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Perspective: Technology Management in the Service Sector

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ABSTRACT

This paper reports out of the symposium on "Technology Management in the Service Sector" which was held as a part of Portland International Conference on Management of Engineering and Technology in 2007. The objectives of the symposium were: to explore, how technology management research and education can contribute to the evolving field of Services Science, Management, and Engineering; to define a research agenda for the field of engineering and technology management that addresses the critical needs of the evolving service economy; and to discuss needed funding structures and programs to foster service oriented research. We tackled these issues in two ways. First, the key leaders from academia, industry and government gave presented the critical issues and challenges that presently exist. Then, small groups analyzed the selected topics in depth. We identified three main components of service science: value, people and technology, and explored how researchers in the field of technology management tackle this new phenomenon.

Keywords – Technology Management, Service Science, Service Innovation, Service Systems

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INTRODUCTION

The integrated concept of Service Science, Management and Engineering (SSME) is recently propagated by industry leaders, such as IBM, and discussed among many academics and practitioners, because there is a general concern that current research and education do not sufficiently meet the requirements of the new service economy. Services account for 75% of the U.S. Gross Domestic Product (GDP) (Pal and Zimmerie, 2005) and 80% of private sector employment in the U.S. (Karmakar, 2004) and play a similarly important role in all other Organization for Economic Cooperation and Development (OECD) countries[2], but services are still often times an invisible "add-on" thing to industrial products in order to sell, distribute or install a manufactured product. Service industry is frequently associated with low-skilled and low-productivity work which does not reflect true picture. Today, industries that deliver consulting, experience, information and other intellectual content account for more than 70% of GDP in most of the OECD countries, and they are the main driver of productivity and economic growth (Spohrer, 2005). According to Lee (2007), the majority of growth occurs in technology-based services, with information technology (IT) being an important backbone and enabler. Despite the importance of services, old "manufacturing" mind-sets and disciplinary silos still prevail, and prevent researchers and practitioners from successfully managing the interaction of business, people and technology that take place in any service environment. As a consequence, many service environments do not deliver the maximum possible value to the customer, are poorly automated, and are slow in the creation and adoption of service innovation. Furthermore, their growth is often impeded by their inability to "scale up" and adjust to increasing demand, as being agile. Recent literature agrees that the role of technology in services is under–explored (Agrawal and Berg, 2007, 2008).

[2] The OECD has thirty member countries, representative of the leading economies in the world. They include: Aus-tralia, Austria, Belgium, Canada, Czech Republic, Denmark, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Japan, Korea, Luxembourg, Mexico, Netherlands, New Zealand, Norway, Poland, Portugal, Slovak Republic, Spain, Sweden, Switzerland, Turkey, the United Kingdom and the United States (www.oecd.org).

We strongly believe that the new advancements in technology management (TM) can help to overcome most of the agility challenges in technology-based services. The TM discipline dates back to the early 1900s when first educational programs were established. It has seen rapid acceleration since the 1970s. By the mid-1990s, more than two hundred educational programs in technology management were established in engineering colleges and business schools worldwide (Reisman, 1994). This number is still growing, as is the number of research publications dedicated to technology management issues, such as IEEE Transactions in Engineering Management (established 1954), Technological Forecasting and Social Change (established 1969), R&D Management (established 1970), Technovation (established 1981), Journal of Product Innovation Management (established 1984), Engineering Management Journal (established 1989), and others. These publications started to cover service topics and have already dedicated a number of special issues to selected service industries (e.g. health care, financial, education). As a discipline, technology management is well equipped to address the some of the needs of the service economy: it does not focus on the development of specific technologies, but on means to efficiently and effectively organize innovation and strategic integration for service providers those use or develop technologies (Kocaoglu *et al.*, 2008). It attempts to integrate theories and research approaches from social science, management, and engineering disciplines. It has a well-defined profile, dedicated venues for publications and has found global acceptance. The application of technology management theories, concepts and methodologies to the service sector can help firms to overcome the some of the major challenges they are facing today.

RESEARCH AGENDA

Spohrer and Riecken (2006) indicate that primary research challenges arise from the multidisciplinary nature of service innovation and the lack of common definition of service science and systems. Almost all speakers in the symposium pointed out that there is presently no common framework for technology management in services, and all of the symposium work groups spent time on clarifying service definitions, discussing service characteristics, and contrasting services and manufactured goods. There are several reasons for the obvious lack of a common language.

First, there is still an ongoing debate in the TM literature about the defining characteristics of services, such as intangibility, variability, and perishability (Demirkan et al., 2008; Ma *et.al*, 2002; Menor *et.al*, 2002). Since these characteristics are generic to any services, it is fairly easy to find a service example that does not display all of the typical characteristics. Shrink-wrapped software, for example, is considered to be intangible because the tangible product component (the CD-ROM or DVD) has little or no impact on the software's value and can easily be replaced by an immaterial software download. The software is, however, highly standardized and easy to store. A surgery, on the other hand, has extremely tangible results for the patient, but the service can neither be fully standardized across different patients, nor can it be held in stock. Marketing literature increasingly acknowledges that all products – goods and services - have physical and intangible elements and that services display "typical" service characteristics in varying degrees (Araujo and Spring, 2006; Phillips et al, 1999). TM research would benefit from a similar perspective.

Second, there are many preconceived notions about the nature of services and service providers that are reflected in over-generalizations, such as "service providers do not develop their technology, but buy it" (true for airlines that buy the airplanes that they fly, but not true for Google), "service companies employ low-wage personnel and have high turn-over" (true for McDonalds, but not true for engineering and design services) and "successful services are based on a total user experience" (true for Starbucks and patient-doctor interactions, but not true for automated business-to-business services). In addition, successful research that leads to relevant and general findings requires adequate categorizations of different groups of service providers. Many such categorizations exists, but they were mostly developed in marketing and do not reflect differences in technology strategy, creation, adoption and use. They also do not sufficiently account for the complexity of many business ecosystems in which different services are provided to different partners by the same service providers. TM needs to thoroughly describe and categorize services, rather than adopting ill-fitted categorizations that were originally intended for other research streams.

Third, service research in different disciplines, such as marketing, information systems, operations, human factors engineering, computer science and technology management still occurs in relative isolation and consequently does not benefit from the advances from other fields (Tax and Stuart, 1997). Technology management and computer science, for example, both address questions of scalable product architectures and design methodologies, that could greatly improve services system design, but there is little interdisciplinary research. Service marketing delivers a deep understanding of value drivers in service encounters and can thus predict customer acceptance for service automation, but there is little interaction with researchers in technology or service operations management (Maritz, 2006). Operations management has devised metrics and approaches to continuous process improvement, but these metrics are rarely systematically considered in service technology planning and decision-making (Schmenner and Swink, 1998). Any service-related research including technology management would greatly benefit from increased interdisciplinary cooperation (Demirkan and Goul, 2008; Kocaoglu *et al.*, 2008).

Service Systems as a Framework

An overarching theme in most part of the symposium discussion was the expressed need to develop an "integrated" or "holistic" understanding of services and to employ a system perspective. This is in line with the state-of-the-art, as reflected in the literature. Many authors refer to “service systems”, though they rarely define them explicitly. Service system characteristics, however, can be inferred from existing publications and symposium discussions: service systems create value for the service user (Grönroos, 1998; Spohrer et al., 2007). The service user participates in the value creation process by inputting a combination of production factors that are external to the service provider, such as service users’ knowledge and information (e.g. education, tax counseling), bodies (e.g. medical services, hair dresser), material property (e.g. house cleaning, car repair, computer hardware), and immaterial property (e.g. financial and insurance services). The service recipient (co-producer) and the purchasing unit of the service can be different entities, as is the case in government provided public education or employer provided health-care insurance. The individual value expectations of the service recipients and the nature and quality of their production input can vary between service users. Also, service systems need to be open and dynamic. They do not occur naturally, but are consciously designed for the purpose of value creation. System elements are the service user, the buyer of the service, and the service providers. Most services are jointly provided by multiple organizations that all contribute to the total value of the service, without having full knowledge and control of the system. The health care service system, for examples, creates value through physicians’ offices, hospitals, independent laboratories, health insurances, and government regulators. Many of the organizations involved are large and complex service systems of their own. As the individual elements of the service system cannot fully foresee, plan and coordinate all system elements, they have to dynamically adapt to changes. These adaptations influence other elements in the service systems and can lead to emergent behavior. Service production requires technological knowledge and physical assets, such as warehouses, stores, computers, and tools. Information and communication technologies transport information, which is an important in- and output factor of any service production. Therefore, they are particular importance for service systems, but they are not the only technologies of relevance (McDermott et al., 2001). In addition to being a technical, the service systems are also human systems. People are element of service systems as providers, co-producers, and users (Buzacott, 2000). Individual expectations, behaviors, levels of trust, knowledge, and relationships can be managed to some extend, but not standardized. The human factor introduces an element of variability into service systems that exceeds the variability in many technical systems. Therefore, service system can be defined as connection of people, technology, internal and external service systems by value propositions and shared information (Spohrer *et al.*, 2007).

In the following sub-sections, we will explore the different elements of service systems and discuss technology, value propositions, and people. We close the discussion by exploring the means and science base of service system research in technology management.

What are technology trends and how do they impact services?

Symposium discussions about future service technologies surfaced two trends: (1) Embedded data capture and for real-time decision support, and (2) Industrialization of services.

Embedded data capture for real-time decision support

Many technical systems presently collect data that is relatively useless for the customer, because they lack the capabilities to analyze it and understand its meanings. Embedded sensors that capture the state of technical components (e.g. stress of a highway bridge component, temperature of an aircraft engine), and transmit data through the internet will likely increase the amount of available data even further. Technology firms will have to think about ways to use this data, combine it with other available data, analyze it and feed it to the customer for real-time decision support. At present, sensors are mostly used to inform about defects and do not provide a lot of context. Future systems could dramatically improve the service by forecasting future defects (e.g. aircraft engine will need unscheduled maintenance in X days) and instantaneously analyzing the implications for the customer (e.g. the unscheduled maintenance will delay flight number 4711 to Miami). One symposium participant characterized this process as "transformation of data into active knowledge". Similar system can be envisioned in the area of health care, where medical devices, such as MRIs, or even sensors embedded in every day things could collect patient data. The data could be used by pharmaceutical companies, insurance companies, and eventually hospitals and doctors to improve medical products and patient care. The producer of the device that captures the data can sell the data and thus capture value from the device long after it has been sold. This can lead to a sustainable competitive advantage, even if manufacturing the device experiences global low-cost competition.

The group agreed that the described future system will require technology improvements, such as high precision and reliability of sensors, fast and reliable data transmission, and massively improved analytics. However, several participants pointed out that the biggest challenge is to change the way technology companies define their product and capture customer needs. They are too often focused on asking the customer for specific requirements, rather than to understand the wider context of the problem. As a consequence, products do not deliver all the value they can, as illustrated by the following example, given by Jay Lee during the course of the discussion: "Part of every elevator design is that you have to click the button and wait for the elevator to come. Whether the elevator goes vertically or horizontally, doesn't matter. The company can use the waiting time to create new value. They can install TV stations in the elevator area to show commercials to sell other products. Thus they can make use of the waiting time and gain money. Other possible service is to provide information of arrival time next to the elevator door so people know which elevator is coming and when". To achieve this objective service innovation methods are needed which map between 1) current and new customers with 2) current and new technologies, and 3) the explicit needs and hidden problems.

Industrialization and standardization of services

Industrialization and standardization of services was another topic of discussion in the symposium resulting in research questions including: How does the level of customization affect the delivery of service? What are the roles of relationship and personal attention in delivery of service? How does a business define the service they are providing through business and customer perspectives? How does a service decide what parts of service to provide themselves and which to outsource or purchase? What are the similarities between standardization of services and industrialization of goods? How does a business know if the automated service gives benefit to customers? What is the equivalent of standard components in the goods world in the service world? How do an industry (or across industries) standardize service components? How does standardization affect competitive strategy? Does commerce in service drive standardization or does standardization drive commerce?

It is important to standardize and integrate different types of services. Companies who buy standard service components may compete on how well they integrate the different pieces. Access point to the services may be standardized but connecting to different services and service providers are not. Costs for using outside services also may hinder adopting them within the company. Standardization may already be occurring. For example, Amazon .com sells a book, yet uses a standard carrier to ship the book and provides package tracking information.

In services customer experience may be affected by the commoditization of services because it could reduce the quality of the experience. How are these features standardized? Industrialization means standardization of the modules of the service so that these modules and services can be improved. Creation of research and development infrastructure (professional societies, university research) aids standardization. Industrialization of service can provide competitive advantage at the firm and the national level (Levitt, 1976). A “moment of truth” interaction is a term from the banking industry. It is an interaction which tests the customer’s belief in the quality of the service. Can these moments be predicted to help develop services which create these moments or to develop contingency plans when they do occur? Until we can understand what a good service encounter is, it’ll never be commoditized.

How is value created and measured?

Bygstad and Lanestedt (2008) found that current innovation studies do not have consensus on whether or not service innovation is fundamentally different from traditional product innovation. They did, however, identify two differences: services are usually developed with close relation with customers and services are innovated by network rather than in a lab. A platform which is a foundation base derivative product has certain domain and common elements (Simpson, 2004). Products can be in a vertical system while services should be more open and broad (Usrey and Garret, 2000). Platforms are commonly seen in high tech industry but usually services are not integrated with products. However, products and services are inherently linked since both of them are customer driven. They should be integrated together. Product platforms usually begin with innovation and then get augmented with improvements to capture market share (Zhang et al., 2006). Services, on the other hand, may not have to be from innovative breakthroughs. Services usually start with problem solving and opportunities.

Service innovation is totally different from one in product innovation (Gallego and Rubalcaba, 2008; Mansury and Love, 2008; Hurmelinna-Laukkanen et al., 2008). Customer needs from marketing is fed backward into production line immediately to satisfy their requirements (Halliday, 2008). Toyota and Dell are typical examples of this customization. In the case of IT, how effectively organization utilizes information among organizations for production, and how it enhances security in an organization are also big issues (Soper et al., 2007). For example, in the IT industry, a company can outsource anything such as hardware or business process, and provide a service by combining these resources. These can be an example of commodity by outsourcing. Agility means how fast and cheaply they provide service to customers (Demirkan, 2008). Outsourcing is getting harder because it requires more paperwork and management of comparing it to doing it all in the company, as well as coordinating all external organizations that are involved in a certain project (Amiti and Wei, 2005). Therefore, it can slow the process down. Another issue is how to launch a new service fast and efficiently (Ren et al., 2007).

What could be the process of new service development? There are many processes in traditional thinking such as analyzing environment, figuring out where we're going, and then designing a new product. A company needs to look at other competitors, gather information outside, and then evaluate its internal resources. Scenarios can be a better approach for setting a strategic goal. It is analyzing situations and coming up with several possible objectives with scenarios (Korte, 2008). Different priorities and resources are given to them. Scenarios give a path when an undesirable situation happens instead going back to initial stage and repeating the process again. There are also other approaches that can be used to identify successful innovation areas such as audit models (Ozyilmaz and Berg, 2004).

There are several other research questions in this area: Is it possible to come up with a new service without any input from customers? Where do those ideas come from? Where do we get the true idea of service innovation? Information could come from internal organization such as marketing and R&D. Searching patterns and getting some idea from them can be helpful (Demirkan and Goul, 2008). However, if information is not available from those existing sources, some tools might be used to identify very first information at the design stage. Marketing survey which is a typical method for this problem requires a well predefined product (Ho and Wu, 2005). However, if it is totally a new service in the market, a general marketing survey is not feasible. Scenario can again be an alternative approach. There are other tools helping to create a new idea and solve a problem such as Triz (Zhao et al., 2007). After an idea of a new service is identified through customers, a company might have a different perception and attitude on the proposal of a new service product due to cultural organizational issues. Some companies may be more risk averse at investing in a new service while risk taking companies look forward to opportunities. Some filtering mechanisms are required to select reasonable ideas. A company can develop prototypes with which they can gather feedback (Zimmerer and Scarborough, 2007). Next is to link the narrowed ideas to resources. Portfolio management or internal buying process, and planning process are required here. In the manufacturing side, if product development itself takes twelve months, it takes two years to launch. Once they come up with a new concept, they will need to race to deploy the service faster than competitors. Therefore, next step after internal research and development is service development and deployment. How a company develops and deploys the new service depends on industry and competition. Wrong decisions on deployment strategy of a new service can bring disaster.

For example, if a company launches a new brilliant web-service without a plan of expansion, an explosive access to the web can result in shutting down the service itself. Classic example is AOL. Originally, people paid for internet service for the time of usage. AOL came up with unlimited internet service with monthly fixed payment. They deployed the service throughout many cities instead of testing it at one city first. It was a huge success with ten times more access to the service, but they didn't have the infrastructure to cover themselves. It ended up being a disaster despite being such an excellent service. Same thing happened in mobile industry in Thailand. A cellular phone service provider launched a hit service, unlimited access, and their sales exploded in a short period. However, customers started not to hang up the phone and just let it be connected all the time. Finally, their network couldn't afford to deal with those heavy loads. These examples show that deployment strategy and plan are critical (Goul et al., 2005).

A framework for data metrics in the services industry is also a requirement. In the case of the Japanese Industrial Services, when the industry adopted RFID technology, originally they had goals of choice to measure the success of RFID (Want, 2006). It was quickly adopted and metrics to measure progress changed. The Six Sigma Process had just what the group was trying to do. The Roadmapping could also be used in these problems. The Roadmap would include a strategy, and a structure. Then, the roadmap would align the organization with the goals (Lichtenthaler, 2008). There is no one service metric that is sufficient, and also there are sometimes unintended benefits that obscure cost metrics. The cost is the metric that doesn't reflect benefits. The approach of government funding for services research doesn't improve the current situation because they failed to separate services sector as a separate intellectual discipline (Chesbrough and Spohrer, 2006). Developing metrics for services from a government policy perspective can help to make policy decisions for research funding.

We already see an increased focus in this area. Recent works by den Hertog et al. (2008), Djellal and Gallouj (2008), Opitz (2008) and Sundbo (2008) explored service innovation in different settings.

People - Educational Needs

Currently, these are no commonly shared mission and understanding of economic activity and way to advance of service sector in academics, so common terminology and methods enhancing our knowledge and understanding the services domain are required to connect universities with service sectors (Chesbrough and Spohrer, 2006). The National Academy of Engineering pointed that the current academy community don't have adequate focus and organization so cannot meet the needs of service business (Hefley, 2006). There is a paradigm shift towards services in industry and those personnel have to be prepared for this new challenge. The key question that arises is: What does this paradigm shift mean for Education? How will the service sector be approached from an educational perspective?

Services have to be seen in a more scientific way. The discussion is concerned with service sciences, "not so much with flipping burgers." The public perception of services on the other hand rather seems to be focusing on services in a less scientific way. Can this public perception be influenced or changed? If it is, how can it be done? Furthermore the group agrees that there are important sectors that somehow define the character of services. Health care, IT and education services, for example, are very important disciplines in terms of services sciences.

When looking at education as a service, and assuming that every service needs a client, who is the client in case of education? Obviously the direct clients of education are the students. Therefore the main question is: How will the educational system in the US prepare the students for the paradigm shift towards service sciences? What is the role of technology in this educational preparation? How important is the technology depth in service education? How much technological knowledge has to be given? What backgrounds do students need to have in order to study services? A background in engineering to provides enough depth to the knowledge base. This opens the discussion towards the topic of a T-model education: There needs to be a horizontal, broader understanding of all influencing factors. Education has to be delivering a systems approach. However, at the same time students should also receive the vertical part of the T-model education: A depth understanding in a certain discipline, preferably engineering or IT-technology.

This lead to two key issues during the discussion: Firstly, how will services be taught? Will there be undergrad programs or graduate programs? Is there a need for full service science degrees at all or can service courses be offered as electives, thereby leaving the decision to the students. Secondly, we have to ask “in which cage the elephant belongs”. Can service sciences be placed in the existing silo-like system of the educational system?

Based on the T-model approach of education there seems to be a need for a thorough technological background in order to study service sciences. Therefore such programs seem to be more suitable for graduate or doctoral programs, building up on undergrad degrees in technical professions.

However, the question remains, whether universities need to establish degrees in service sciences at all. Maybe it would be enough to develop classes for service sciences that will be offered in addition to existing industrial engineering or engineering management programs (Glushko, 2008). Thus universities would offer their students the opportunity to choose an education in service sciences, without committing completely to this new approach. An example was given in this context: Six Sigma. The Theory of Six Sigma and the application to manufacturing are well known and studied, but if applying Six Sigma to services a new field of studies might emerge (Zhao, 2005). Could this be “fixed” just by adjusting the curriculum or offering a new class, or do completely new degree programs have to be established?

In order to answer the second question the group comes back to the idea of offering a complete systems approach in education. Therefore there might be a need to give funding to interdisciplinary master programs. The idea of integrating several disciplines seems to be a trend in education that meets the needs of the shift in industry that services have caused. But it is rather difficult to implement interdisciplinary programs. People are resistant to change and nobody is willing to give up his or her turf. That means that the implementation of such interdisciplinary courses might not be compatible to the silo-like educational system into which the US universities have developed over time. This leads to the question whether universities should try to move away from the concept of departments and become more flexible? Could universities be organized in a different way, solely based on the idea of offering different programs, and thereby offer more flexibility and interdisciplinary? This would be a great setup in order to meet the needs for education, but the implementation seems impossible.

The primary client may be the student body, but there is a “layered system” behind the students: students use their education to work, and their employers have customers who receive benefits of that education. That means that another important stakeholder is the industry. The industry needs to support the universities (Demirkan and Goul, 2006); this can happen in two ways: Firstly the industry and the universities could try to jointly develop new programs. The industry needs to understand its role as a customer of the educational system and has to communicate its needs. However, “to herd the cats you have to move the food", as one member pointed out, industry funding is necessary to trigger a shift in the research focus of universities. Secondly, industry support could possibly be done through more internship. As mentioned earlier, technological depth knowledge is important. The problem with service sciences is that a service environment cannot be simulated in a lab; the service environment is far too complex for that. Therefore, students need to learn the dynamics of this environment by actually participating in it. This can only be achieved through internships and industry projects that offer students the chance to get in touch with the real service environment.

A last aspect that was discussed is the role of cultural factors. It seems that expectations towards services depend on the environment and/or culture: In the US services seem to be concerned a lot with efficiency, while other countries rather emphasize factors such as a "personal touch", creating jobs, and therefore splitting service processes in smaller fractions. On the other hand this might be subject to different evaluations of services, but this does not necessarily mean that the approach to services has to be different in different countries.

How can service systems be researched and understood?

Service System Comprehension

The service sector is complex and difficult to understand; therefore, people are afraid to even attempt to abstract service sector processes and instead treat them all in a holistic manner. That being said, the group then attempted to seek out what elements can be used to understand the service industry. It was agreed that different modeling techniques were already available in order to measure components of the service industry. The problem was in appropriately applying the techniques in the service sector. One suggestion included having many different departments of a service company define individually what makes them successful, how they individually achieved that success and have all the departments work together, figure out how to resolve disputes, make tradeoffs between themselves and develop a comprehensive, successful service process. Given this internal focus, the issue of the customer was brought up as they play a beneficial role as they are the recipient of the service. A counterpoint was brought up that customers may not always know what they want out of a service. Integrating the customer's thoughts and the opinions of other stakeholders shows the dynamic and multi-dimensional nature of developing a process for the service industry (Chesbrough and Spohrer, 2006). With regards to working with the customer, service level agreements have statements about predictions. However, there really are no assurances on these predictions and neither party really understands the elements that were used to back up the data. Seemingly though, there is co-creation of value for both parties. So, now attempt to create a service co-design and establish boundaries. A comment was brought up that there is too much focus on the customer experience. A more rich and dynamic design of the service process must be developed. NSF requires scientific information and relevant, concrete questions to answer from academia so that funding can be considered for the service sector. But, academia needs this data from industry in order to analyze it (Demirkan and Goul, 2008; Siegel et al., 2008). The majority of experiences for a lot of services can be automated, yet there are exceptions where human interaction is needed to resolve a problem. The analogy was made to a Loch Ness Monster-like probability distribution. The big body of the monster represents the lion share of the experiences that can be handled by automation; it is the small tail of the fewer experiences that represent those interactions requiring human to human dialogue.

Science Base for Services

Defining service science starts with defining the education discipline. The objective of this type of discipline would be to generate T-shaped people (broad and deep) who are often required for service fields. Front line people end up having to make trade-offs between things that they don't understand. The graduates need the depth, but also need to communicate across boundaries. At the master's level they don't need more education in computers (using computer science as an example), but in organization culture, management, business, and marketing (Bitner and Brown, 2006). Institutes such as University of California at Berkeley, North Caroline State, Carnegie Mellon, and Arizona State Universities are trying to incorporate this into Computer Science and Business Schools. In the undergraduate case, industrial engineers are the closest to the services. They cover process optimization, operations management (abstract but not human perspective). The science base of service is not a list of sciences, any attempt to describe it this way is considered an oxymoron. Knowledge management institute in Japan is trying to reorganize the program to meet the new needs as they know that service science is an important emerging field (Kameoka, 2006). Service science should have to interact with both objective and subjective issues. For example, in addition to technology and management, social sciences need to be incorporated. Fundamentally service is about people, and therefore the science needs to understand the way that people interact and require services. The objective should be understanding of and be able to communicate across service systems, computers, organizations, and business processes. There is also a psychological level of the issue. Some people still don't believe computer science is a science, because there is not a unifying theme. At NSF, they did not recognize computer science as an individual discipline, nor engineering for a long while. The issue needs to be brought to the attention of the policy makers through research, publishing. Science can be defined as discovery and understanding of nature and technology as manipulation of nature. Although experimentation, reproducibility are not necessarily nature, we can define "service" technology as manipulation of nature for service industry and "service" science as manipulation of nature for service industry using the previous logic. As outlined before there are three prongs of science base: social (people are a part of nature), process and philosophy. For service science, function and logic would be covered by a formal language, process by systems, and societal system by function and logic crossed with systems. A science base is required so that we can look at various levels of skills and so that we don't have to retrain everybody in multiple disciplines. Science base is the 'nature' that you are dealing with that you need to understand and manipulate. Service science is beyond computer science because it doesn't involve enough language (business, organizational theory, psychology). It needs to include language, processes and societal systems (organizations & people) and needs to provide research and education that adds to computer sciences that provides literacy (additional) in specific functional language, functional processes, and functional organizations to which computers can be applied. Language includes natural language, concepts related to specific fields such as business management, economics, marketing, technology, and people).

CONCLUSIONS

In the last 50 years, the service sector has grown remarkably and has become dominant economic activity, as societies move from traditional agriculture and manufacturing to knowledge services (Spohrer and Riecken, 2006). Service science is a new emerging discipline that arises from social and technological change and needs. However, the new paradigm is suffering from the absence of a deep understanding of major concepts, as well as from a lack of frameworks and methods to advance it.

A services research agenda requires addressing service and technology management strategy that can integrate the heuristic nature of designing, modeling, representing, and warehousing best practice business processes. This research agenda also requires extending traditional services science semantic approaches, development lifecycles, tools, and standards for the context of business process execution, intra- and inter-service system stability and self-organization, inter-enterprise collaboration, and an 'enterprise physics' that remains to be elaborated.

The ultimate goal is to build on the core foundation of an integrated service culture. Such a culture is characterized by a cross- and multi- disciplinary attitude that recognizes that fulfilling customers' needs is the primary objective (Zeithaml et al., 2006). A secondary attitude within that culture must be an awareness of the complexities associated with what we refer to as service tradeoff decision making that tradeoffs among value, risk and cost. The emerging trans-disciplinary field of service science is substantively grounded in the cross-functional issues of business, and its theoretical roots lie in the business disciplines, engineering, technology and the social sciences: e.g. theory of transformation (stated in terms of value deficiencies, work processes, decision making, and social net-works); socio-technical systems theory (stated as self-regulation for interactions of physical & institutional structures); service complexity theory (expressed as a function of the number and variety of people, technologies, and organizations linked in the value creation net-works) and consumer behavior theories (stated in terms of customer decision-making, experience, satisfaction and perceived quality) (Bitner et al., 2006).

As a new managerial perspective, service-oriented technology and management emphasizes the importance of encouraging the sharing of business processes, IT, data sharing and technology-related business practice across different business units. It is very important to align business with technology for organizations to respond customers' needs as fast and as accurate as possible, become agile (Demirkan et al., 2008). Organizations need to provide test bed service systems for the most effective education programs.

We identified three main components of service systems - value, people, and technology, - and explored how academia in the field of technology management and industry presently perceive and tackle the new phenomenon. Valuable insights were provided through the discussion of four major questions. What are the technology trends and how do they impact services? How is value created and measured? What skills are required and how should they be developed? What is the science base for the emerging field?

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