

Services Science, Management, and Engineering: A Literature Review in the Perspective of Management Science

Hui-Fen Li^{1,2}, Jian-Jun Wang¹, Hong-Lei Yu¹, De-Li Yang¹

¹School of Business, Dalian University of Technology, Dalian, R.P. China, 116024

²Neusoft Institute of Information, Dalian, R.P. China, 116023

Abstract - Although services science, management, and engineering (SSME) is a new topic to both academics and practitioners, there are still many literature available so far. Since the subject is at the stage of development, a review of the literature on SSME with the objective of knowing what have been done will initiate further research and develop potential opportunities. This paper reviews the literature on SSME using a suitable classification to identify the gap between ideality and practice and to suggest future research directions. The 32 articles on SSME are classified into five categories: SSME overview, services science, services management, services engineering, and SSME education. A comprehensive list of the referenced literature is presented. We hope that the findings of this study will provide useful insight into anatomy of SSME literature and be a good source for anyone who is interested in SSME. The paper also provides some future research and education suggestions.

Keywords - Services science, SSME, literature review

I. INTRODUCTION

There is no doubt that the service economy and service employment is growing rapidly not only in developed countries but also in some of the developing countries, such as China and India. The term “service sector” once was mainly related to unskilled, low-payment, labor-intensive activities in industries such as wholesale and retail trade, hotel, travel guidance, and restaurants. But modern service industries are closely associated with technology/knowledge-intensive service jobs, which are performed by well educated, highly skilled, and ideally paid employees and are characterized by making advanced use of information and communication technologies (ICT).

While academic study on services has a long history which was started in the 1970s and has made a lot of exciting research findings, it is mainly a subfield of marketing in business schools [1]. Nevertheless, modern ICT enabled service innovation patterns are differ somewhat from those of in the manufacturing sector, the later has a high level in-house research and development (R&D) investment while the former relies less on it. Comparatively, innovation in the service sector is dependent on a synthesis of equipment, R&D, ICT, highly skilled workers, business model, and the extent of engaging customer in the service co-production processes [2]. Maglio *et al.* [3] pointed out “service systems are value-creation networks composed of people, technology,

and organizations.” Based on [4], they gave the definition framework of services that involved people, business, products, technologies, artifacts, environment, information, and codified knowledge. A service scientist needs to know deeply the service stakeholders to find out problems and opportunities. He needs also to design a formal service system model and survey the system’s dynamics. That is to say, to explore the value of service systems, we need a synthesis of originally isolated respective subjects or knowledge.

With the leading global corporations, such as IBM, Hewlett Packard, Accenture, Oracle, and EDS, shift their business strategies from product-orientation to service-orientation, the existing college degrees are not compliant with the demand of industries and economy. Universities need to re-evaluate their degree programs in light of these changes [5].

Just like its great effort to facilitate the formation of computer science (CS) discipline in the 1940s, IBM initiated another experiment of developing a new academic field named Services Science, Management, and Engineering (SSME) in 2004 [6]. SSME means that services science is a way to create knowledge about services, and services engineering is a way to use knowledge to create service value, and services management invests to improve the process of creating and capturing service value [3]. “The goal of the SSME discipline is to make productivity, quality, sustainability, learning rates, and innovation rates more predictable across the service sector [7].”

In the next sections, we discuss several streams of literature dealing with SSME from the perspective of management science (MS), and highlight the role that ICT has played in improving services innovation. We use a suitable classification to distribute the papers into five categories and give a comprehensive list of the referenced literature. Finally, we propose some interesting research and education suggestions what the future directions may be for MS scholars.

II. REVIEW METHODOLOGY

To meet the research objectives outlined in section 1, it is necessary to practice a two-step process. The first step is selecting the papers to be included in this review. The second step involves identifying and classifying the selected papers.

To serve our review perspective, we select journals from mainstream MS journals. To ensure that the literature reviewed is as current as possible, the proceedings of influential MS conferences are also examined. We specifically exclude books and doctoral dissertations from our selection process assuming that most book/dissertation authors have produced articles which summarized their research findings. Since SSME has its genesis in 2004 by IBM, the selected publications are considered from 2004 through 2006. To select the papers included in this review, we examine each of the publications and exclude those that are obviously not focused on services science (SS) or SSME. Totally, we review 32 articles and classify them into one of the five categories in term of their subjects: (1) SSME overview (general introduction about SSME), (2) services science (creating knowledge), (3) services management (improving value), (4) services engineering (using knowledge), (5) SSME education (SSME curriculums and students cultivation). We regard this classification framework is just revealed the nature of SSME. Although this search is not exhaustive, it serves as a comprehensive platform for understanding SSME research. During our classification process, once more we find that, while some authors are quite explicit in dealing with a particular question, others are less clear. Identifying the research objectives of these papers necessitates additional judgment and interpretation. Our intent is to place each paper in the single category to which it belonged. Again, this requires us to make some judgments. But if a paper is involved in more than one of our categories and ignoring any category is improper, we place it in the related categories repeatedly.

III. DISTRIBUTION OF ARTICLES BY SUBJECTS

The distribution of articles by subjects is shown in table 1.

TABLE I
CLASSIFICATION OF THE REVIEWED LITERATURE

Classification Criteria	Number of Articles	Percentage of Subjects	Referenced Literature
SSME overview	8	25%	[1,3,5,8,9,14,26,28]
Services science	1	3%	[11]
Services management	20	63%	[2,4,10,12,13,15,16,17,18,19,20,21,23,24,25,29,30,31,32,34]
Services engineering	2	6%	[27,33]
SSME education	6	19%	[1,3,5,8,9,14]

A majority of articles (20 out of 32 or 63% of the total) are related to “services management”. It is not surprising because service is a historical research theme in the mature business discipline, including management,

marketing, operation, human resources, and has been widely discussed by researchers. But we understand that different factors are important at different stages in the development of service economy. In the early stage, service management questions were discussed only from business perspective. But more business-technology synthesis perspectives are expected to be conducted at the current stage.

The second largest number of articles published is associated with “SSME overview”. 25% (8 articles) fall under this category with the ACM service science special articles being the majority. This category is the lowest level of the framework. The article distribution reflects the fact that SSME is a relatively new research area. In the preliminary stage of the development of it, researchers have attempted to know about what SSME is, what is its research scope and its implications to research future, etc.. Also, it is a time to develop a clear conception and framework for SSME.

There are relatively fewer articles on “Services education” (6 articles, 19% of the total). We understand this situation caused by the same reason of the initial development stage of SSME. Only a few universities are paying intensively attention to SSME program education and most of them are supported by IBM Corporation [6].

Because our literature review is from the perspective of MS and the search scope is limited to the field, some articles published in CS journals and conferences have not been searched. So the articles dealing with “Services engineering” mainly in the computer technology and science area may be excluded in our review. We do not find many articles on “Services engineering” (only 2 articles).

Finally, we find few articles on “Services science”, which means creating new knowledge with technology-business combined systematic methodologies. We conclude all the reasons mentioned above. During the infant stage of SSME, creating new knowledge is more difficult than improving technology and process. The former requires innovative composition of business knowledge, technology knowledge, and social-organizational knowledge. And that is just the prime intention of SSME proposition [7]. Again, our search scope described in the last section may distribute to the situation given that research on “Services science” is absolutely multidisciplinary and it is possible that related articles are published in the journals on computer technology and science field.

IV. IMPLICATIONS

SSME has attracted the attention of both practitioners like IBM and academics such as UC Berkly, Arizona State University, Carnegie-Mellon, Massachusetts Institute of Technology, Oxford, Tsing Hua, North Carolina State University, Georgia Tech, San Jose State University and Stanford [7]. In particular, research activities on SSME have increased significantly after 2005.

We believe that SSME is becoming increasingly pervasive to facilitate modern service economy growth rapidly. This paper reviewed 32 articles on SSME published from 2004 through 2006 in mainstream MS publications. Although this review does not claim to be exhaustive, it does provide insight into SSME and its research.

In addition to the above implications, we would like to offer the following suggestions for further directions on SSME for MS scholars.

Based on services innovations are intensively associated with ICT innovations and adoption and diffusion of ICT, there is a rich context for MS researchers on services design, services development, services marketing, services delivery, services management, and services operation from behavioral, economics, technical, and organizational perspectives. Some classical research topics may be re-explored from these new perspectives, and we believe that some interesting even exciting conclusions may be found. Finally, since that both service economy in macroeconomic level and service innovation in organizational level is strongly depended on well-educated talent, we should take more efforts and actions rightly to facilitate education innovation and curriculum reformation on SSME.

Our future research should be conducted into a extended one that includes detailed review for each of the representative papers to highlight their contributions.

REFERENCES

- [1] M. J. Bitner, and S. W. Brown, "The evolution and discovery of services sciences in business schools," *Communications of the ACM*, vol. 49, no. 7, pp. 73-78, 2006.
- [2] J. Sheehan, "Understanding service sector innovation," *Communications of the ACM*, vol. 49, no. 7, pp. 43-47, 2006.
- [3] P. P. Maglio, S. Srinivasan, J. T. Kreulen, and J. Spohrer, "Service systems, service scientists, ssme, and innovation," *Communications of the ACM*, vol. 49, no. 7, pp. 81-85, 2006.
- [4] J. Cadrey, and F. Gallouj, *Productivity, Innovation and Knowledge in Services: New Economic and Socio-Economic Approaches*. Edward Elgar Publisher, UK, 2002.
- [5] S. Allen et al., "Service science, management and engineering curricula and research at nc state university," www4.ncsu.edu/~hp/ssme1.pdf, 2006.
- [6] "Services sciences, management and engineering," <http://www.research.ibm.com/ssme>.
- [7] "What is SSME?," <http://www-304.ibm.com/jct09002c/university/scholars/skills/ssme/index.html>.
- [8] H. Chesbrough, and J. Spohrer, "A research manifesto for services science," *Communications of the ACM*, vol. 49, no. 7, pp. 35-40, 2006.
- [9] J. Zysman, "The algorithmic revolution-the fourth service transformation," *Communications of the ACM*, vol. 49, no. 7, pp. 47-48, 2006.
- [10] R. T. Rust, and C. Miu, "What academic research tells us about service," *Communications of the ACM*, vol. 49, no. 7, pp. 49-54, 2006.
- [11] A. Sheth, K. Verma, and K. Gomadam, "Semantics to energize the full services spectrum," *Communications of the ACM*, vol. 49, no. 7, pp. 55-61, 2006.
- [12] B. Dietrich, "Resource planning for business services," *Communications of the ACM*, vol. 49, no. 7, pp. 62-64, 2006.
- [13] W. B. Rouse, and M. L. Baba, "Enterprise transformation," *Communications of the ACM*, vol. 49, no. 7, pp. 67-72, 2006.
- [14] S. I. Feldman, K. S. Nathan, T. Li, K. Hidaka, and C. Schulze, "The clarion call foe modern services: china, japan, europe, and the U.S.," *Communications of the ACM*, vol. 49, no. 7, pp. 86-87, 2006.
- [15] D. J. Morrice, E. G. Ahderson, and S. Bharadwaj, "A simulation study to assess the efficacy of linear control theory models for the coordination of a two-stage customized service supply chain," in *Proc. of the 2004 Winter Simulation Conference*.
- [16] K. Sengupta, D. R. Heiser, and L. S. Cook, "Manufacturing and service supply chain performance: a comparative analysis," *The Journal of Supply Chain Management*, fall, pp. 4-15, 2006.
- [17] L. M. Ellram, W. L. Tate, and C. Billington, "Understanding and managing the services supply chain," *The Journal of Supply Chain Management*, fall, pp. 17-32, 2004.
- [18] V. Venkatesh, "Where to go from here? thoughts on future directions for research on individual-level technology adoption with a focus on decision making," *Decision Science*, vol. 37, no. 4, pp. 497-518, 2006.
- [19] D. D. Waart, and S. Kemper, "Five steps to service supply chain excellence," *Supply Chain Management Review*, Jan./Feb., pp. 28-35, 2004.
- [20] J. J. Chamberlain, "A real-life success story," *Supply Chain Management Review*, Sep., pp. 38-44, 2004.
- [21] K. Ruggles, "Technology and the service supply chain," *Supply Chain Management Review*, Oct., pp. 12-15, 2005.
- [22] T. Abe, "The development of service science," *The Japanese Economy*, vol. 33, no. 3, pp. 55-74, fall 2005.
- [23] H. Demirkan, and H. K. Cheng, "The risk and information sharing of application services supply chain," *European Journal of Operational Research*, in press.
- [24] N. Seth, S.G. Deshmukh, and P. Vrat, "A framework for measurement of quality of service in supply chains," *Supply Chain Management*, vol. 11, no.1, pp. 82-94, 2006.
- [25] T. Itata, T. Mikola, A. Virtanen, and P. Asikainen, "Seamless service chains and information processes," in *Proc. of 38th Hawaii International Conference on System Sciences*, 2005.
- [26] L. D. Paulson, "Services science: a new field for today's economy", *Computer*, IEEE Computer Society, Aug. pp. 18-21, 2006.
- [27] U. Schultze, and W. J. Orlikowski, "A practice perspective on technology-mediated network relations: the use of internet-based self-serve technologies," *Information Systems Research*, vol. 15, no. 1, pp. 87-106, 2004.
- [28] A. Rai, and V. Sambamurthy, "Editorial notes—the growth of interest in services management: opportunities for information systems scholars," *Information Systems Research*, vol. 17, no. 4, pp. 327-331, 2006.
- [29] E. D. GÜNe, and O. Zeynep A., "Value creation in service delivery: relating market segmentation, incentives, and operational performance," *Manufacturing & Service Operations Management*, vol. 6, no. 4, pp. 338-357, 2004.
- [30] K. Hosanagar, R. Krishnan, J. Chuang, and V. Choudhary, "pricing and resource allocation in caching services with multiple levels of quality of service," *Management Science*, vol. 51, no. 12, pp. 1844-1859, 2005.
- [31] G. Iyer, and V. Padmanabhan, "Internet-based service

- institutions,” *Marketing Science*, vol. 25, no. 6, pp. 598–600, 2006.
- [32] R. T. Rust, and T. S. Chung, “Marketing models of service and relationships”, *Marketing Science*, vol. 25, no. 6, pp. 560–580, November–December 2006.
- [33] C. Anderson, J. A. Rothermich, and E. Bonabeau, “Modeling, quantifying and testing complex aggregate service chains”, in *Proc. of the IEEE International Conference on Web Services*, 2005.
- [34] F. Quinn, “Don’t forget the service supply chain”, *Supply Chain Management Review*, pp. 7, July/Aug., 2004.