, social and behavioral sciences, information systems, and computer science and computational modeling, among others. Though marketing, operations, industrial engineering and operations research, and information systems have each contributed concepts and methods to the study of service systems, a theoretical foundation for service innovation is still lacking. Because service systems are sociotechnical systems with emergent properties that depend on interactions among multiple stakeholders and technologies, computational modeling is likely to be effective in understanding service systems.

Broader Impacts: Service problems have enormous practical importance because (a) more than 80% of jobs in the US are in the service sector; (b) complex service problems that involve coordinated action among people and technologies resist traditional types of optimization; and (c) private investment in service research is relatively low because of the low margins in non-technology-intensive service businesses, and the US lags behind countries such as Japan, China, Finland, and Germany, in public investment. It is time for the NSF and industry to focus attention on service problems and opportunities. This workshop aims to develop a credible service research agenda for NSF and industry partners. Anticipated outcomes of the proposed meeting also include new collaborations and increased capacity in the research community for advancing interdisciplinary studies of service. In addition, some focus on education in service from the STEM fields are expected to produce plans for cross-disciplinary, cross-institution programs.

Proposal: Workshop to Develop a Research Agenda for Service Innovation

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The rise of global service-based business models have transformed the way the world works, enabled by new information and communications technologies, specialization of businesses and professions, global regulations, and increased use of external services (Wirtz & Ehret, 2012). Service innovation is a key priority for nations, businesses, and citizens (Council on Competitiveness, 2005). Now, there is a new awareness of the need for an interdisciplinary science of service to help make innovation more systematic and more sustainable (Abe, 2005; Chesbrough & Spohrer, 2006; Ganz & Meiren, 2003; Horn, 2005; IBM Research, 2004; IfM and IBM, 2008; Maglio, Kieliszewski & Spohrer, 2010; Ostrom et al., 2010; Spohrer, Maglio, Bailey & Gruhl, 2007; US Congress, 2007; UK Royal Academy, 2009).

Over the last two hundred years, there has been a rise and fall in resources allocated to local production of goods, with more reliance on increasingly complex cognitive and social interactions (Bell, 1973; Clark, 1940/1957; Fuchs, 1968; Levitt, 1972; Pine & Gilmore, 1999), resulting in the rise of the so-called "service sector" of the economy (Fitzsimmons & Fitzsimmons, 2010). Though there is a rich and diverse set of disciplinary research on service, including economics, marketing, operations, industrial engineering, computer science, design, and more (see Chase & Apte, 2007; Fisk & Grove, 2010; Spohrer & Maglio, 2010; Spohrer & Kwan, 2009), there is also fragmentation and a lack of awareness among researchers and scientists in these disciplines (Rust, 2004; Roth & Menor, 2003; Spohrer & Maglio, 2010). *Service science* aims to draw the various disciplinary threads together into a single, coherent study of service phenomena (Glushko, 2008; Larson; 2008; Maglio, Srinivasan, Kreulen & Spohrer, 2006; Spohrer & Chesbrough, 2006; Spohrer, Maglio, Bailey & Gruhl, 2007;).

The traditional view holds that services constitute the third sector of the economy: service activities are those economic activities that are left over after agriculture and manufacturing (Fitzsimmons & Fitzsimmons, 2010). Over time, disciplines including economics, marketing, operations, management, engineering, and more have all focused some attention on service activities, primarily from the perspective of this traditional view (for historical perspectives, see Brown, Fisk & Bitner, 1994, Maglio & Spohrer, 2010, and Vargo & Lusch, 2004). Yet even given this broadly agreed upon view of service, different disciplines have not used the same basic definition of service. For instance, economics defines service as a distinct type of exchange (other than exchange of goods), a category for counting and analyzing jobs, businesses, and exports (e.g., Triplett & Bosworth, 2004). Traditionally, marketing defines service as a distinct type of exchange (Shostack, 1977), delivered by a distinct type of process (Bitner & Brown, 2006), and often characterized by customized human interactions or "moments of truth" with customers (Carlzon, 1987). In the field of operations, service is usually defined as a process that is dependent on customer inputs (Chase, 1981; Sampson & Froehle, 2006). The disciplines of engineering and operations research have defined service by the distinct type of modeling and optimization problems that result from customer variability (Dietrich & Harrison, 2006; Mandelbaum & Zeltyn, 2008; Riordin 1962). In computer science, service is defined by a particular kind of abstraction for network-accessible capabilities with unique discovery, composition, and modeling challenges (Sheth et. al, 2006; Zhang, 2007). There are many more disciplinary views of service (see also Spohrer & Maglio, 2010, and Spohrer & Kwan 2009).

Given the traditional view that service activities are separate and left over from agriculture and manufacturing, disciplines have multiplied characterizations and grown apart with unique perspectives on service (Spohrer & Maglio, 2010). Service science aims to bring these perspectives back together, and to do this, we must develop a unified definition. In our view, *capabilities, interaction*, *change*, and *value* are fundamental to service. At its most basic, service results in change in one entity brought about as a result of interaction with another entity (Hill, 1977). To be effective, this change must be preferable and leave the entities better off than they were before they interacted (Vargo, Maglio & Akaka, 2008). Entities interact because each may have specialized knowledge and capabilities (Bastiat, 1850/1979), and a group composed of specialized capabilities can achieve more than individuals with multiple capabilities (Ricardo, 1817/2004). Simply put, service is the application of competences for the benefit of one another, making all economic activity an exchange of service for service (Vargo & Lusch, 2004). More precisely, service can be defined as *value cocreation*, value as change that people prefer, and value cocreation as a change or set of related changes that people prefer that is realized as a result of communication, planning, or other purposeful actions (Spohrer & Maglio, 2010; Maglio & Spohrer, in press).

Over 10 years, there has been an explosion of activity aimed at knitting together multiple disciplinary views of service into a single, unified whole (e.g., Demirkan, Spohrer & Krishna, 2011; Salvendy & Karwowski, 2010, Maglio, Kieliszewski & Spohrer, 2010; Hefley & Murphy, 2008; Maglio, Spohrer, Seidman & Risto, 2008; Ostrom et al., 2010; Spohrer & Reicken, 2006; Spohrer, Kwan & Fisk 2013). Yet there has been little crosstalk among disciplines, and progress toward broad and systematic understanding of service phenomena has been slow. Globally, public investment in service research has increased from less than $100M to more than $1B annually, mostly driven by national funding in Japan, China, Finland, and Germany. National priorities around the world today aim toward economic improvement, driven by scientific understanding and systematic innovation (e.g., Council on Competitiveness, 2005; European Commission, 2011; National Science Board, 2010). Simply put, the US is lagging behind. It is time to focus deep scientific and engineering attention on service innovation (National Academy of Engineering, 2007).

Theoretical Challenges

One challenge to focusing research on service is a lack of a theoretical foundation for service innovation. As mentioned, fields such as marketing, operations, industrial engineering and operations research, and information systems have each contributed a number of theoretical concepts and scientific methods to the study of service systems in specific contexts. For instance, there is a long history of analytical modeling to understand and improve service systems (e.g., Riordan, 1962); many optimization models of service systems focus on shortening process wait times and streamlining tasks (e.g., Paul & MacDonald, 2013), others focus more on human resources and skill matching, among other related issues (e.g., Mojsilović & Connors, 2010). Service domains rife with optimization models include transportation and logistics (e.g., Saltzman, 2012) and healthcare processes (e.g., Rouse, 2008).

Another challenge is the need to link information technology research with service innovation (Raj & Sambamurthy, 2006; Davis, Spohrer & Maglio, 2011). At the infrastructure level, service-oriented architecture promotes loose coupling of software components for interoperability across platforms and dynamic choreography of business processes, but even here, multiple perspectives are required to transform architectural decisions into business value (Demirkan, Kauffman, Vayghan, Fill, Karagiannis & Maglio, 2008). In general, information technologies embody capabilities that can be traded against human capabilities to create efficiencies in service systems (Campbell, Maglio & Davis, 2011; see also Zysman, 2006). In some cases, technology (or information) can substitute for interactions with service personnel (Glushko & Nomorosa, in press), and in others, entirely reconfigure service processes and responsibilities (Campbell et al., 2011). In general, distribution of effort (and of roles and responsiblities) across a distributed service system, including customers, suppliers, and firm, is a design parameter that determines a system's effectiveness (Roels, Karmarkar & Carr, 2010). Technology does not by itself determine value cocreation; rather, value cocreation depends in large part on social connections among human participants in a service system that can be enhanced through technology (Breidbach, Kolb, & Srinivasan, in press).

Recently, a number of comprehensive theoretical approaches to understanding and improving a broad set of complex service systems have begun to emerge (e.g., Maglio & Spohrer, in press; Sampson & Froehle, 2006; Vargo & Lusch, 2004). However, to this point, service innovation theory has not yet developed enough to guide experimentation, modeling, and practice across the full range of service activities. Because service systems are sociotechnical systems (Rouse & Baba, 2006) with emergent properties that depend on interactions among multiple stakeholders and technologies (see also Maglio, 2011, and Maglio & Spohrer, in press), computational modeling is likely to be a very effective modeling approach (e.g., Oliva & Sterman, 2001, 2010; Rand & Rust, 2011). Computational modeling of sociotechnical systems is now becoming a favored modeling approach in a number of related areas (Lazer et al., 2009; Vespignani, 2009), and complexity science and systems approaches are already being applied to service system problems (e.g., Briscoe, Keränen & Parry, 2012; Kieliszewski, Maglio & Cefkin, 2012).

The Need for a Workshop

The intellectual motivation for this workshop is that studying complex service systems requires strong interactions and collaborations across a diverse range of research communities. Because there is currently no scientific funding program in the US specifically for studying complex service systems and because academic institutions reward disciplinary research, rigorous scientific work is not yet common in this new area. In addition, service innovation practice is running ahead of theory, and so linking academia and industry on shared open service system data sets also presents unique challenges that will be addressed by workshop participants.

We propose to hold a workshop that will help create the intellectual direction for the future scientific study of complex service systems, and identify knowledge gaps that need to be closed to increase service and technology innovation. Thirty to forty participants from a variety of service-related areas will be invited to attend the two-day meeting in Washington DC to outline specific, cross-disciplinary NSF-directed proposals for scientific and engineering research. Approximately 30 will be drawn from academic institutions, the rest, from industry and government. Participants will be selected based on expertise and background, incorporating a broad mix of disciplines, including marketing, operations, industrial engineering and operations research, computer science and computational modeling, information systems, and design. The workshop will consist of presentation of project ideas from multiple disciplinary perspectives on service, and facilitated discussions leading to formation of multidisciplinary project teams to sketch substantive, interdisciplinary proposals. The primary intended outcome is to identify knowledge gaps, foster and spur new interdisciplinary collaborations that advance a research agenda for service innovation, informing the strategic direction for potential NSF funding in this area, generating novel project proposals, and cultivating cross-disciplinary and cross-institution educational programs.

Broader Context: Impact of Service Innovation

Service activities represent the largest sector of the economy in the US and in all developed countries worldwide (e.g., Spohrer & Maglio, 2008). More people work in service activities than work in either manufacturing or in agriculture activities (International Labor Organization, 2008). Yet improvements and innovations in service do not lie on the same trajectory as improvement in agriculture and manufacturing, mainly because service systems necessarily involve coordinated action among people and technologies and resist traditional kinds of optimization and other interventions. Closing knowledge gaps so that service innovation can be on as solid a scientific and technological footing as other economic activities is a key national priority (Council on Competitiveness, 2005; European Commission, 2011; National Academy of Engineering, 2007).

Public sector investment in service research is relatively low because of the low margins in service businesses, which are not knowledge-intensive or technology-intensive, and the US lags well behind countries such as Japan, China, Finland, and Germany, in public investment. In Europe, the *Cambridge Service Alliance* at Cambridge University, UK, and the *Karlsruhe Service Research Institute* at the Karlsruhe Institute of Technology, Germany, are well known for excellence in service research and education, their close ties to industry partners, and their ability to generate substantial opportunities for external research funding. In the US, the *Center for Services Leadership* at Arizona State University, and the *Center for Excellence in Service* at the University of Maryland are established thought leaders in service research, with business, science, and educational missions. In addition, the University of California, led by Dr. Maglio at UC Merced, is now establishing the multi-campus *California Center for Service Science* to help advance the frontier of service research and education in California and the US. It is time for the NSF and industry to focus substantial attention on service problems and opportunities. The proposed workshop will help propel the US initiatives by aiming to inform establishment of broad-based, national funding programs on service research topics, and by helping to seed cross-disciplinary collaborations on fundamental service research topics.

The Service Enterprise Systems (SES) program at NSF has supported fundamental research in service for many years. Though it has broad applicability, the program is focused particularly on optimization and policy development in the areas of healthcare and public service. Recent projects funded by SES include "Stochastic Modeling and Optimization of Longitudinal Health Care Coordination**",** "Models For Designing Evidence-Based Patient-Centered Health Care Systems", and "Health System Modeling and Simulation: Coordinated Care Example". The Civil Infrastructure Systems (CIS) program at NSF also includes many service-focused projects, which often come from the most critical service areas in the economy, including cities, buildings, water systems, cyber infrastructure (communications, data), and transportation. The new System Science (SYS) program at NSF aims to fund research that creates a solid foundation for systems engineering, including work that takes account of how individuals and organizations work with one another and with technologies to create complex and large scale engineered systems. Evaluation and Assessment Programs (EAP) at NSF provide effective processes to chart the path between societal needs and NSF programs, which can help us determine how workshop outcomes might be implemented in future programs. SES, CIS, SYS, and EAP all represent potential stakeholders in outcomes of the proposed workshop: SES focuses on service and optimization, CIS focuses on critical infrastructure systems and services, SYS focuses on engineered (sociotechnical) systems and complexity, and EAP focuses on evaluation of research program effectiveness across the board. Simply stated, our argument is that to put service innovation on the same scientific foundation as technology innovation, we must focus both on societally important service systems and on complex sociotechnical systems at the same time. This workshop aims to outline a research agenda for service innovation that does just that.

Meeting Organization

The workshop will aim to develop a research agenda for service innovation by (a) laying out the societal context for service research, (b) identifying technology needs for service innovation, and (c) developing a set of basic science and engineering questions that need to be addressed to unleash technology development. Participants will comprise international experts in these and related areas. These participants will be selected to represent a cross-section of scientists, engineers, and practitioners who have already engaged in service research. In addition, we will ask faculty to nominate graduate students and postdoctoral researchers to participate, and a small number of these will be invited to participate as well, given budget constraints. Students and postdocs will serve as scribes for the workshop.

<u>Meeting Agenda</u>

The workshop will be structured to facilitate conversation and interaction among participants, leading ultimately to development of broad scientific agenda for service innovation. We see three key research themes for complex services: (a) modeling nested, networked service systems, (b) skills and knowledge-intensive service innovations, and (c) technology-enabled service system innovations. Prior to the workshop, each participant will be given one of the three theme areas and asked to develop a one-page paper outlining a key research challenge and knowledge gaps to be closed in that area (delivered prior to the workshop). The first day will begin with a session in which each participant will have two minutes to present a single slide describing this service research challenge and knowledge gaps. This session will be followed by structured and facilitated conversations among participants to form teams, leverage complementary skills and insights, develop substantive and lasting research relationships, and build effective cross-disciplinary research ideas. In particular, teams will be formed from those presenting compatible or consistent research ideas across themes. The organizers will propose teams (five members each) based on the papers and presentations. The goal of each team will be to develop a preliminary set of scientific research challenges in service innovation and then to identify technology needs. The second day will end with a session in which teams will have fifteen minutes to present their consolidated research agenda items.

Meeting Outcomes

The organizers will write a final report after the meeting summarizing the intellectual content of the meeting, and the lessons learned. The report will describe discussions and outcomes of the workshop along three main lines related to service systems research: (a) societal needs and societal contexts, (b) relevant technologies and technology areas, and (c) gaps in knowledge that must be filled to realize and enable effective technologies. The final report will include an appendix compiling all the final project slides, and will be disseminated through email to participants and through the California Center for Service Science website at http://ccss.ucmerced.edu. The final report will provide the basis of a journal paper to be submitted to a quality journal in the service field, such as *Service Science* or the *Journal of Service Research*, summarizing key points of the workshop and its results.

After the workshop, we plane to assess its outcomes over the short term (within five years) and long term (beyond five years). In the short-term, one measure is the number of service system research proposals submitted to the NSF and other agencies for funding. This is a good measure of how the workshop and the dissemination of its report stimulate the interest of the community in pursuing research in the area. As part of this measure, the extent to which the workshop participants take part in and spawn other proposals directly and indirectly can also be observed. Another measure is the number of research programs at NSF and other funding agencies that solicit service system research proposals. A third measure is the percentage of successful proposals that receive funding. A fourth measure relates to expansion of the research agenda and of involvement from disciplines beyond those involved in the workshop. This is a good measure of the extent to which the workshop has catalyzed new multidisciplinary approaches to the study of complex service system. In the longer-term, a follow-up study five years from the workshop could investigate the extent of these measures and provide a perspective on the workshop's lasting impact.

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