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# A RESEARCH MANIFESTO FOR SERVICES SCIENCE

*The services sector has grown over the last 50 years to dominate economic activity in most advanced industrial economies, yet scientific understanding of modern services is rudimentary. Here, we argue for a services science discipline to integrate across academic silos and advance service innovation more rapidly.*

century ago, most people in the U.S. and around the world worked on farms. During good times, food was plentiful. However, hard times meant starvation or dislocation as during the Irish potato famine. Today, agricultural employment is less than 5% in advanced economies. Despite these low percentages, there is plenty of food: mass starvation is a distant historical event in advanced economies. Why? The difference lies in the incredible productivity increases we have enjoyed in agriculture and more recently, in manufacturing. We are living longer and healthier lives at a higher standard of living because of these increases.

Let's be clear why most of us live in a "post agricultural" world today, while acknowledging the importance of agriculture. The productivity of agriculture increased due to the shift of people out of agriculture into knowledge-intensive, specialized industries that support agricultural productivity, including manufacturing of farm equipment, fertilizers, pesticides, superior seeds, land management practices, improved commodity markets, transportation services, fuel supply services, government and institutional support services, and more. In sum, vast new bodies of knowledge embedded in new institutions, industries, businesses, professions, and technologies exist to support the productivity of a much smaller population who call themselves "farmers" and provide for us all.

Today we live in a "post manufacturing" world, while acknowledging the importance of manufacturing. We enjoy unsurpassed material comfort, because of a vast array of services that comprise nearly 80% of our economic activity [59]. The rise of information and communication technologies (ICT) that improve automation and connect us to global labor markets has resulted in a shift of people out of manufacturing into knowledge-intensive service industries that support manufacturing and innovation. Can we continue rapid productivity advances in a largely services-based economy? There are signs of hope, but also reasons to be worried.

A hopeful sign is in how we treat patients in hospitals. Up until 1910, a patient had about a 50/50 chance of improving his or her medical condition by visiting a hospital to treat a disease. Today, even with the concerns about health insurance and medical errors, patients' chances are enormously improved by seeking health care instead of avoiding it. Patients enjoy much more accurate diagnoses. They are highly unlikely to contract new diseases in the hospital. And they have much more knowledge about the behaviors they can adopt to improve their medical health status.

We know the productivity gains of the past have arisen from the R+D efforts of millions of people and organizations over many decades. At the heart of this R&D system is the academic university, and the academic community of scholars, students, and alumni that comprise the greater academic community. In services, however, there is no academic community of scholars that shares a common mission to understand the roots of this arena of economic activity, or how to advance it. Granted, services subfields are emerging in separate, siloed academic areas such as management, engineering, and computer science schools, but precious few attempts to integrate them have been undertaken.

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Since we now live in a services-based economy, it is disconcerting that universities are not more focused on the vital services sector in their research activity. At a time when concerns about outsourcing and offshoring white collar jobs are raising alarms, a field that could assist in understanding how to add value to those jobs goes unexplored. Our ability to achieve a further rise in our standard of living requires a deep understanding of how to innovate in services.

If academics, industry, and government can create a shared agenda of research focused upon the services sector, this need not continue. Through developing common terminology and methods that increase our insight into the services domain, we can reconnect universities to the dominant economic activities of the larger society that supports them.

## Conceptual Confusion

Where did the term "services" come from? The modern usage arose out of the 1930s U.S. Department of Commerce's Standard Industrial Classification (SIC) codes. In these codes, the major economic sectors were agriculture, manufacturing, and services. At that time, services was a residual category for other activities that didn't fit into agriculture or manufacturing [53]. Today, stretched beyond the point of being meaningful, that residual is the bulk of economic activity, and by far the fastest growing part of economic activity in the U.S. How is the term "services" defined today? Ted Hill, an influential scholar, suggested that [45]:

"A service is a change in the condition of a person, or a good belonging to some economic entity, brought about as the result of the activity of some other economic entity, with the approval of the first person or economic entity."

Importantly, the U.S. government has accepted this definition as the basis for defining service products in the new North American Product Classification System (NAPCS) [57]. Other definitions of services can be found that emphasize an exchange between two or more parties and a transformation (potentially intangible) received by a customer [47, 53, 80, 81].

One example of a service innovation is the FedEx online package tracking system. By utilizing an online tracking system, FedEx can respond to customers' needs very rapidly, without any human intervention on its part. The customers, who enter in all of the information, do not mind, because they get the latest, accurate, and authoritative information. FedEx saves money on having to update and notify customers when packages will arrive, while customers are much more satisfied. Transparency of operations is a common theme in service innovation.

The leading role of services in the economy comes as no surprise to many companies. GE and IBM, leaders in the manufacturing sector, find that services are the fastest growing parts of their business. Indeed, IBM today receives the majority of its revenues from its IBM Global Services Business, a unit that did not exist prior to the 1990s.

Today services mean jobs and growth, but the companies who have been leading the charge lack a strong conceptual foundation for their work and are now reaching out to academics. To be sure, these firms have accumulated substantial knowledge bases from their engagements in each industry vertical market. But the knowledge bases are often company confidential and have not been studied by outside academics.[1] Any larger patterns that might clarify and illuminate their functions have avoided detection to date.

The current approach of government funding for services research isn't helping to improve the situation. According to the study by the National Academy of Engineering [59], federal funding agencies do not fund long-range, high-impact academic research in services fields such as logistics, because these agencies do not see services as *a separate intellectual discipline.* The same study asserts that U.S. academic research enterprise is not focused and organized to meet the needs of service business [58].

### TOWARD A FOUNDATION FOR SERVICES SCIENCE

Notwithstanding these difficulties, there are elements common across many different types of services that might form a foundation for such a field. They include the:

- Close interaction of supplier and customer [35, 91];
- Nature of knowledge created and exchanged [60, 108];
- Simultaneity of production and consumption [92];
- Combination of knowledge into useful systems [44];
- Exchange as processes and experience points [77]; and
- Exploitation of ICT and transparency [24, 103].

The nature of services activity is broad (government, health care, education, finance, transportation, communication, business, and so forth). Services exchange is qualitatively different from both the earlier agricultural and manufacturing epochs.[2] It involves a negotiated exchange between a provider and an adopter (supplier and customer) for the provision of (predominately) intangible assets. This frequent lack of a central artifact raises an important and interesting corollary: *Each party in the exchange needs the other's knowledge in negotiating the exchange.* The provider lacks the contextual knowledge of the customer's business, and how the customer is going to leverage the offering to compete more effectively in the market. The customer lacks the knowledge of the full capabilities of the provider's technologies, and the experience of the provider from other transactions in assessing what will work best. While information asymmetries have always existed in economic exchange, the intangibility of services and the scale of modern B2B IT result in new levels of coordination complexity.

When products were the main focus of the exchange, those artifacts helped each side communicate effectively with the other. As products and their functions became well understood, suppliers did not need to understand the customers' business to be an exchange partner. Similarly, customers did not need to understand their suppliers' prior experiences and capabilities, since these were reflected in the products they could see, touch, and experience directly. Technical standards further facilitated exchange, and helped customers switch suppliers, if necessary, at little or no cost.

The services transaction is different [25]. The exchange is co-generated by both parties, and the process of adoption or consumption is an integral part of the transaction [105]. So often the adopter is a co-producer, intimately involved in defining, shaping, and integrating the service. However, the depth of this relationship likely varies considerably between consumer services and enterprise services. In consumer

[1]We believe it would be in the interests of these providers to share their engagement experiences with academics, under appropriate protections for client confidentiality, so that more robust theoretical classifications of their activities could be proposed.

[2]Some argue that services innovation is not very different from product innovation [110]. Others contend that services are indeed different, but suggest a synthetic approach to innovation that seeks commonalities across services and manufacturing [25].

services, the interactions are built around episodic experiences and brands. In the enterprise, the interactions are built around long-term relationships over the life of the enterprise [28].

This leads to the nature of the knowledge involved in a services exchange. Both codified and tacit knowledge must be considered. Codified knowledge refers to knowledge that is transmittable in formal, systematic language [65]. An example of codified knowledge is the technical specifications of a product that specify its dimensions, its different components, and how it should be assembled and operated. We commonly refer to codified knowledge as "information." *Codification enables communication.*

Unlike codified knowledge, tacit knowledge is difficult to transfer between people, between groups, and between organizations. A famous example of tacit knowledge is the ability to ride a bicycle. Although the individual knows how to ride a bicycle, it is difficult to state explicitly how to perform this function [64]. The nature of tacit knowledge complicates the services exchange, and limits the ability of each party to fully comprehend the needs and abilities of the other.

Services exchange today involves many complex combinations of both codified and tacit knowledge. Indeed the abundance of information and the need to factor in tacit knowledge makes the creation of systems that combine these into coherent solutions a challenging problem. The questions of how to efficiently partition, integrate, and coordinate the recombination and reuse of information from one instance of a custom service into a new instance are fundamental to the economics of service activities.

Translating the many dimensions of a modern business into information of necessity leaves out a lot of tacit knowledge. Nevertheless, practitioners selling B2B services refer to the concept of "business process modeling." This technique deconstructs a business into constituent parts [23]. MacDonald's and Starbucks represent successful replication of business process as franchises. Some franchises fail to replicate due in part to uncodified tacit knowledge.

The formalization of business process within the framework of Service Oriented Architecture (SOA) is a hot topic in computer science departments these days [31]. SOAs support the codifications of identifiable business processes, such as an application for credit. Web Services (WS) and SOA are poised to transform B2B collaboration. However, before the transformation can occur, standards must evolve up the stack beyond the transport (communications links in network), and payload (format of content) levels to the business process level (the required and optional activities that make up a business process, rich in tacit knowledge). As standards move up the stack, a multidisciplinary perspective toward services becomes increasingly important to gradually codify tacit knowledge.

## Can Services Science Become an Academic Field? Insights from Earlier Attempts

It is an open question whether services science will be able to become an academic field. To be sure, not all potential areas of intellectual inquiry end up as academic departments. In the 1940s, computing was not accepted as a scientific discipline by the academic community. However, by 1946 five major U.S. research universities had already gained experience with computing: Columbia, Harvard, MIT, Pennsylvania, and Princeton [7]. During the 1950s, these universities were conducting research in computing through interdisciplinary laboratories or as part of existing departments such as math or physics.

The formation of computer science departments was not easy. Indeed, a survey of university computing conducted at the time stated that universities were "having a hard time learning to cope with their new role in society in general and, in particular, learning how to effectively incorporate these new fields into the academic structure" [32]. This incorporation also took time with government funding agencies. According to Aspray [7], "It was not until 1980s that the NSF gave the same institutional status to computer science as it confers upon traditional scientific disciplines such as physics, mathematics, or chemistry."

External support was critical for these universities to form strong computer science departments. Columbia University's success in establishing computer science as a research field was primarily due to IBM's support. Thomas Watson Sr., chairman of IBM, was a trustee of the Columbia University since the 1930s. Building on this relationship Columbia University and IBM established the Watson Scientific Computing Laboratory on the Columbia campus in February 1945, and taught the first class on computer science in 1946 [78].[3] Asprey [6] summarized the crucial nature of external support for the emergence of this scientific discipline as follows: "The single strongest impulse for introducing computers on campuses in the mid-1950s did not come from the

[3]External support also was a critical factor in MIT's success in computing. MIT was extremely well connected with the federal scientific leadership and program offices. Vannevar Bush and his colleagues had strong ties to the government and the military. Furthermore, MIT's electrical engineering department, where computing research was taking place at MIT, had strong ties to the industry, which was not common among the U.S. universities at that time.

schools themselves or from any federal agency, but instead from IBM."

New disciplines arise in many ways and for many reasons. Nevertheless, two points are clear: most attempts to start new academic disciplines never succeed, and the new academic disciplines that do succeed, succeed for many factors that unite multiple groups in a common cause. For example, Murmann [58] describes the way academics, businesses, government, and other institutions aligned in Germany in the mid-19th century to establish modern chemistry and the dye industry. Because of the coordinated and mutually reinforcing efforts of these groups, Germany became the dominant economic power and beneficiary of innovations in chemistry for over 70 years.

Over the last two decades, a number of European countries have done a great deal of work to understand the growth of their services sector and to try to increase government investment in services. However, the approaches to service innovation, despite many solid contributions [76, 104], have remained balkanized in different academic disciplines. No unified model has yet emerged. It seems unlikely to us that systematic approaches to service innovation can be achieved without an interdisciplinary effort that unites academic silos around a common set of problems.

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## Why Now?

One may reasonably ask, why is this the time for considering a field in services science? To be sure, the role of services has been growing in the economy, but this has been a long-term trend over many decades. What has prevented the emergence of a field earlier, and equally, what enables such a field to emerge now?

The critical enabler today is ICT. As these technologies have advanced according to Moore's Law, the ability to codify and transmit knowledge, and to reuse and recombine that knowledge, has grown exponentially as well. More subtly, advances have enabled knowledge to be separated from artifacts in the form of high velocity information. Stripped of the artifacts in which they were previously embodied, this information can move at much higher velocity in specialized businesses, professions, and tools. In addition, the information is not consumed in the exchange, but remains available for additional use or reuse by others [83]. This was not true in the earlier epochs, where the consumption of a product meant that others could not consume it. It is this liberation of knowledge into information, and embedding that information in systems augmented and accelerated by Moore's Law, that explains why the services science field may now be able to emerge. Similarly, the knowledge embedded in business organizations is being codified, modeled, and separated from the businesses, again accelerating the velocity at which this new kind of information—formal representations of business—can be reused and customized. The abundance of information about people, technological artifacts, and organizations has never been greater, nor the opportunity to configure them into service relationships that create new value. Now is the time for a science of service.

## The Grand Challenge

This liberation of knowledge from artifacts and organizations, enabled by the rapid and continuing advances in sensors and ICT as well as legal changes (for example, the Sarbanes-Oxley Act), informs the central problems in services science. How can this information of the capabilities of artifacts and organizations be recombined and accelerated in its velocity to create value? How can it be integrated in context to create new and valued services and solutions to customer problems? How can the tacit knowledge of parties in the exchange be managed, so as to create value out of that exchange? How do people and organizations negotiate the creation of intangible assets that produce value for both? In sum, we need a theory of value co-creation [105].

Answering these questions is central to the field of services science. If these questions seem rather abstract, their pursuit should lead to some very practical and important insights. For example, why do we see such different levels of productivity across industries, and even within industries [29, 51]? As Tom Kalil of UC Berkeley and Paul Horn of IBM have separately observed, the answers to these questions have enormous implications for job creation in the U.S., the standard of living in the U.S., and the competitiveness of U.S. firms in global markets. To ask the question from a computer industry perspective: Why does value tend to concentrate at one layer of the technology stack at one time, and shift to other layers at another time?

Any useful answers to "why companies and industries vary in their productivity," or "why value migrates to different parts of the stack" will invariably involve business process modeling, business models, systems integration and design, organizational change, and allied inquiries. A deep understanding of customer needs (including the customer's own business model and allied processes) also will be required. Services science could be the emerging discipline that unites the many stakeholders.

This is a daunting agenda, but what alternative is there for the academic research enterprise in a services economy? As IBM Research Senior Vice President Paul Horn notes, "At IBM we've been working closely with academic institutions to stimulate a cross-disciplinary focus on 'services science.' We need to overcome the silos of departments and disciplines if we are going to generate the innovation needed in a services economy." We agree, and would add that advancing the prosperity of our society depends upon it. **C**

A complete bibliography of the literature used in the course of preparing the articles for this special section on services science is available on page 33.

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