

# ***FIS2306H An Introduction to Service Science***

## ***Course Syllabus***

***Winter 2008***

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### ***Course Description:***

Service science is a new, interdisciplinary field that combines social science, business, and engineering knowledge needed for individuals and organizations (private, public, or non-profit) to succeed in the shift to the service and information-based economy.

Even as this new field emerges, there is little agreement on what constitutes a service. Common concepts suggest that services are: intangible, perishable, experiential, and co-produced between consumers and providers. Many services involve information-intensive practices. This course examines services in the context of the information economy.

There is a need for innovation in services to bring social and economic benefit to organizations and individuals. Information-intensive services are especially important. One challenge to systematic service innovation is the interdisciplinary nature of services, integrating across technology, domain-specific issues, and social and cultural implications.

The topic of service science supports the Faculty of Information's vision of providing leadership in the future of information practice as society is transformed by the rise of digital technologies of computation, communication, and information. The second goal of the Faculty of Information is exploring the future of information practice generally. In every global market, the service sector is the fastest growing sector. Service is a major component of information practice in the future. The scale of this growth and speed of labour migration is unparalleled in human history. Organizations and institutions are seeing significant shifts in the amount of their activity which is based in services.

This course covers several aspects of service science including service systems, modeling, innovation, and service oriented architectures. Students will study each of these aspects of services in the context of their field of research (such as library systems, museums and archives, or information systems). This course will investigate the nature of services, the need for interdisciplinary approaches to services innovation, and the technology and tools needed to provide services innovation. Students will review several papers, engage in discussions, facilitate case studies, complete assignments (including use of business modeling tools), given presentations and write a final paper.

### ***Course Objectives***

At the end of this course, students will understand:

- How researchers and practitioners are defining services and service science and the motivation behind the study of service science

- What theories are emerging in the area of service science and how those theories apply to specific kinds of services including current limitations in applying those theories
- The multidisciplinary nature of studying service science and example service science research projects
- How organizations are changing organizationally and through innovative uses of technology and the implications of these changes
- How social computing technologies are providing innovations in services, specifically providing greater opportunities for co-production
- Some modeling techniques for modeling services including hands-on experience with modeling tool(s)
- The general notion of service-oriented computing and how its techniques can be used to architect services

In addition to learning the specific course material, students will also:

- Experience evaluating and critiquing papers and presentations
- Share their knowledge and contribute to the learning of their classmates
- Understand challenges of interdisciplinary research and difficulties of reviewing and critiquing papers in areas outside their field
- Learn what companies feel are important skills for the 21<sup>st</sup> century
- Hear perspectives of business people and practitioners through guest lecturers
- Experience using social computing tools to enhance learning and collaboration
- Practice presenting in front of an audience and answering questions posed by audience members

This course is of interest to students who want to expand their knowledge and skills by reading papers in new areas and experimenting with on-line tools, who want to study an emerging field with potential for future jobs, who want to apply their experience and knowledge in a new environment, and to those who enjoy working collaboratively and participating in group discussions.

## ***Methods***

Lectures, readings and critiques, case studies, guest lectures, hands-on tool experience, contributions to wiki, blog posts, presentations, papers.

## ***Course Requirements***

Students are expected to bring and relate past experiences along with knowledge they are gaining through other courses to the topics discussed in class. The course material will be made available on a wiki and all students will be asked to contribute material and discussion on the wiki as part of class participation. For one assignment, students will be asked to present their assignment as a blog post

and comment on each others' posts. Students should be comfortable reading and critiquing papers, finding resources and information, and with using new software and tools.

## **Course Outline**

This course is broken into four main topic areas each covered in approximately one quarter of the course:

1. Introduction to Services Science, services, service systems: What is it? Why is it important? Interesting? Definitions and theories and how they apply (or not) to real service systems
2. Modeling, analyzing, and optimizing services: review of literature and hands-on experience using software tool(s)
3. Innovation in services: What new ways of doing business or new business models could be used to enhance services? Review of case studies
4. Service Oriented Architectures (SOA) and Service Oriented Computing: How can SOA help implement and architect service systems?

## **Week 1 Introduction and Overview of the Course**

Assignment for the class: Read and come prepared to discuss the following:

- Jim Spohrer, Paul P. Maglio, John Bailey, Daniel Gruhl, "Steps Toward a Science of Service Systems," *Computer*, vol. 40, no. 1, pp. 71-77, Jan., 2007. This gives a perspective of the motivation behind service science and defines service systems as well as giving examples of service systems. It demonstrates the need to bring multidisciplinary approach to service science research.
- Scott E. Sampson, Craig M. Froehle, "Foundations and Implications of a Proposed Unified Services Theory," *Production and Operations Management*, vol. 15, no. 2, pp. 329-343, Summer 2006. This paper brings a management and business perspective and presents a frame of reference for defining services and identifying common attributes in very different kinds of services.
- Amit Sheth, Kunal Verma, Karthik Gomadam, "Semantics to energize the full services spectrum," *Communications of the ACM*, vol. 49, no. 7, pp. 55-61, July, 2006. This paper brings a computer science perspective and provides a semantic way of representing service systems. There are several other interesting articles in this issue of CACM as it is a special issue on "Services Science, Management, and Engineering" for those interested in reading further.

## **Week 2: Overview of Service Science, Definitions and Theories**

- Introduction to Service Science and Service Systems
- Motivation: Why is this topic important?
- Definition: What is a service? What are service systems? How do they relate to existing theories

- Analyzing service systems through 3 readings assigned last week.
- Two Readings assigned for next week on service systems:
  - R. J. Glushko and L. Tabas, "Bridging the 'Front Stage' and 'Back Stage' in Service System Design", Proceedings of the 41st Hawaii International Conference on System Sciences, Jan. 2008
  - J. Spohrer, S. L. Vargo, N. Caswell, and P. P. Maglio, "The Service System is the Basic Abstraction of Service Science", Proceedings of the 41st Hawaii International Conference on System Sciences, Jan. 2008

### **Week 3: Applying Service Science Definitions and Theories**

- Assigned papers are critiqued and discussed
- Analysis of a specific service system presented (collaborative industry / academic service system)
- Assignment 1 assigned: Prepare an analysis of a service system

### **Week 4: Service Science and Modeling**

- Students present their service system analysis and receive feedback from classmates
- Overview of modeling: The motivation for creating a science of services was covered previously in class. This motivation is contrasted with the motivation for an individual business or service organization to improve performance while being able to respond to clients' needs immediately, dealing with suppliers and partners around the clock, seeing increased competition from all over the world, trying to provide predictable results, responding to changing government regulations and requirements, adapting to mergers and acquisitions, while ensuring the ability to provide services to users / clients effectively. These goals require being able to model the organization to understand how it works, who does what, the interactions within and external to the organization, etc.

### **Week 5: Business Process Modeling**

- Example business process presented in detail
- Experiment with business process management video game
- Hands-On Tutorial of IBM's WebSphere Business Process Modeling Tool (Part 1)

### **Week 6: Business Process Modeling**

- Hands-On Tutorial of IBM's WebSphere Business Process Modeling Tool (Part 2 – opportunity to further experiment using it)
- Two readings (papers on modeling) assigned:

- K. Vergidis, A. Tiwari, and B. Majeed, "Business Process Analysis and Optimization: Beyond Reengineering", IEEE Transactions on Systems, Man, and Cybernetics -- Part C: Applications and Reviews, Vol. 38, No. 1, January 2008, 69-82
- R. Aguilar-Saven, "Business Process Modeling: Review and Framework", International Journal of Production Economics, Vol. 90, 2004, 129-149

## **Week 7: Business Process Modeling and Service Innovation**

- Paper critiques presented and discussed
- **Assignment 2:** Having completed the WebSphere Business Process Modeling tutorial, and reviewed papers on this subject, identify 2 questions for Pablo Irassar (guest speaker on Business Process Modeling) that can augment what you've learned
- Guest Lecture on Business Process Modeling by Pablo Irassar, Senior Technical Staff Member and Lead Architect, IBM WebSphere Business Process Management tools (ways in which real world organizations use modeling tools to model organizations, institutions, entities)

## **Week 8: Service Innovation**

- What is innovation, why is it important, how are companies innovating, where do innovations come from
- Examine specific method designed to bring innovations from within an organization through service innovation case study:
  - Case study: "Engineering Systems Solutions to Real World Challenges"  
<http://esd.mit.edu/staging/HeadLine/calendar/2006/101706sanford.html> -- Each student will be asked to come up with 3 points of critique or comment on the case study
- Discussion: Students will be challenged to identify service innovations in their chosen service systems
- Guest Lecture on Service Innovation as differentiated from Product Innovation: Dr. Henry Kim, Assistant Professor, Schulich School of Business

## **Week 9: Service Innovation**

- Guest Lecture Stephen Perelgut from IBM on social computing tools to enhance innovation in services
- Hands-on tutorial using Second Life
- Discussion on use of social computing tools to enhance innovation: New Directions for Social Computing in Virtual Worlds: Applications for Business and Social Sciences
- **Assignment 3:** Students will be asked to look at blogging, virtual worlds, and / or the class wiki and report on how these environments can enhance innovation in a service system.

## **Week 10: Service Innovation and Service Oriented Architectures**

- Automating an Existing Service: An Example of innovation and SOA
- Paper reviewed:
  - N. V. Flor and P. P. Maglio, “Modeling business representational activity online: A case study of a customer-centered business”, Knowledge-Based Systems 17 (2004) 39-56. Presents a method for helping a service business take advantage of interactive capabilities of online technologies
- Group exercise in class (Part 1):
  - Take an existing offline service and collaboratively identify modifications to enhance the service using interactive capabilities of online technologies. Then use the model of symbols and channels presented in the above paper to systematically do the same.
- Guest Lecture on Service Oriented Architectures -- Ross McKegney, Independent Consultant

## **Week 11: Service Oriented Architectures**

- Group exercise in class (Part 2):
  - Take an existing offline service and collaboratively identify modifications to enhance the service using interactive capabilities of online technologies. Then use the model of symbols and channels presented in the above paper to systematically do the same.
- Discussion of final papers / topics / review, etc.

## **Week 12: Wrap Up of Course and Final Paper Presentations**

- Summary of Course and Comparison to other Service Science Curricula:
  - University of California Merced Cognitive Science and Business
  - University of Alberta Computer Science
  - University of California Berkley School of Information:
    - R. J. Glushko, “Designing a service science discipline with discipline,” IBM Systems Journal, Vol. 47, No.1, 2008, 15—27
- First set of final paper presentations

## **Week 13: Final Presentations**

- Second set of final paper presentations

## ***Assignments and Grading***

The course evaluation is made up of class participation, assignments, reading critiques, case studies, and a final paper and presentation. Grades will be assigned accordingly:

### **5% Class participation and discussion**

- Both on-line in the wiki and in-class.

### **25% Assignments:**

- The number and type of assignments will vary depending on availability of guest speakers, numbers of students in the class, and new challenge that come up year to year. Generally, there will be one assignment for each of the four main topics presented in the course. The following assignments are examples of typical ones:
  - **Assignment #1 (15%):** “Service Systems and Service Processes: Applying the Theories Read to Real Systems”
    - **Having read and / or discussed the following papers,**
      - [1] Jim Spohrer, Paul P. Maglio, John Bailey, Daniel Gruhl, “Steps Toward a Science of Service Systems,” *Computer*, vol. 40, no. 1, pp. 71-77, Jan., 2007.
      - [2] Scott E. Sampson, Craig M. Froehle, “Foundations and Implications of a Proposed Unified Services Theory,” *Production and Operations Management*, vol. 15, no. 2, pp. 329-343, Summer 2006.
      - [3] Jim Spohrer, Stephen L. Vargo, Nathan Caswell, Paul P. Maglio, “The Service System is the Basic Abstraction of Service Science”, *Proceedings of the 41st Hawaii International Conference on System Sciences*, Jan. 2008, 10 pages.
    - Students select a service of their choice and analyze it according to several provided criteria that are defined and discussed in the papers. Students are asked to give examples from their chosen service that match the criteria or explain why or how their service doesn’t map to the specific criteria.
    - They first give a presentation in class of a draft of their answers to allow them to receive input and feedback from their colleagues in the class. Then they must submit their analysis in writing incorporating feedback from the class in their chosen format (point form, bullets are fine).
  - **Assignment #2 (5%):** “Modeling Service Business Processes”
    - Having completed the WebSphere Business Process Modeling tutorial, and reviewed papers on business process modeling, students are asked to identify and articulate two questions that will be posed to a guest speaker and business process modeling expert that can augment what they've learned. They are evaluated on the clarity and insight of the questions posed.
  - **Assignment #3 (5%):** “Service Innovation using Social Computing”

- Students are asked to research an innovation in service delivery that uses social computing (one or more of wiki, blog, virtual world, etc.) and write it up in a blog post. They should include the following and anything else they think is relevant:
  - What is the innovation? How does it use social computing techniques / tools?
  - Why is it innovative?
  - How will it improve the service to users?
  - Include links as appropriate
- Students are graded on how well they address the points above, the general quality of the writing, and the blog-style of the post.
- Students are then asked to submit a comment on another person's blog and are graded on its clarity and constructiveness.

## **20% Paper reviews and case facilitations**

- All students in the class will be required to read the papers or the case studies. One student will be assigned to present a critique of the paper followed by class discussion. The way in which reading critiques are presented is up to the presenter (ie, could be powerpoint slides, whiteboard, hand-out, or something creative) but it should follow this outline and will be graded on these aspects
  - Summary of the assigned paper (key points) – briefly
  - Critique of the paper (what was strong, what was missing, etc.) – this should invoke some discussion among the group
  - Discussion of other (potential) relevant readings or concepts or thoughts / ideas – this is a key part of the presentation
- Papers assigned will vary depending on current literature. The following papers and case studies provide examples of the typical ones:
  - Scott E. Sampson, Craig M. Froehle, "Foundations and Implications of a Proposed Unified Services Theory," *Production and Operations Management*, vol. 15, no. 2, pp. 329-343, Summer 2006.
  - Amit Sheth, Kunal Verma, Karthik Gomadam, "Semantics to energize the full services spectrum," *Communications of the ACM*, vol. 49, no. 7, pp. 55-61, July, 2006.
  - Jim Spohrer, Paul P. Maglio, John Bailey, Daniel Gruhl, "Steps Toward a Science of Service Systems," *Computer*, vol. 40, no. 1, pp. 71-77, Jan., 2007.
  - R. J. Glushko and L. Tabas, "Bridging the 'Front Stage' and 'Back Stage' in Service System Design", *Proceedings of the 41<sup>st</sup> Hawaii International Conference on System Sciences*, Jan. 2008.

- J. Spohrer, S. L. Vargo, N. Caswell, and P. P. Maglio, "The Service System is the Basic Abstraction of Service Science", Proceedings of the 41<sup>st</sup> Hawaii International Conference on System Sciences, Jan. 2008.
- Case study: "Engineering Systems Solutions to Real World Challenges"  
<http://esd.mit.edu/staging/HeadLine/calendar/2006/101706sanford.html>
- Case study: "Systems Solutions to Real World Challenges at NYPD: The Real-Time Crime Center"  
<http://esd.mit.edu/staging/HeadLine/calendar/2007/050307onalfo.html>
- Case study: "Engineering Systems Solutions to Real World Challenges in Media and Entertainment: Threshold Animation Studios"  
<http://esd.mit.edu/HeadLine/calendar/2007/032207threshold.html>
- Case study: "Engineering Systems Solutions to Real World Challenges in Healthcare"  
<http://esd.mit.edu/staging/HeadLine/calendar/2006/121406vassar.html>

### **50% Final presentation and major paper (individual)**

- The final paper will describe some facet of service science in the context of information. It can present social issues in services science or relate services science to the students' areas of expertise. It can also investigate a technology or set of technologies that are employed in services or investigate an innovative services model that has not been covered in the course. It should be conference publication length and quality. Suggested Final Paper Topics (these will vary from year to year):
  - Debate: "Is there a science of services" backing up your argument using existing papers. Write a paper about why (or why not) scientific methods can apply to services and give some examples.
  - Identify some processes in a services business, implement them using WebSphere Business Process Modeler (or another tool), and write up a description of the processes, roles, resources, etc. and the decisions used to model them.
  - Innovation in Second Life: Is this Second Life paradigm really bringing value or is it hype? Are there really ways that existing services organizations can take advantage of the Second Life paradigm to create some true innovations in their services? Choose a services business or type of service (existing or made up) and discuss innovation for that services business or type of service in a Second Life environment.
  - Review existing modeling techniques and tools and identify which ones might work best for modeling service systems and why.
  - Service innovation: prepare a survey of social computing innovations in libraries or other service organizations
  - Write a literature review or a survey of a topic area covered in the course.
  - Write a paper about using ThinkPlace as a collaborative architecture. It's a kind of "ideas" marketplace. If you were running a services organization (library, eg) and were looking for ways to get grassroots innovation to the surface, what would you do? What

are the strong points, what could be improved upon? Can you think of other creative ways to achieve this result?

- Students give a presentation to the class 2-3 weeks before their papers are due. It is expected that their classmates will provide feedback and input which can be used in preparing the final paper.
- Depending on the number of students in class, presentations are between 20 and 30 minutes long. Feedback is provided by assigning a subset of class to ask 1-2 questions to the presenter.
- The presentation is worth 10% of the final mark based on the following criteria:
  - Presentation content; Clear objective(s) or thesis stated
  - Effective use of presentation medium and presentation organization; Listeners informed of key ideas to be discussed (i.e., structure); Provides closure for presentation by summarizing main point(s)
  - Quality of verbal presentation; Clear enunciation of words and appropriate volume; Not read from script; Appropriate modulation of voice to maintain listeners' attention; Good use of eye contact with listeners; Delivered in assigned time (i.e., not too long or too short)
  - Creativity in the way presented
  - Effective handling of questions.
- The final paper should be conference paper length and quality (8-10 pages 2-column format). It is worth 40% of the final mark based on the following criteria:
  - Content of the paper: Is the thesis or main point/argument of the paper clear? Are sufficient the pertinent points included, and are they arranged in a logical order?
  - Quality of background research and references
  - Relevance / relationship to the course material
  - Organization of topics presented: Is the paper easy to follow? Does it flow easily from one point to the next?
  - Clearness and quality of presentation; Is each point clearly and completely explained? Quality of sentence structure, spelling, vocabulary

### ***Additional Readings***

The following papers can augment assigned readings and may be included:

Abe, Tadahiko. "What is 'service science?'" Fujitsu Research Institute. 8 March 2005.

S. Alter, "Service system fundamentals: Work system, value chain, and life cycle", IBM Systems Journal, Vol. 47, No. 1, January 2008.

Andriole, Stephen J. "The collaborate/integrate business technology strategy." Communications of the ACM 49.5 (2006): 85-90.

Barothy, Thomas, Markus Peterhans, and Kurt Bauknecht. "Business process reengineering: emergence of a new research field." *ACM SIGOIS* 16.1 (1995): 3-10.

R. C. Basole and W. B. Rouse, "Complexity of service value networks: Conceptualization and empirical investigation", *IBM Systems Journal*, Vol. 47, No. 1, January 2008.

Berg, Daniel and James M. Tien. "Services research and education." Department of Decision Sciences and Engineering Systems: Rensselaer Polytechnic Institute.

Bitner, Mary Jo, and Stephen W. Brown. "The evolution and discovery of services science in business schools." *Communications of the ACM* 49.7 (2006): 73-78.

Bolloju, Narasimha. "Improving the quality of business object models using collaboration patterns." *Communications of the ACM* 47.7 (2004): 81-86.

Caetano, Artur, Antonio Rito Silva, and Jose Tribolet. "Using roles and business objects to model and understand business processes." *Symposium on Applied Computing* (2005): 1308-1313.

N. S. Caswell, C. Nikolaou, J. Sairamesh, M. Bitsaki, G. D. Koutras, and G. Iacovidis, "Estimating value in service systems: A case study of a repair service system", *IBM Systems Journal*, Vol. 47, No. 1, January 2008.

Chesbrough, Henry, and Jim Spohrer. "A research manifesto for services science." *Communications of the ACM* 49.7 (2006): 35-40.

Chesbrough, H. "Breakthrough Ideas for 2005: Toward a new Science of Services." *Harvard Business Review*. Boston: HBS Publishing, February 2005.

R. J. Clarke and A. G. Nilsson, "Business services as communication patterns: A work practice approach for analyzing service encounters", *IBM Systems Journal*, Vol. 47, No. 1, January 2008.

Curtis, Bill, Marc I. Kellner, and Jim Over. "Process modeling." *Communications of the ACM* 35.9 (1992): 75-90.

M. M. Davis and I. Berdrow, "Service science: Catalyst for change in business school curricula", *IBM Systems Journal*, Vol. 47, No. 1, January 2008.

Dietrich, Brenda. "Resource planning for business services." *Communications of the ACM* 49.7 (2006): 62-64.

Fein, Louis. "The role of the University in computers, data processing, and related fields." *Communications of the ACM* 2.9 (1959): 7-14.

Fitzsimmons and Fitzsimmons. *Service Management*. New York, NY: McGraw-Hill.

R. J. Glushko, "Designing a service science discipline with discipline", *IBM Systems Journal*, Vol. 47, No. 1, January 2008.

J. Hickey and J. Siegel, "Improving service delivery through integrated quality initiatives: A case study", *IBM Systems Journal*, Vol. 47, No. 1, January 2008.

Kahn, Beverly K., Diane M. Strong, and Richard Y. Wang. "Information quality benchmarks: product and service performance. *Communications of the ACM* 45.4 (2002): 184-192.

Khalaf, R., Keller, A., Leymann, F., "Business processes for Web Services: Principles and applications", *IBM Systems Journal*, Vo. 45, No. 2, 2006, pp 425 -- 446

Khazanchi, Deepak, and Bjorn Erik Munkvold. "Is information system a science? An inquiry into the nature of the information systems discipline." *ACM SIGMIS* 31.3 (2000): 24-42.

Kim, Hyoundo. "Conceptual modeling and specification generation for B2B business processes based on ebXML." *ACM SIGMOD* 31.1 (2002): 37-42.

R. C. Larson, "Service science: At the intersection of management, social, and engineering sciences", *IBM Systems Journal*, Vol. 47, No. 1, January 2008.

N. Leon and A. Davies, "Managed service paradox", *IBM Systems Journal*, Vol. 47, No. 1, January 2008.

Leymann, F., D Roller, MT Schmidt. "Web services and business process management." *IBM Systems Journal* 41.2 (2002).

R. F. Lusch, S. L. Vargo, and G. Wessels, "Toward a conceptual foundation for service science: Contributions from service-dominant logic", *IBM Systems Journal*, Vol. 47, No. 1, January 2008.

I. Miles, "Patterns of innovation in service industries", *IBM Systems Journal*, Vol. 47, No. 1, January 2008.

Oliva, Rogelio, and John D. Sterman. "Cutting corners and working overtime: quality erosion in the services industry." *Management Science* 47.7 (2001): 894-914.

Orriens, Bart, and Jian Yang. "Establishing and maintaining compatibility in service oriented business collaboration." *ACM International Conference Proceeding Series* 113 (2005): 446-453.

Paulson, Linda D. "Services science: a new field for today's economy." *IEEE Computer Magazine*. August 2006: 18-21.

O. Pitkänen, P. Virtanen, and J. Kemppinen, "Legal research topics in user-centric services", *IBM Systems Journal*, Vol. 47, No. 1, January 2008.

Pitt, Leyland F., Richard T. Watson, and C. Bruce Kavan. "Service quality: a measure of information systems effectiveness." *MIS Quarterly* 19.2 (1995): 173-187.

Rouse, William B., and Marietta L. Baba. "Enterprise transformation." *Communications of the ACM* 49.7 (2006): 66-72.

Rust, Roland. "A call for a wider range of service research." *Journal of Service Research* 6:3 (2004): 211.

Rust, Ronald T., and Carol Miu. "What academic research tells us about service." *Communications of the ACM* 49.7 (2006): 49-54.

Sampson. *Understanding Service Businesses*. New York, NY: John Wiley.

Schmidt, M.-T., Hutchison, B., Lambros, P., Phippen, R., "The Enterprise Service Bus: Making service-oriented architecture real", *IBM Systems Journal*, Vol. 44, No. 4, 2005, pp 781--797

Sheth, Amit, Kunal Verma, and Karthik Gomadam. "Semantics to energize the full services spectrum." *Communications of the ACM* 49.7 (2006): 55-61.

Spohrer, Jim, and Doug Riecken. "Services Science: Introduction." *Communications of the ACM* 49.7 (2006): 30-32.

Spohrer, J. and P. Maglio. "The Emergence of Service Science: Toward systematic service innovations to accelerate co-creation of value." IBM. Manuscript available at: <http://www-304.ibm.com/jct09002c/university/scholars/skills/ssme/emergence.pdf>

Sheehan, Jerry. "Understanding service sector innovation." *Communications of the ACM* 49.7 (2006): 42-47.

C. H. Tian, B. K. Ray, J. Lee, R. Cao, and W. Ding, "BEAM: A framework for business ecosystem analysis and modeling", *IBM Systems Journal*, Vol. 47, No. 1, January 2008.

Tien, J.M. and D. Berg. "A case for service systems engineering." *Journal of Systems Science and Systems Engineering* 12:1 (2003).

R. Verma, G. R. Plaschka, B. Hanlon, A. Livingston, and K. Kalcher, "Predicting customer choice in services using discrete choice analysis", *IBM Systems Journal*, Vol. 47, No. 1, January 2008.