

SERVICE SCIENCE, GLOBALLY INTEGRATED ENTERPRISE, AND INNOVATION-DRIVEN ECONOMIES: RELEVANCE TO SINGAPORE

Note: This paper intends to fuel the dialogue within academic, government, and industry communities in Singapore, about an emerging field called Service Science, Management, and Engineering. Please note that a similar paper has been drafted by University of Cambridge and IBM. Rather than repeat much of that content here, readers are advised to reference that source directly and see this as complementary.

Introduction

The service sector, and service activity more generally, have been increasing in terms of number of people employed and relative contribution to the economy. Improvements in productivity for some service industries (government, healthcare, education, etc.) have not kept pace with those for manufacturing. Raising productivity for the service sector is becoming an urgent issue for all industrialized nations.^{i, ii}

At the same time, performance in the service sector is based largely on the intuition and experience of employees, and investment in research and development for services remains disproportionately low. Where services knowledge has been codified, firms have found substantial opportunities for productivity improvement, from both process improvements and globalization (exporting services).

The body of knowledge about how services work is referred to as service science. In recognition of the impact arising from “knowledge in action,” the emerging field has sometimes been described as Service Science, Management, and Engineering. For ease in exposition, in this paper we refer to this field as service science.

Service science seeks to make simple, and render explicit, what makes service activities effective, efficient, and sustainable. These activities typically take place in a larger service system, which refers to collections of resources (including people, information, technology, and organizations) connected by value propositions.¹ Understanding service systems provides valuable tools in dealing with two emerging dynamics that matter to companies and countries today: globalization and the role of innovation.

Role of Services and their Growing Importance in the Economy

The shift to services represents the single largest labor force migration in human history. Global communications, business and technology growth, urbanization, technology-enabled productivity gains in manufacturing and agriculture, and low labor costs in the developing world are all in part responsible for this dramatic shift.

The service sector accounts for a growing proportion of the gross domestic product (GDP) of developed and developing countries. It is a vital part of the world economy.

¹ For more about the resources that make up a service system, see Spohrer, J, P. P. Maglio, J. Bailey, D. Gruhl (2007) “Towards a Science of Service Systems,” *Computer*, 40(1), pp. 71-77.

In Singapore, it accounts for approximately 65 percent of the labor force and 68 percent of its nominal GDP. In the United States, the service sector accounts for more than 75 percent of the labor force. Across ASEAN, services is a key pillar and it contributes towards a significant proportion of the GDP for ASEAN countries.ⁱⁱⁱ China, representing 21 percent of the world's labor force, has seen its service sector grow by 191 percent in the last 25 years and aims to shift 420 million workers from farms to services in the next five years. For almost all countries, the importance of the service sector has been rising significantly. 40 percent of the world's labor force is now employed in the service sector, compared with 38.7 percent in agriculture and 21.3 percent in manufacturing.

The picture is similar in most *businesses* the world over. Services are an increasing portion of their revenues, but this portion is more labor-intensive than the product-based revenue, and therefore is not as profitable.^{iv} Companies have reacted to global competition by building more efficient IT systems, streamlining their business processes, and embracing the Internet through a proliferation of web-based services. New business service offerings and entirely new business models are being created. Even companies outside of the service industry are more and more reliant on “service-based business.”^v

This has meant a profound shift in the global economy, and the world is becoming a giant service system, composed of six billion people, millions of businesses, using technology that connects them together in service networks. Just as the agrarian markets shifted to manufacturing markets, the change to a services market is happening all over the world. “The importance of knowledge-intensive service activities and innovation to companies in the global economy is rapidly increasing, both quantitatively and qualitatively, in manufacturing and service industries alike.”^{vi}

However, the 21st Century economy is still wedded to 20th Century, manufacturing age tactics. Over 71 percent of the US economy is represented by services, but it is directing only 37 percent of research investment to it (two-thirds of research spending is invested in the 17% of the economy represented by manufacturing).

The Globally Integrated Enterprise

In his 2006 article in *Foreign Affairs*, IBM's Chairman Sam Palmisano noted the emergence of a new form of corporation.^{vii} Previously many firms with international presence were structured as Multi National Corporations, with replicated functions in many countries around the world. Recently, with communications and other technologies “flattening” the world^{viii}, companies have started to focus on where (globally) is the best place to locate a particular function. Along with optimizing where work gets done, firms are deciding – for more and more functions – by whom it should be performed.

This combination of optimizing who does the work and where, opens up many new possibilities for increasing the firm's performance. Many companies can be seen to be chasing the trend of outsourcing and offshoring, in attempts to reduce costs through labor arbitrage. But the real story is far more interesting (and more subtle).

Real, sustained competitive advantage comes from the fusion of invention and insight, to transform how things are done. This ability to rethink (and improve) how work is done becomes not only an opportunity, but a mandate in the globally integrated enterprise.

This environment presents four key challenges (opportunities) to firms:

1. Finding and hiring the right *skills*
2. Regulation of *Intellectual Property*, not only in terms of protection, but also business models that assure equitable value distribution across partners.
3. *Trust*, particularly in a company's brand, given that there can be so many players involved in even simple transactions
4. Adapting *organizational cultures*

While the above represent opportunities for firms and governments, there is an additional challenge for governments. Regions (or countries) must decide what competitive advantage they can offer, in order that their role(s) in the global economy are well-defined, known, and sustainable.

For small countries such as Singapore, this challenge is especially important. Existing roles must be continually examined, both in light of globally integrated organizations, and also emerging fields such as service science.

Understanding Service Systems: Key to Innovation

Recent years have seen many firms questioning their own role in various functions. In particular, internal services (such as cafeteria, telecommunications, travel agency, logistics, and so on) are candidates for outsourcing to suppliers whose core competence more closely mirrors that service area. This exploration extends beyond those obviously tangential functions and can incorporate functions seen heretofore as primary (such as manufacturing, procurement, product design, and so on).

This impacts the classification of jobs, and therefore how a country's GDP is split across service and manufacturing. As manufacturing firms outsource various functions, the supplier provides these as a service to the firm. In this way, service constitutes a greater share of the economy.

It may at first appear that there is little change in this shift other than classification. In fact, there is a more powerful difference. As service firms providing a given function take on more and more business, they are able to concentrate their attention on service excellence. They are required to improve performance well beyond what was expected from the customer's internal department providing that function. Indeed, it is their core competence and the basis upon which they compete.

Innovation has been defined as "invention combined with insight."^{ix} People most commonly associate innovation with product or service development (new things or services a firm brings to market). Understanding how to develop services is a key part of service science, and that link to innovation is straightforward.

However, innovation reaches beyond that sphere into three other areas as well: business model innovation, process innovation, and societal innovation.

“Real innovation is about more than the simple creation and launching of new products. It is also about how services are delivered, how business processes are integrated, how companies and institutions are managed, how knowledge is transferred, how public policies are formulated – and how enterprises, communities, and societies participate in and benefit from it all.”^x

The relevance of service science to service innovation, process efficiency, business models (where more and more are service businesses), and societal innovation is fairly evident. But understanding service systems is also key to the leverage of innovative new products.

New products, often grounded in some new technology or breakthroughs in using existing technology, are typically delivered in the context of a service system. For example, using nanotechnology to purify water supply, can represent an exciting breakthrough and change the economics of water purification. But the effectiveness of this innovation – its leverage – is dependent on how well it is incorporated in the ecosystem of private firms and government in bringing clean water to people.

Another example comes from applying supercomputing to detection of the most probable virus mutations. By identifying the most likely mutations of the Avian flu virus, vaccines can be produced in advance of that mutation. But whether such an invention truly benefits humankind will depend on how effectively it is utilized within the service systems made up of government policy, biotechnology firms, vaccine manufacturers, individual health care providers, and so on.

So, understanding service systems (in other words, service science) even has an important role in *product* innovations. Depending on the extent to which this knowledge is extended, codified, spread, and applied, nations will be more or less effective at innovation.

A Need for Knowledge, a Need for Skills

An increasingly competitive, service-based global economy levies a higher need for skilled professionals who

- are knowledgeable in how services work,
- are knowledgeable about how they are deployed,
- understand service systems and factors that make services successful & profitable.

The “information age” is rapidly becoming the “talent age.”^{xi} The current education system does not adequately teach most students about the service economy, even though they are embedded in it. What is needed is a new education offering that can help prepare students to be adaptive innovators in the 21st century service economy.

Very good work is being done in universities the world over in various academic disciplines, building highly valuable strands of knowledge that can be applied to the study of services. However, a more integrated approach is needed. Without a clear understanding of services and their connection with existing theories, knowledge will continue to be fragmented.^{xii}

Service leaders need a strong mix of business, technical, and people skills. Service science programmes must be multi-disciplinary, cutting across the often siloed schools of engineering, computer science, business, and the social sciences. This new academic discipline aims to bring together ongoing work in the more established fields of computer science, operations research, industrial engineering, management sciences, and social and legal sciences, among other fields in order to develop the skills required in a services-led economy.

Service science challenges universities to change both what they are teaching and how they teach it. In addition to requiring a multi-disciplinary approach to curriculum, service science also requires universities to evolve from teaching concepts relevant to the manufacturing era to those relevant to the services economy.

Accelerating New Service Professionals' Time-to-Value

A key question for all governments is how they can help create a highly-skilled workforce, as well as legislative, social, technological and environmental infrastructures to enable service innovation.^{xiii} Different governments and universities will focus research dollars or academic studies on areas of service that matter most to them.

For example, Singapore's focus may be on financial services, healthcare services, IT services, transportation services or e-government services, areas where Singapore has distinguished itself and has the potential to export its services on a global level. Or, it may also focus on grand challenges, like how does a small nation like Singapore with limited resources continuously move up the services value chain and successfully export services excellence?

Is domain expertise or technical expertise more important in educating the 21st Century workforce? Is working at Starbucks a better education than Harvard, Stanford or MIT? Does working at Singapore Airlines provide a better education than a university degree from NUS, NTU or SMU? These questions highlight the growing value that industry puts on domain expertise. In services driven economies, domain expertise trumps technical expertise.

The majority of engineers, scientists, mathematicians will have jobs in the service sector. In Singapore, the Intelligent Nation 2015 (iN2015) master plan calls for IT graduates who are well prepared to work in the financial sector, biotech, digital media, and health sector. These are all examples of domain expertise needing to accompany technical expertise. Service science-trained graduates will have the knowledge and skills to pull it all together and work in multidisciplinary teams on society's and business's most exciting opportunities and challenges.

Singapore Priorities and its Role in Globally Integrated Enterprises

As the world becomes more globally integrated, Singapore's challenge will be in structuring its economy and shaping its workforce to compete and win. It has the opportunity to become a global knowledge center where cutting edge innovative services are created, constructed and delivered to all points of the globe seamlessly.

To do this, Singapore companies will need to raise their service level capabilities, become more systematic in achieving service innovation, and extend their global reach in order to export service excellence.

Singapore's competitive advantage is that it is already an open economy where its companies are exposed to global competition; it has an educated, highly skilled workforce, an efficient government, and a transparent and reputable legal system.

Singapore has also made substantial investments in research and development. It has plans to raise its R&D expenditures to 3 percent of GDP in line with other major developed countries. Also, Singapore has targeted promising fields such as interactive digital media, water and environment, and biotech for development. Overall, Singapore is allocating US\$8.1 billion to R&D over the next five years.

In addition, information technology penetration is among the best in the world. Singapore has in place an integrated I.T. masterplan called iN2015, which sets out a 10 year vision for growing its infocomm sector and building a well-connected society. With the unprecedented pace of change happening at a global level, and the advent of social networking and enhanced collaboration models that take place on a global level, this is a vitally important ingredient in building an ecosystem for service innovation to flourish.

Singapore's education system is among the best in the world. Singapore students have gained a global reputation for excellence in science, technology, engineering and math disciplines. It is weaker in teaching softer skills in the liberal arts, which are often key enablers in achieving service excellence. This blending of soft skills and disciplines help address challenges stemming from the human dimensions required in service interactions. Entrepreneurialism, especially in the services industry, is another area where the blending of hard and soft skills is a critical enabling factor.

These are key challenges that services science looks to address. Singapore can leverage it to further enhance the quality of life, and build on the success of its service industry, especially in competing in culturally diverse markets and for exporting service excellence. It can also benefit from services science in educating a new generation workforce that are both deep and broad in their education and better able to address the demands of applying their knowledge in a services business environment.

Singapore's livelihood has always depended on trade. However, in the 21st century, trade in services is becoming the dominant engine for growth. This holds true for Singapore. As Singapore competes on an expanded global playing field, whether it is in financial services, healthcare, logistics and transportation, or in cutting edge areas like environmental services, interactive digital media, or biotech, its success will stem from the resources of its people, the collaborative networks it creates, and its ability to produce innovative and highly valued services.

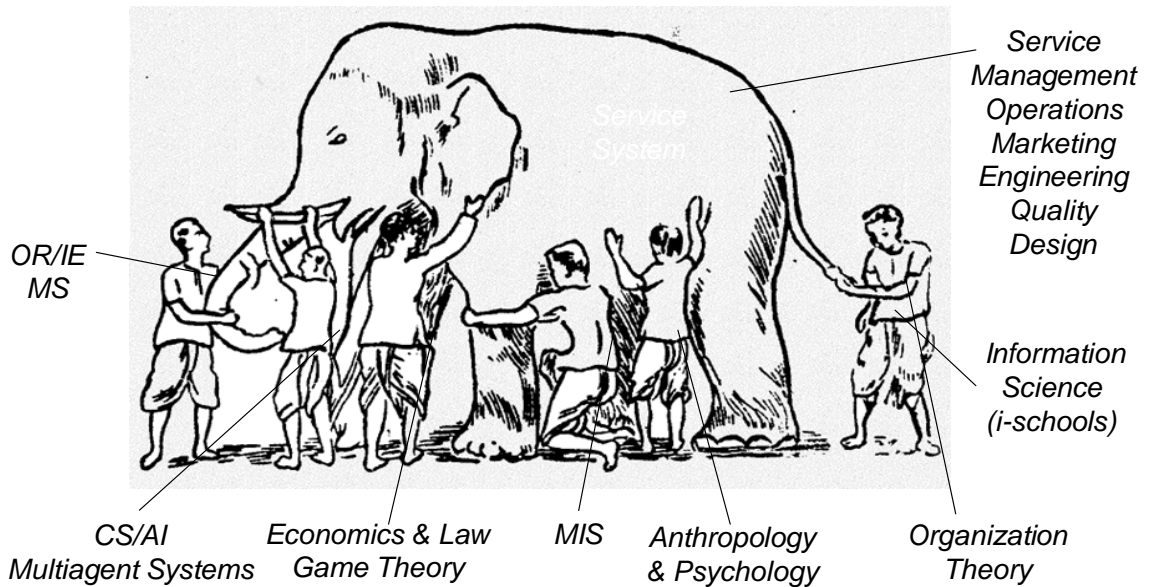
Singapore has done an excellent job in creating a network of free trade agreements that opens markets for its goods and services. It should continue to pursue this track as well as support the WTO efforts in the DOHA Round to liberalize trade in services on a global basis. At the same time, it needs to do more to understand the nature of services, the critical factors, and life cycle patterns that are at the heart of achieving

service innovation and service excellence. Singapore can also use the knowledge to explore barriers and enablers to exporting services. Service science provides a means by which Singapore can become a global knowledge center in education and research, which will help it become a global leader in service excellence and services innovation.

Questions for Singapore

Many are familiar with the fable of the blind men and the elephant (see figure below). What advantages can come from recognizing the elephant, versus its individual parts?

“Service science is just _____”



How can the success of local service businesses (such as Singapore Airlines, Banyan Tree Hotels, DBS Bank, Neptune Orient Lines, PSA and SingTel) be leveraged for Singapore’s greatest economic advantage and reputation?

Suppose Singapore became known as a nation with world-class understanding and application of service science. How might that look, and how might that affect Singapore’s role in the global economy?

What does it mean to export services? Early research suggests a nation’s culture (whether high- or low-context) can profoundly impact success in exporting services. How is Singapore positioned to export services, and which approaches can provide maximal leverage?

Codifying knowledge allows us to spread learning from the patterns observed in successful practice. New ideas can come from extending these practices, from a base of knowledge, or from a blank sheet of paper. To which end of this spectrum are Singaporeans better suited, and what are the implications for how Singapore might best pursue service science?

What programmes can the Singapore government put in place that provide an incentive for industry to rotate people from the field into research and teaching assignments at top universities to create stronger industry-academic linkages around service innovation?

What programmes can the Singapore government put in place to establish service science laboratories (service systems engineering and design laboratories) to further enhance students experience on service system improvement projects globally?

What programmes can the Singapore government put in place to encourage the creation of intellectual property and patents that improve service system performance (e.g., productivity, quality, regulatory compliance, and sustainable innovation)?

How can Singapore's Institutes of Higher Learning (IHLs) rise to the challenge of bridging academic silos, to ensure that its students have the right skill sets to compete in a globally interconnected world?

How can Singapore IHLs meet the demands of industry that is increasingly shifting to a service oriented business model?

How can Singapore IHLs teach entrepreneurship and leadership in service based industries? What knowledge and skills are needed to succeed in it?

What is the most effective way for Singapore to leverage current world-renowned thought leaders in Services to the nation's best advantage?

Conclusion? Up to Singapore

Hopefully this draft and the above questions provoke a healthy discussion and debate. Once Singapore as a nation has decided whether and how to act on this opportunity, it can apply its considerable resources, renowned discipline, and laser focus to rapidly mobilize its agencies, institutes of higher learning, and industries.

For Singapore a recommended path forward includes:

- Government needs to make service innovation a bigger priority, as change accelerates and provide funding to seed research and education in service science – GDP growth depends on it. Government policy should more highly prioritise multidisciplinary services research and education centres. Industry, academics, and government need to work more closely together to articulate the need and the potential national and global benefits.
- Businesses need to share more of their data. Businesses should be investing more to make innovation in services more systematic. Vast quantities of service data are generated by the business world every day, and yet precious little is being leveraged by research institutions.
- Academic silos should be bridged. There is an opportunity at the intersection of social sciences, business schools, and science and engineering schools:
 - (1) To create a unified theory of service system evolution, management and design
 - (2) To graduate professionals that better meet the needs of society (highly interconnected, rapidly changing).

IBM stands ready as an active partner to help Singapore realize its own path, once chosen, in pursuing service science.

Appendix: IBM teams up with governments and universities in Asia Pacific to drive SSME

Harvard Business Review called services science one of the "Breakthrough Ideas for 2005."

Just as IBM was integral to the creation of computer science as an academic discipline in the 1950s, we are now playing a key role in making SSME an effective approach to services innovation.

As many countries in the Asia Pacific are transforming themselves into services-led economies, it is important for the governments and businesses to prepare their people in terms of skills, mindset and culture. That IBM's business has shifted to a predominately services-led model gives IBM unmatched depth of knowledge and experience to drive the adoption of SSME curriculum in the region. IBM wants to play a vital role, as a newly-defined corporate citizen, and collaborate with key stakeholders in the ecosystem to develop the human resource skills required in a services-led global economy.

Australia

Deakin University has created a specialization in services science management and engineering, with an IT service management focus, in its master of IT program. The specialization consists of four units in the master program. It can also be studied as a stand-alone graduate certificate.

The University of Sydney has also moved into the field, bringing a postgraduate course called services sciences, management and engineering into its curriculum this year.

Greater China Region - China

In early 2006, Tsinghua University (THU) and Peking University (PKU) started offering Service Science Management and Engineering courses to graduate students and PhD candidates from IT and Management Schools of those two universities. The classes are conducted by senior researchers of IBM China Research Lab and key university professors. The pilot program has been extended to multiple universities in 2007 including Chinese University of Hong Kong.

IBM and the Ministry of Education signed a Memorandum of Understanding late last year which would lead to the creation of a new academic discipline within Chinese Universities -- Service Science, Management & Engineering (SSME). The Ministry of Education and IBM hope to initiate an SSME curriculum within two to three years at 50 leading universities across the country. IBM will share knowledge, teach skills, furnish case studies and teaching materials and conduct joint research with the universities. As it trains faculty members, it will introduce teaching materials and best practices from its operations around the world.

In November, 2006, IBM co-hosted the 2006 Asia Pacific Symposium on Services Science, Management and Engineering with Tsinghua University in Beijing. More than 200 researchers and professionals from government, academia and industry met to discuss issues and share their insight, research and experiences in the areas of services science, management, engineering, solutions, education and policy.

Greater China Region – Taiwan

In March, 2006, National Cheng Chi University (NCCU) offered an SSME curriculum to post-graduates. In December, 2006, National Tsing Hwa University (NTHU) announced that it will establish a graduate school on Service Science in Taiwan.

In December 2006, the Taiwan government hosted the first SSME e-Policy Forum in the island. Also, Institute for Information Industry (III) and Industrial Technology Research Institute (ITRI) were funded by the government to focus on IT-enabled services and “Software as a Service” research.

In July, 2007, Paul Kontogiorgis, IBM SSME Ambassador and IT Services Curriculum Program Director, gave a keynote speech to the think tank at Chung-Hwa Institute for Economic Research. This was followed by the visit of Nick Donofrio, Executive VP, Innovation & Technology, IBM, in August. Nick delivered a speech concerning SSME at a public forum attended by more than 400 leaders from the academic field as well as various industries in Taiwan.

India

IBM and the Indian School of Business (ISB) signed a Memorandum of Understanding in April, 2007, for a joint research to develop a first-of-its kind 'Research on Service Science Management and Engineering' (SSME) in India. As part of this initiative, ISB and IBM will create cutting edge research and develop case studies to streamline service processes and replicate them across industries.

In June, 2007, at the first India Service Science, Management, and Engineering - 2007 conference held in Bangalore, IBM announced collaborative SSME curriculum initiatives with leading business and tech schools in India, including Indian Institute of Management-Bangalore, IITs and Indian Institute of Science. Specific cooperation with various institutions:

- **National Institute of Design (NID)** and IBM will jointly study design phase of services across different industry verticals to develop services design jumpstart framework which will help to benefit IT service curriculum development.
- **SP Jain Institute of Management & Research, Mumbai (SPJIMR)** and IBM will study IT deployment services management model, and the study results will help SPJIMR and IBM to develop a courseware in services design.
- **Nirma Institute of Management (NIM), Ahmedabad**, has teamed with IBM to study managed deployment of eGovernance services. The study result is expected to provide guidance in managing the IT-based system deployment of eGovernment projects particularly in the area of citizen services and to contribute in developing a courseware on the eGovernance services.
- In August, 2007, two Services Supply Chain Workshops were held in Mumbai and New Delhi on August 7&8. The workshop titled, “Integrated Services Supply Chain Management”, was hosted by SP Jain Institute of Management & Research in Mumbai, and the Faculty of Management Studies (FMS) in New Delhi. The agenda included an overview of services supply chains, how they differ from traditional supply chains, and business value in services supply chain management. In Mumbai, 236 students and faculty members attended from 12 business schools. In Delhi, 177 students and faculty members attended from 5 business schools.

Korea

In April, 2007, sponsored by Ministry of Finance and Economy), various government departments in Korea (Office of the President, Ministry of Finance and Economy, Ministry of Commerce, Industry and Energy, Ministry of Information and Communication, Ministry of Health and Welfare, Ministry of Culture and Tourism), Korea Society of IT Services, National Information Society Agency, Universities and IT services companies together held a meeting to discuss the foundation of Service Science National Forum (SSNF). SSNF plans to collaborate with service industries, and conduct research/business activities for service innovation nation-wide. IBM Korea participates in SSNF as a member of committee.

New Zealand

Starting from the second semester 2007, the University of Auckland's Business School offers a postgraduate course in Service Science. In 2006, IBM executives and 26 other academics from around New Zealand and Australia, the University met and discussed how to drive SSME in Australia and New Zealand.

Thailand

In February, 2007, IBM entered into an agreement with four ministries and eight universities under the Ministry of Education in Thailand to establish the "Service Science Collaboration Program", a joint initiative to introduce SSME into mainstream university education. The four ministries are:

- National Science and Technology Development Agency (NSTDA);
- National Electronics and Computer Technology Center (NECTEC);
- Computer Clustering Promotion (CCP) under Ministry of Science and Technology; and
- Software Industry Promotion (SIPA) under Ministry of ICT, and Commission on Higher Education.

In April, 2007, IBM held the SSME Roadmap workshop for over 150 officials from 13 universities and 14 organizations.

The Philippines

IBM has started talks with the Department of Science and Technology to introduce SSME as a new discipline.

IBM is also in discussions with the country's top academic institutions, including the University of the Philippines, Ateneo de Manila University, De La Salle University, Far Eastern University, University of the East, University of San Carlos in Cebu and the Asia Pacific College to explore collaboration in crafting a new curriculum.

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Note: In the US, the University of California at Berkeley has an SSME course and announced an SSME campus director. North Carolina State University started an SSME program in 2006.

Note: The authors of this document welcome comments, suggestions, and feedback, towards the end of more effective consideration and accelerated action, on the service science agenda in Singapore. Contact information follows:

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