Designing a service science discipline with discipline

R. J. Glushko

This paper relates our experiences at the University of California, Berkeley (UC Berkeley), designing a service science discipline. We wanted to design a discipline of service science in a principled and theoretically motivated way. We began our work by asking, "What questions would a service science have to answer?" and from that we developed a new framework for understanding service science. This framework can be visualized as a matrix whose rows are stages in a service life cycle and whose columns are disciplines that can provide answers to the questions that span the life cycle. This matrix systematically organizes the issues and challenges of service science and enables us to compare our model of a service science discipline with other definitions and curricula. This analysis identified gaps, overlaps, and opportunities that shaped the design of our curriculum and in particular a new survey course that serves as the cornerstone of service science education at UC Berkeley.

INTRODUCTION

While some of the pioneering programs in service education, such as those at Arizona State[1] and the University of Maryland,[2] are now in their second decades, the efforts made by IBM in the last few years have facilitated the emergence of numerous other academic programs in what IBM began to call, in late 2004, *service science, management and engineering*—or simply *SSME*.[3] These initiatives have some similarities, but each is developing a distinct emphasis and character that reflects the academic unit organizing it, its location, its faculty, and the typical companies employing its students.

This paper reviews the effort at UC Berkeley to define service science as a discipline and to develop a curriculum through which we would teach our students the knowledge and skills needed to succeed in the information and service economy. We compared our model of a service science discipline with other definitions and curricula and determined where we were. Our analysis identified gaps, overlaps, and opportunities that shaped the design of our curriculum and especially a new survey course that serves as the cornerstone of service science education at UC Berkeley. We then present our initial experiences in teaching service science and discuss how it inspired and focused some new research about how to define and design services.

CALL FOR A SERVICE SCIENCE

Economic statistics conclusively demonstrate that local, national, and global economies are increasingly based on information and services[4,5] and that

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demand is growing and exceeding supply for people with the knowledge and skills to be effective workers in this new economy.[6–8] A consensus is emerging that the cumulative and interconnected innovations in information and computing technology, industrial engineering, business strategy, economics, law, and elsewhere cannot be described and understood by a single academic discipline.[9–12]

However, the multidisciplinary or transdisciplinary character of the transition to a service-dominated economy makes it intrinsically difficult to define what a new, unifying discipline might look like. In addition, there is substantial academic debate about how to describe the transition and the implications of different characterizations for research and practice.[13,14] This uncertainty and ambiguity is inevitable during the startup phase of any emerging discipline, but it means that calls for new academic programs to train new workers for the new economy are often vague or almost tautological.

The vagueness is apparent in proposals that prescribe *T-shaped people* as the essential workers in the information and service economy. T-shaped people are defined as having strengths in multiple complementary disciplines, but different definitions do not agree on the disciplines and are not grounded in specific bodies of required knowledge and skills. For example, Brown states that T-shaped people ". . . have a principal skill that describes the vertical leg of the T—they're mechanical engineers or industrial designers. But they are so empathetic that they can branch out into other skills, such as anthropology, and do them as well. They are able to explore insights from many different perspectives and recognize patterns of behavior that point to a universal human need."[15] In contrast, IBM has characterized T-shaped skills as ". . . encompass[ing] both deep business skills, represented by the horizontal line of the 'T,' and technical understanding, represented by the vertical line."[16]

Many of the concepts, techniques, and curricula for service design and operations originate in and emphasize person-to-person services. However, they do not fit well when person-to-person services are replaced or complemented by self-service, and hardly fit at all for automated information-intensive services provided by one computational or automated process to another.[17] We might conclude that the word *service*, as in person-to-person services, and *service*, as in service architecture, are homonyms and not try to unify them conceptually and methodologically, but we will make little progress toward a service science if we do not find abstractions that unify them or establish clear boundaries between them.

We can ask whether a call for a service science is a call for a discipline or a call for a curriculum. IBM, among others, has called on universities to train students for new career opportunities in services and urged the creation of a new discipline. Of course, some university business schools have well-established programs in service marketing and service operations. Leading thinkers have begun to consider whether these programs can evolve and expand to treat services as a field of study that, in the words of Bitner and Brown, ". . . cuts across disciplines including management, marketing, operations and human resources."[18] Yet, much of the fastest growth of the service economy is evident in Web-based and computing-intensive domains. This fact calls into question whether a discipline of service science can evolve from business school programs when ". . . the impetus stretches beyond the business disciplines into engineering and computer science, industrial and systems engineering, organization theory, and economics."[18]

It may be true that universities do not recognize the creation and provision of services as a separate field, but Adam Smith, Karl Marx, Frederick Taylor, Alfred Chandler, and numerous others have identified scientific principles and insights about services for centuries.[19] Therefore, a more fundamental challenge to developing service science may be that its intellectual roots are too old and broad to be taught in an integrated way given the inertia inherent in the organization of universities into academic silos (vertically organized, relatively

insular departments). It may be unrealistic to expect a discipline of service science to emerge anytime soon, especially in business programs that have traditions of focusing on person-to-person services.

Rather than calling for a new discipline, some schools are focused on a more limited goal of adapting and expanding current academic programs to incorporate more service-related topics. A 2006 National Science Foundation workshop on *Education for Service Innovation*, for example, listed among its goals:

- To identify and make explicit the knowledge and skills that industry has empirically observed are important to service innovation, and the gaps in our existing curricula
- To outline and debate some initial curricula developments that address the unique educational needs of careers in the service economy
- To identify how existing curricula can be enhanced to enable service innovation knowledge and skills to be acquired.[20]

Just a few months after the NSF workshop, IBM convened a conference on *Education for the 21st Century*. It called for a new discipline and new curricula to be intertwined, but without making it clear which one should be viewed as more central: "... the conference aimed to demonstrate results in the formation of multidisciplinary SSME (including ways SSME has been introduced into curricula, and services research that is under way or is planned), and also to outline a road map for establishing SSME as its own discipline (including how practitioners can join with faculty and administrators to focus efforts on cross-functional, service-oriented courses and research, and recommended actions for academia and governments)."[21]

DESIGNING A DISCIPLINE OR A CURRICULUM?

Does it matter whether we think of service science as a new discipline or as a new curriculum? This section explains why and how it mattered a great deal to us at UC Berkeley.

Discipline

A *discipline* is an integrated field of study defined by some level of agreement about what problems are worth studying, how they should be studied, and the criteria by which findings or theories about those problems are evaluated. The extent of this consensus differs substantially among disciplines because of inherent differences in the extent to which the problems are systematically interrelated—hence the distinction between *hard* fields with robust scientific and rule-governed foundations and those with a more qualitative character.

Even in hard disciplines, however, the structure of the field is not necessarily logical and coherent. The concepts and principles of a discipline sometimes reflect the views of the winners of intellectual or professional battles about how to study the key phenomena or problems. In the words of Light, Jr., "Most of the disciplines today are an accumulation of historical accidents and arbitrary turns made by the head of the academic profession as it blindly snaked its way through the city of knowledge."[22]

The scopes or jurisdictions of disciplines, or the boundaries between them, are never exact; Abbott describes "... continuously negotiated and contested professional divisions of labor."[23] But despite the arbitrariness over time and the inexactness of interdisciplinary boundaries, the structure of disciplines becomes deeply embedded in academic curricula and degrees in many ways: licensing and regulation for professional practitioners, standards and patterns of publication and citation, and the requirements for predictable hiring, tenure processes, and granting of degrees. Mechanisms for research funding by governments and grant agencies are usually tied to disciplinary structure, adding another constraint on disciplinary evolution.[24]

In *The Structure of Scientific Revolutions*,[25] Kuhn shows that the consensus defining a discipline is not necessarily permanent and that new disciplines occasionally emerge. The current discussion about whether there could be a service science is happening now because of the growing recognition that many aspects of the information and service economy cannot be completely understood from current disciplinary perspectives.

Curriculum

A *curriculum* is a program of study to instill in students some specified body of knowledge or skills. A curriculum contrasts with a discipline because there is no inherent requirement that the different topics in a curriculum exhibit any degree of integration.

Academic curricula are often designed to lead to a certificate or degree, in which case they usually include some topics that, by disciplinary consensus, must be included. Yet there are usually many curricula in a given discipline, even in the same institution. The differences in coverage or treatment of a discipline in the curricula reflect the institution's distinct emphasis and character, which emerges from its history, location, faculty, and the typical employers for their students. Prospective students, employers, and professors can rationally prefer one institution or degree program over another on the basis of how well a chosen curriculum exploits these distinctions as sources of comparative advantage.

These comparisons among inter- and intra-institutional curricula are possible, however, precisely because of the reference model provided by the consensus about the discipline. This model is what enables meaningful comparisons about topical inclusion, breadth compared with depth of coverage, methodological approaches, industry focus, and other curricular dimensions.

Bootstrapping at UC Berkeley

Whether a goal involving service science is to design a new discipline or to design a new curriculum, by definition it requires collaboration among people from different disciplines. UC Berkeley has a strong tradition of interdisciplinary work that encourages faculty from different disciplines, especially senior faculty, to collaborate, and some academic units, such as the School of Information, are themselves highly interdisciplinary.

IBM played a crucial role in promoting collaboration among UC Berkeley faculty. In 2003–2004, IBM invited several UC Berkeley faculty members in business, engineering, economics, and information management and systems who had previously collaborated to participate in various IBM-sponsored conferences and workshops,[26,27] including the Architecture of On Demand Business summit, hosted by Paul Horn, Senior Vice President, IBM Research Division, in May 2004. These events brought together many academic and industry researchers and consultants to discuss topics that were slowly but steadily coalescing into the new field of service science. In retrospect, we can see that these events were critical to our efforts at UC Berkeley because they stimulated us to begin talking with one another for the first time, and we continued the conversation when we returned to campus. A core of UC Berkeley faculty who had a degree of interest in SSME emerged and began to meet periodically.

From late 2004 to early 2005, partly motivated by the UC Berkeley faculty participation in the IBM conferences and workshops, a series of executive-level meetings between UC Berkeley and IBM took place. These led the UC Berkeley Dean of Engineering to propose an SSME initiative[28] hosted in the system-wide UC Center for Information Technology Research in the Interests of Society (CITRIS). Soon thereafter, an Executive Director was hired for the CITRIS SSME activity, and he has since continued to advance the cause for service science on and off the UC Berkeley campus. However, the shape of service science at UC Berkeley has been determined mostly by self-organizing activities by faculty rather than by central direction.

By mid-2005, five UC Berkeley faculty were directly involved in occasional discussions about service science: the author, AnnaLee Saxenian and Larry Downes from the School of Information, Henry Chesbrough from the Haas School of Business, and Rhonda Righter from Industrial Engineering and Operations Research. Our collective expertise is in business process and document modeling for service architectures, system design, Web-based service implementation, globalization, the coevolution of law and technology, innovation, and optimization.

One of our first work products was an inventory of about 20 courses being taught at UC Berkeley, including seven taught by us, that at face value could be included under service science. To have specified that the service science curriculum at UC Berkeley consisted of the set of courses we were already teaching would have reflected the timeless truth of Conway's Law—that the default structure of a solution mirrors the organizational structure of the entities that come together to build it.[29] A temptation in such an approach was that it would enable us to begin the process of establishing a certificate program, modeled after the Management of Technology program at UC Berkeley,[30] through which graduate students in the engineering, business, or information schools could earn a distinction for interdisciplinary study above and beyond their separate master's degrees.

However, such a modest repackaging of our existing courses would not have given us any new understanding about what service science might be. More importantly, if we aimed only to define a curriculum without the frame of reference provided by a model of a discipline, we would have no clear path for its evolution or a means to compare it with service science efforts elsewhere.

We had planned to use our own list of courses as a checklist against which to compare the curricula being proposed at other universities. However, this turned out to be surprisingly difficult and not entirely useful. Course names and descriptions embody the concepts and jargon of the institutions and faculty offering them. Because service science is new and imprecisely defined, we had no framework with which to compare courses to establish the equivalence between a UC Berkeley course and those from other academic institutions. Indeed, the very fact that several faculty members from different disciplines had come together for these discussions meant that we were accepting, on faith, that service science had some theoretical foundation that could not be discerned within our respective disciplines of computer science, engineering, law, management, and organizational sociology. However, we resisted the chance to declare, based simply on the fact of our diverse backgrounds and experiences, that service science was a composite discipline whose components were those we collectively brought to the table. We wanted to design a discipline of service science in a more principled and theoretically motivated way. We decided to invest a significant effort in understanding the perspectives from which each of us viewed service science and use that as a starting point to consider it as a discipline.

We read each other's new books[31–33] and from time to time sat in on each other's courses. Building on these interactions, Henry Chesbrough taught a new course, Service Innovation, in the spring of 2006 in which another one of us gave guest lectures for three weeks. By then the occasional meetings of the five faculty had been further institutionalized as a weekly seminar meeting of two professors and three graduate students, with the other UC Berkeley professors in our original working group continuing to serve as consultants. Like those of the faculty, the backgrounds of the three students were diverse, encompassing computer science, industrial engineering, and social science.

Our effort to identify the crosscutting issues and questions that span the foundation disciplines of service science has been intellectually provocative and promising. We suspected when we started that this analysis would not be easy, and that we might end up with a model of service science that did not completely fit our existing competencies and courses. We were right. It has not been easy, and the fit between where we are and where we want to be is not perfect, but we now have a clearer view of how to proceed.

DIMENSIONS OF A DISCIPLINE

We cared relatively little about the institutional form that service science might take at UC Berkeley, but we cared immensely about the intellectual form. We wanted the design of this prospective discipline to be inclusive and neutral, not biased toward or against any existing discipline or approach.

From our original, imprecise goal of thinking about what a service science discipline might be, a more precise objective of devising a new framework for understanding service science emerged. The most obvious purpose for this framework was the systematic organization of the topics we had identified as being relevant to service science. This would enable us to compare courses and curricula and identify gaps and overlaps, which we might then remedy in our own courses and curricula. Somewhat unexpectedly, we discovered that the new framework helped us identify promising areas for research.

Questions for service science

Instead of beginning with one of our existing courses that addressed some aspect of services, we started with a blank slate and asked, "What questions would a service science be expected to answer?" We thus avoided debates about service categorization, which would have been easy to fall into and unproductive.

Framework for questioning

Our goal of identifying broad questions about services led us away from a "domain-centric" view characterized by identifying different service domains, such as financial services, health-care services, or educational services. We still had to

choose a framework, however, and we considered several of them.

Many researchers and practitioners in service design and operations seem to view it as unquestioned dogma that a customer-centric approach is inevitable and essential.[34] However, while a focus on the customer and customer interactions (the *front stage*) has been shown to contribute to quality in person-to-person services,[35] it is not straightforward to apply the same focus to the design of self-service and automated information-intensive services.[17] Especially in the case of computational services, there is substantial value in design methodologies and representations of service models, such as UML (Unified Modeling Language) sequence diagrams,[36] that treat every actor, whether human or computational, with a role in the service system in a more balanced way, including those far removed from customer interactions (the *back stage*). Other researchers, such as Nigam and Caswell[37] and Shapiro et al.,[38] promote design techniques and representations that highlight the information artifacts whose creation or transformation are the results of the service.

Service life-cycle framework

In the end, we decided on a life-cycle framework for organizing the questions we thought a service science should address. This perspective seemed more robust, generative, and abstract than the other approaches we considered, and thus could be applied to a broader set of services.

The questions that can be asked about a service science inquire about some activity in the life cycle of a service. We can ask, *How is a service. . .?* and then fill in the blank with: *designed, planned, forecasted, specified, provisioned, composed, integrated, deployed, delivered, managed, certified, used, reused, evaluated, optimized, archived*, et cetera.

This list, while far from complete, illustrates that a very large number of activities or processes could be important parts of the life cycle of a service or set of services. Because services can be people-to-people, people-to-technology (self-service), or computer-to-computer (e.g., Web services), a variety of methodologies apply to the service life cycle. These methodologies partition the life cycle differently, use different words to talk about each activity, and make different design decisions and trade-offs.

For example, the field typically called *service operations* or *service management* organizes the service life cycle for person-to-person services into three key stages: service concept, service content, and service style.[39] Because person-to-person services involve a substantial amount of coproduction between the service provider and service consumer, the design and specification stages of the service life cycle are relatively less important than the delivery stage. According to this perspective, many of the key design decisions relate to the intensity of the service encounter or experience, because that strongly influences how usable, enjoyable, customized, and responsive the service appears to the service consumer. Service quality is highly subjective and is measured from the perspective of the service consumer.

In contrast to service operations, the service-oriented architecture (SOA) perspective that underlies the design and deployment of Web-based services views the service life cycle in a nearly opposite way.[40] SOA methodologies emphasize service design because precise, modular, specification-of-service interfaces and outputs are essential for reuse and interoperability. Instead of the highly variable experience of person-to-person services, service delivery in an SOA context is efficient and scalable. Service quality is objectively measured and often governed by service-level agreements that emphasize activities and measurements of the service provider.

Our evaluation of the service life cycle from different perspectives forced us to confront the semantic challenge of harmonizing the conceptual and linguistic categories of different disciplines so that we could frame questions in ways that all of us could accept and understand. This harmonization, and the merging of specific activities into more abstract ones, gave us a more general life-cycle model whose activities could apply to all kinds of services. The life cycle and associated activities are shown in the first two columns of ***Table 1***.

The innovation life-cycle stage, for example, includes activities for determining requirements and experimenting with or prototyping solutions that satisfy those requirements. Similarly, the realization stage centers on the construction of the designed service. This stage might be limited to training of service personnel for person-to-person services, but

Table 1 The discipline-by-life-cycle matrix

		D1	D2	D3	...
Strategy	Planning				
Design	Innovation				
	Specification				
	Composition				
	Realization				
Operation	Deployment				
	Management				
	Evaluation				
	Optimization				
	Evolution				

would include software design, implementation, and testing for Web-based services, or the configuration of equipment for technology-based self-service designs.

Disciplines and the service life cycle

We then turned to the challenge of considering which disciplines could provide answers to the questions that spanned the service life cycle. We began with our own disciplines of computer science, engineering, management, business strategy, law, and organizational sociology. We applied a simple *Did they have something to say?* test to each of them with respect to the questions. We visualized this work as adding a column to produce a discipline–by–life-cycle matrix (Table 1).

An example of a core question about service operation is to ask how different disciplines or perspectives evaluate a service. The following are some examples of answers:

- A business strategy perspective might focus on market share or return on investment
- A business operations view might emphasize benchmarking or capability maturity
- Industrial engineering and operations research might rely on techniques for modeling and measuring service performance and quality
- An information systems perspective might monitor conformance to a service-level agreement
- A legal perspective might be concerned with compliance and competence
- An economist might look for market failures.

Another example of a core question in service design is to ask how and when a service is composed or created out of other services. We realized that parts of the answer were provided by different disciplines, such as the following examples:

- Business strategy answers the question using the concept of core competency
- Business operations provides insights about organization design, outsourcing, and supply chains
- Computer science and information systems address composition with concepts of service architecture, modularity, reuse, application interfaces, and interoperability
- User-centered design emphasizes issues about the interaction design and usability of the composite service.

As we identified potential contributions from different disciplines, we often perceived ways in which their different disciplinary concepts and concerns interacted. This reinforced our conviction that service science might be more than the sum of its parts.

Finally, our analysis suggested that we needed to augment the service life-cycle model with a more diachronic or historical perspective about the emergence and evolution of service as an economic and technological category. Thus, we added some additional questions, such as *How have the concepts and methods that each discipline brings to the service life cycle changed over time?* and *How does each discipline describe how firms encode what they learn in new mechanisms, organizational forms, or information technology?*

USING THE LIFE-CYCLE FRAMEWORK

We are not yet satisfied with our framework for a service science discipline. This is why we presented a conceptual view of the matrix in Table 1 rather than the one we have been developing. Our current *something to say* test is too low a threshold; it does not help us determine the priority or criticality of each of the answers to the service life-cycle questions from the viewpoint of each discipline. In addition, while the rows and columns of the matrix generate a set of topics and provide some sense of their relationships, they do not suggest an order in which to teach them. Finally, we admit to some difficulty maintaining clear boundaries between our candidate disciplines when we identified concepts and meth-

ods for answering the life-cycle questions. In particular, while we wanted to enforce some distinction in perspective between business strategy and business operations and between computer science, information science, and information technology (IT) perspectives, we were often unable to do so. We iterated over the number and names of the columns representing the candidate disciplines but were unable to converge on a model that satisfied us.

Nevertheless, taking a systematic and principled approach to ask *What is service science?* made us think about our disciplines in new ways, so, while we are not ready to publish our matrix as a definitive road map, we strongly recommend that others designing a service science program undertake a similar assessment of where they are and where they might want to go.

We spent much of the first half of 2006 analyzing and deliberating to develop this new framework for understanding service science, which we called *the matrix*. We had hoped to establish it as a model that would be objective and robust enough for us to use in deconstructing the inventory of UC Berkeley courses we had identified the previous year.

This analysis was sobering. We had developed the inventory of about 20 courses when we had only a vague notion of the scope and dimensions of service science. Now that we had a more refined understanding, we saw that only a handful of the courses fit clearly defined places in the matrix. In most cases, these were the courses that we had ourselves designed or were currently teaching, including courses on Web services, document engineering, technology management and strategy, and innovation. Most of the other courses in our inventory were not as service-related as we had thought. We concluded that we had engaged in some wishful thinking when we assumed that courses focusing on product design or engineering could easily be recast as service-related.

We also used the matrix to analyze the curricula others had proposed for service science. Given the lack of a reference model for a service science discipline, we expected that different service science curricula, like the set of courses we had identified at UC Berkeley, would also show limited coverage of the topics defined by our matrix. The summary of our analyses follows:

- Most service science curricula are in business or management schools and focus on traditional areas of service marketing, management, and operations. These programs emphasize person-to-person services and human resource issues, and de-emphasize technology issues. They have little coverage of informatics, software, or Web-based service design and implementation.
- Programs centered in industrial engineering or decision science have much greater coverage of the technical topics in service design, evaluation, and optimization, but approaches such as queuing theory and discrete-event simulation are too abstract to include the human dimension in service design.
- Programs with core competencies in user interfaces and human-computer interaction focus on service experience design, but do not situate these topics in the broader context of business strategy or service management.
- Not surprisingly, the curriculum at the first research university in the United States to develop a master's-level curriculum initiative in service science—North Carolina State University[41]—covers more of the matrix than any other program, but it still lacks coverage of the economics and policy topics.

The framework for the service science discipline represented in the matrix made these contrasts easy to see. Our analysis demonstrated that it is challenging—or maybe even impossible—for a single institution to propose and deliver a comprehensive curriculum in service science. Nevertheless, we decided to see what we could do.

UC BERKELEY SERVICE SCIENCE CURRICULUM

The analysis of our existing courses and of other service science curricula made us realize that a course which provided an introduction to the service science discipline had yet to be developed. We decided to use our matrix to guide the design of such a course. This survey course could then serve as the foundation for specialized courses that systematically covered the topics defined by the matrix.

"Information and Service Economy" foundation course

In the summer of 2006, we developed a new one-semester survey course titled "Information and Service Economy,"[42] which serves as the foundation

of our master's level Information and Service Design program.[43] Sometimes survey or foundation courses are presented as a set of separate topics, each taught by a different expert. This provides the most competent and rigorous coverage of each topic, but at the cost of being weak in demonstrating linkage among the topics. Of course, a very ambitious or confident instructor might attempt to teach a survey course alone. This approach typically yields a course in which some topics are covered with expertise but others in less depth.

For a new candidate multidisciplinary field, it is impossible almost by definition for one person to teach a survey course well. The only reasonable approach is a middle ground in which the survey course is taught by a team of instructors, each of whom is an expert in some of the topics. This approach should result in individual lectures of a higher than average quality because each is taught by an expert. It should also result in richer integration and coverage of linkage among the topics—at least if all the instructors attend all the lectures and learn from each other.

Perhaps the service science of education will someday have developed techniques for determining the optimal number of instructors for a survey course. Our solution was determined by a more pragmatic constraint: Only two professors were available and willing to take on this challenge. These were the author of this paper, a cognitive scientist, software engineer, and entrepreneur, and AnnaLee Saxenian, an economist and political scientist whose research focuses on how institutions and social structures shape patterns of information exchange and innovation. Our complementary competencies covered a substantial number of the topics in the matrix, but there were still topics that neither of us knew well, let alone had taught before.

We designed the course as a survey of the emergence of the information and services economy through a review of literature from the numerous disciplines embodied in our matrix. Even though the matrix provided a set of topics and some idea of their relationships, it did not give us much direction about specific readings and how best to order them in a syllabus. We finally decided to start with broad, framing ideas and classic papers (by authors such as Adam Smith, Karl Marx, Ronald Coase, and Peter Drucker) from the fields of economics and organizational theory about the nature of work and how it is organized. We taught how technology, business architectures, and the law coevolve to explain the progression from the manufacturing era to the 21st century, with service-intensive businesses whose componentized functions are globally distributed, on demand, and often Web-based. We took a top-down approach that briefly introduced service design and the service life cycle, but we intentionally deferred details of methodology and technology to more specialized courses.

■ We might posit that a new and synthetic discipline of service science is desirable, but we should not assume it is inevitable. ■

We taught the "Information and Service Economy" course for the first time in the fall semester of 2006. Most of the 20 students were enrolled in the School of Information, but others came from business, computer science, and engineering. All but one were graduate students.

Teaching the historical evolution of business organizations (i.e., the evolution of the firm), the nature of work, business architecture, law, and policy helped students understand the dynamic and innovative nature of the information and service economy. This approach also highlighted a critical shift in conceptual categories; it made sense to use the firm as the unit of analysis when the economy was dominated by large hierarchical and vertically integrated enterprises, but today the service system is a more useful concept for organizing our research and teaching.[44] We introduced the concept of a service system early in the semester and now believe it should be at the core of the course and curriculum as the unifying construct.

Nevertheless, we learned that the course can be improved. Our effort to ground the syllabus in the most important papers from the component disciplines of service science assumed that we could identify them and that they would be accessible to students from diverse backgrounds. The former assumption was partly true, especially after we vetted our syllabus with our UC Berkeley faculty working group and with Paul Maglio, IBM Senior

Manager, Service Systems Research, and Jim Spohrer, Director of Services Research at the IBM Almaden Research Center, but we found that the latter assumption was not wholly true; some classic papers assumed so much disciplinary expertise that they were nearly impenetrable unless one had the appropriate educational background. This situation undermined our goal of making interdisciplinary connections.

Fortunately, by the end of the semester, the two instructors and their students had managed to make many of the interdisciplinary connections themselves. We expect that over time more polished versions of student papers like those from this first year[45] may become important readings in the course syllabus because they embody a service science perspective. Nevertheless, we now have more realistic expectations about how easily and quickly we can turn students who come to us as specialists in one discipline into the T-shaped people IBM and other firms hope they will be when they graduate.[16]

BEYOND THE FOUNDATION COURSE

We had been adamant in not wanting to build a service science curriculum as a menu of rebranded existing courses. However, it is hard work to start from a clean slate, and there is not enough time or sufficient institutional support to design all of our courses with the care and effort that went into the first one. Yet now that we have developed the foundation course, we can build on it with the matrix as our guide to develop or revise additional courses in a strategic way.

In our *Information and Service Design* course, time constraints meant that we were unable to delve deeply into specific categories or domains of services, so we organized a weekly service science lecture series.[46] Most of the speakers were service industry executives or experienced service designers. These lectures provided students tangible and current examples of service design issues and applications.

To bridge the gap between theory and practice, we are developing an information systems clinic[47] whose mission is to give students real-world experience in the design, implementation, deployment, and evaluation of information and service systems. The primary client base of the clinic will be organizations on the UC Berkeley campus, but it will also work with campus IT organizations and industry partners. The clinic will focus on evolving technologies and methods that—while not experimental—are still not yet widely deployed in industry. This will balance the educational needs of the students with the practical goals of the constituent organizations. In particular, we expect that many projects will involve business-process analysis, document modeling, and Web services. Organizational-capability assessment, technology transfer, and change management will also be important themes in clinic projects.

IMPLICATIONS FOR RESEARCH IN SERVICE SCIENCE

Developing the discipline–by–life-cycle matrix as a new framework for service science and teaching a course that was designed with the matrix as a guide had the somewhat unexpected result of suggesting topics for new multidisciplinary research projects. Following are some examples.

Bridging the front stage and back stage in service design—Many approaches to service design emphasize the coproduction that takes place in the front stage of face-to-face interactions between the person providing the service and the one receiving it.[35] However, the explosive growth of self-service applications and Web-based services has made it apparent that the back stage of services, especially services that are information intensive, is also a critical contributor to service quality.[17]

Service design patterns—Innovation in services has not been studied as extensively or rigorously as innovation in products. Instead, we propose to think of services in terms of the design dimensions or patterns they follow. This view creates a richer characterization of services and encourages a systematic approach to service design and innovation.[48]

Globalization and information services—Information services rely on digital technologies that are increasingly ubiquitous and accessible to populations around the world, including vast populations in emerging economies that have recently opened their markets. This means that service producers need the ability to search globally for complementary capabilities and that they must also distribute their activities to optimize variations in local

resources, such as markets, specialized skills, and researchers.

CONCLUSION

When different disciplines and perspectives come together, the outcome is unpredictable. One discipline can become dominant and absorb parts of the others, or the overlapping pieces can break away and form a new field. But if the new field never becomes more than the sum of its parts, it can fade away over time. Occasionally, however, a new and important discipline emerges as a synthetic combination.

We might posit that a new and synthetic discipline of service science is desirable, but we should not assume that it is inevitable. Legal scholar and federal judge Frank Easterbrook pointed out that law schools do not teach the law of the horse because the legal issues that arise with horses in disputes about property, commercial transactions, and liability are largely the same as those that arise for other entities.[49] Ironically, Easterbrook's arguments were made at a conference titled *The Law of Cyberspace*, held in the early 1990s. In the past decade it has become obvious that a new body of cyberspace law needed to be developed because attempts to apply existing legal concepts to questions raised by the Internet ended up requiring fundamentally different categories and concepts in order to be answered adequately.

Will service science emerge as a creative synthesis of other disciplines, or just as a curriculum of convenience to make it easier for students to brand themselves as ready for jobs in the information and service economies? We think our new life-cycle–discipline framework shows that service science does more than merely appropriate concepts and methods from other fields. We think that there are unique and emergent interactions and research questions and we have suggested a few of these. Service science is not merely interdisciplinary; it must be transdisciplinary—bringing together different perspectives to span the boundaries between them.

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Robert J. Glushko
School of Information, University of California, 313 South Hall, Berkeley, CA 94720 (glushko@ischool.berkeley.edu). Dr. Glushko is an adjunct professor at the University of California, Berkeley, in the School of Information, the Director of the Center for Document Engineering, and one of the founding faculty members of the Information and Service Design and Services Science, Management and Engineering programs. He holds a B.A. degree in psychology from Stanford University, an M.S. degree in software engineering from the Wang Institute, and a Ph.D. degree in cognitive psychology from the University of California, San Diego. During the 1990s he founded or cofounded three companies, the last of which was Veo Systems in 1997, which pioneered the use of XML for electronic commerce before its 1999 acquisition by Commerce One. He was named an Engineering Fellow by Commerce One in 2001. He joined the University of California, Berkeley, faculty in 2002 and has received awards for outstanding teaching and mentoring. ■