Research Report

No. 246 December 2005

What is Service Science?

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ABSTRACT

The service sector is becoming increasingly important throughout the developed world, in terms of both the amount of value added and numbers of employees. However, compared with the manufacturing industry, productivity in the service sector is low, and there have been consistent calls for its improvement. Additionally, the future effects of investment in services and the level of future predictability are also low for the service sector. As a result, both service providers and clients are highly dissatisfied with the current assessment and distribution of value that they feel should be attainable through investment in services.

In response to this, a new concept has emerged, centered on IBM's "service science" (now abbreviated as SSME, for services sciences, management, and engineering). The goal of service science is to increase the productivity of the service industry, promote innovation, and create greater validity and transparency when assessing the value of investments in services.

Generally speaking, the service sector is based heavily on the intuition and experience of employees. Service science seeks to take these elements and examine them scientifically, investigating them through the use of existing academic disciplines in order to raise productivity and create visible assessments of investments. An example of such efforts would be improved future predictability of the effects and risks of service investments through the mathematical modeling of business processes, which in turn would lead to improved productivity.

This report examines the present conditions of service science in the U.S. and Japan. Currently, the concept of service science is not yet widely known, but the recognition of its importance is growing in developed nations across the globe, and there is a strong possibility that it will become a strong movement in the future. In Japan as well, the promotion and research of service science has finally begun to take root. In the years to come, it is crucial that Japanese companies and universities cooperate openly and construct a service science field that is appropriate to Japan's service sector.

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1. Introduction

In recent years the trend toward services within the structure of industry is progressing rapidly throughout the developed world. The service sector is increasingly becoming the central industrial sector of developed countries from the perspective of both value-added levels and numbers of employees. In Japan as well, beginning with business services the demand for services is skyrocketing. Moreover, it has become possible to offer a plethora of services over the Internet due to the trend towards open platforms on the Internet, and other examples of new services are also increasing. This trend is also visible in the change in the sales structure ratio of companies offering IT services such as including consulting, which is the most representative of current services: on the heels of the shift from hardware divisions to software divisions is a prominent shift toward service divisions as well. Furthermore, in the manufacturing industry, the competition to keep prices down for hardware products is intensifying on a global scale, and companies seeking a way out of this struggle are turning to the practice of adding services to their products.

In this way, the importance of the service industry in Japan is growing for the country as a whole. The demand for new services using IT is also becoming increasingly strong, and the importance of services in inter-corporate competition is rising as well. In the midst of these changes, the need for a deep understanding of services and improved productivity is becoming unavoidable. Despite this, research and development in the service sector is still limited at both the national level and the level of individual service providers and customer-side companies, and the productivity of the service industry is not nearly as high as that of manufacturing. If the current state of affairs—a growing service sector with inferior service productivity—continues unabated, Japan will be faced with the danger of declining affluence on a national scale. In general, Japanese businesses' awareness of the effects of investment in IT services has tended to be low when compared with foreign companies, but in recent years quantitative checks on investment effects have become increasingly strict. On a global level, actively promoting innovation and raising productivity in the service sector are becoming urgent issues for all industrialized nations, and customer-side businesses have also begun taking notice of the effects of investment in IT services.

Out of the demands for innovation in the service sector, and as a result of strong calls for quantitative explanations of the effects of investment and implementation of IT and related services, came the Council on Competitiveness' report titled *Innovate America*. This report, written with the help of the Council's cochairman and president of

IBM Samuel Palmisano, was the first to raise the concept of service science and emphasized the importance of the new discipline as the foundation for service innovation in economic growth. Following this report, service science activities began to spread, with IBM at the helm. In Japan as well, the concept of service science has begun to draw interest in academic and IT service provider circles.

The concept of service science has only just been born, and it has yet to become an established theory or spread on a large scale. Regardless, there is little doubt that service science will become a vital concept for the innovation-led service sector in the years to come. In anticipation of this, proper understanding of service science and appropriate responses on both the national and individual business levels are urgently needed.

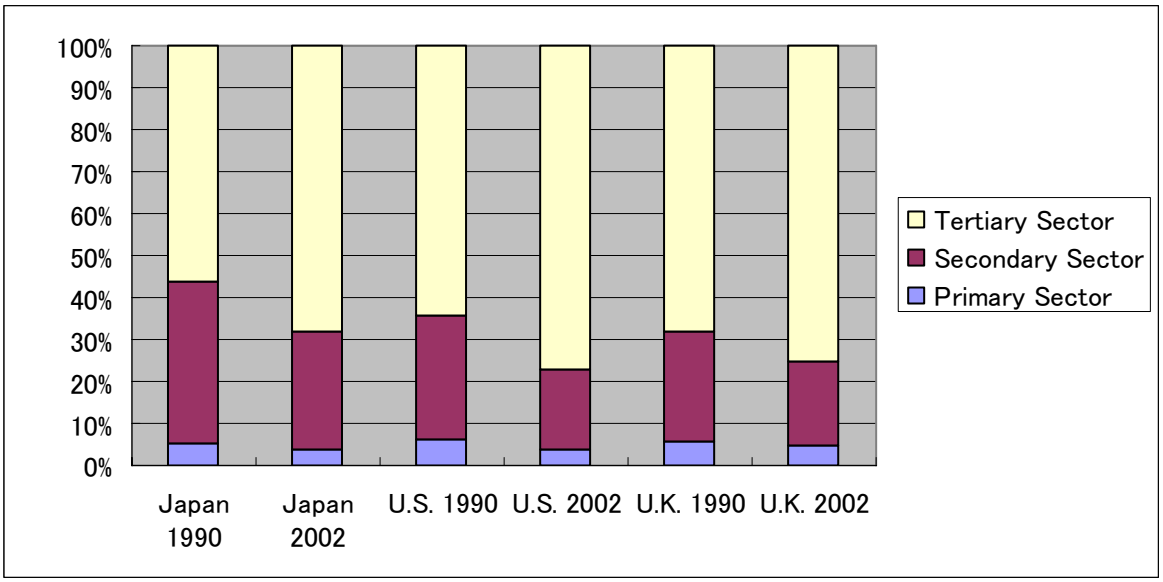
2. What Is Service Science?

2.1 Behind the Emergence of Service Science

2.1.1 The Trend toward Services in Industrial Structure

Beginning with the industrialized nations, the industrial structures of the world economies have been shifting toward services in recent years. Figure 1 shows a comparison of the changes in the ratio of the GPO (Gross Point Originating) in the industrial structures of Japan, the U.S. and the U.K., divided into the tertiary sector, secondary sector, and primary sector. Japan shows a particularly high rate of development toward the tertiary sector, which consists largely of service-related functions. Though this figure shows only the GPO, the same shift is also present in the number of employees.

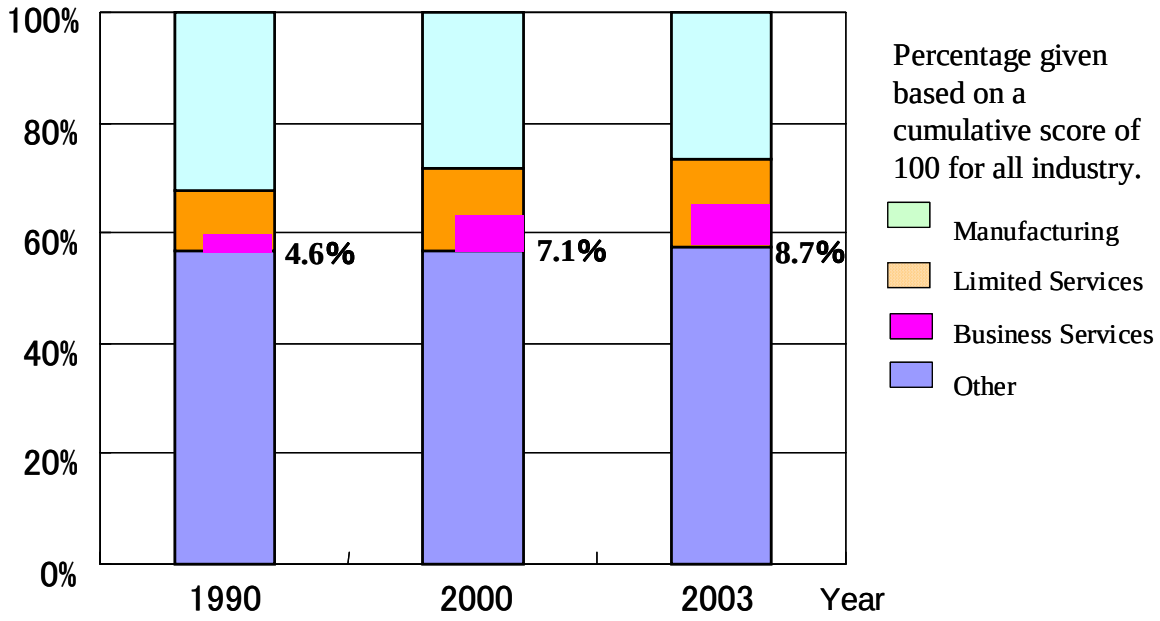
FIGURE 1. Shifts in Industrial Structure in Japan, U.S. and U.K.



Source: MIC Statistics Bureau (2005). Compiled by author.

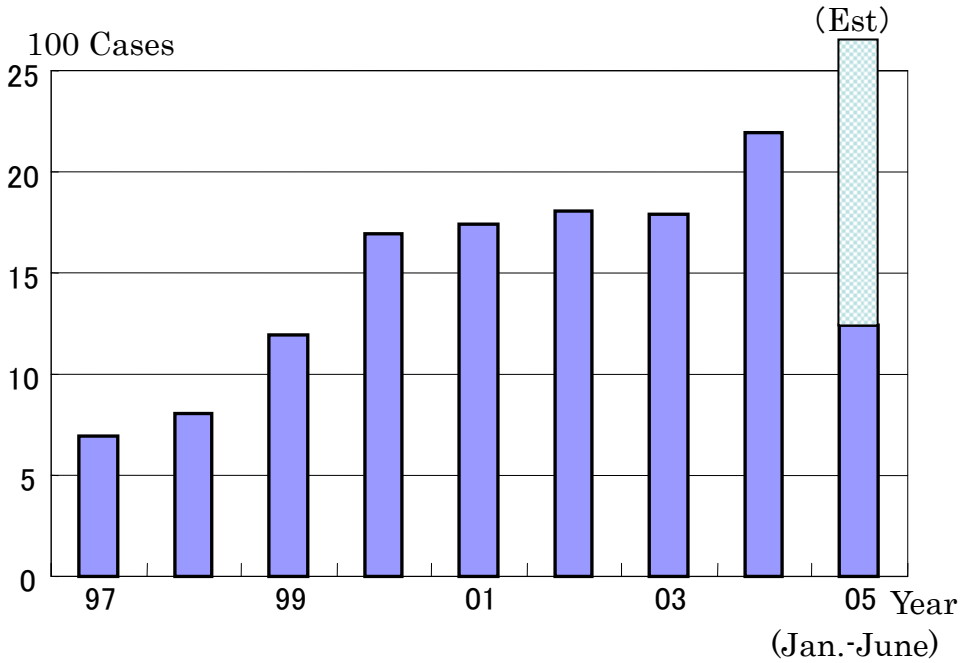
Within the service sector, what kinds of services are increasing? As shown in Figure 2, the business service sector is expanding in Japan. This increase is a swift reaction to the changing management environment in Japan, which has spawned in increase in cases of M&A, as shown in Figure 3. This has resulted in demands for the integration of business processes between companies through M&A, an increased need for prompt decision-making within business processes, and growing calls for IT services that are more precise and enable quick decision-making through IT. Furthermore, with recent calls for companies to select and concentrate their operations, the number of non-core operations being outsourced is also increasing. Within this reorganization and innovation of business processes, consulting and other business services are becoming increasingly important.

FIGURE 2. Service Industry in Japan – Breakdown by Sector



Sources: Finance Ministry, MOF (1990, 2000, 2003). *Finance and Fiscal Statistics Monthly Report: Business Corporation Statistics Annual Report Special Issue*. Compiled by author.

FIGURE 3. M&A Cases in Japan

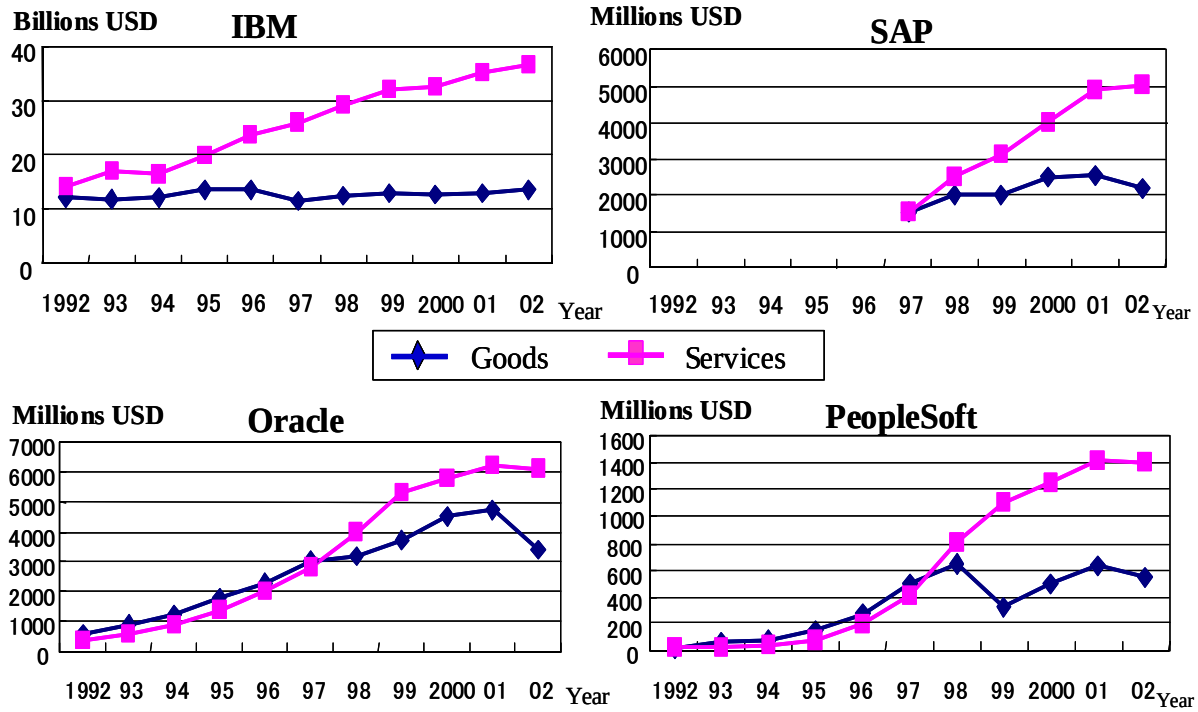


Source: RECOF statistics, *Nihon Keizai Shimbun*, 21 July 2005. Compiled by author.

2.1.2 The Trend toward Services in the Sales Structure of IT Providers

Currently, profits from services are rising in many business communities around the world, and there are changes occurring on the service provider side as well. Specifically, IT vendors are also exhibiting an accelerating trend toward services in their sales structure. Figure 4 shows the sales structure for the world's major IT providers, divided into software packages (products) and services. From this figure it is clear that the sales of services have far outpaced those of software packages, even for companies like Oracle and PeopleSoft that were originally seen as primarily software package dealers.

FIGURE 4. Changes in Sales Structure of Major IT Providers



Source: Cusumano, Michael A. 2005. *The Business of Software*. Compiled by FRI.

There are changes in the service-client side. Where client companies were once dependent upon outside service providers for certain tasks, there is a growing trend for client companies to include such operations in their core business processes and thus conduct such tasks in-house. Yamato Transport Co., for example, opened its own ASP delivery service. As a result, it has become necessary for past providers to further enhance and focus their strengths so as to protect the scope of their operations.

2.1.3 The Increasing Importance of Services in Hardware Competition

As the current surplus of goods continues and hardware prices decline across the board, differentiation between hardware products based solely on low prices and good quality has become more blurred and products have become more difficult to sell. In order to survive in this environment it is becoming increasingly crucial that companies not only improve product development capacity and productivity, but at the same time increase the differentiation of their products by adding services in order to meet the needs of customers. A representative example of this is FANUC's remote supervision of machine tools. In this way, superiority in services is becoming a deciding factor in a company's competitiveness within product competition as well. A deep understanding of services is also necessary in manufacturing and other industries. In other words, the increasing importance of services is not limited to the service industry.

2.1.4 The Growth of New Services

As IT and Internet technologies in particular continue to develop rapidly, and the Internet moves more and more toward open platforms, there is a growing opportunity for various new services to arise from this progress.

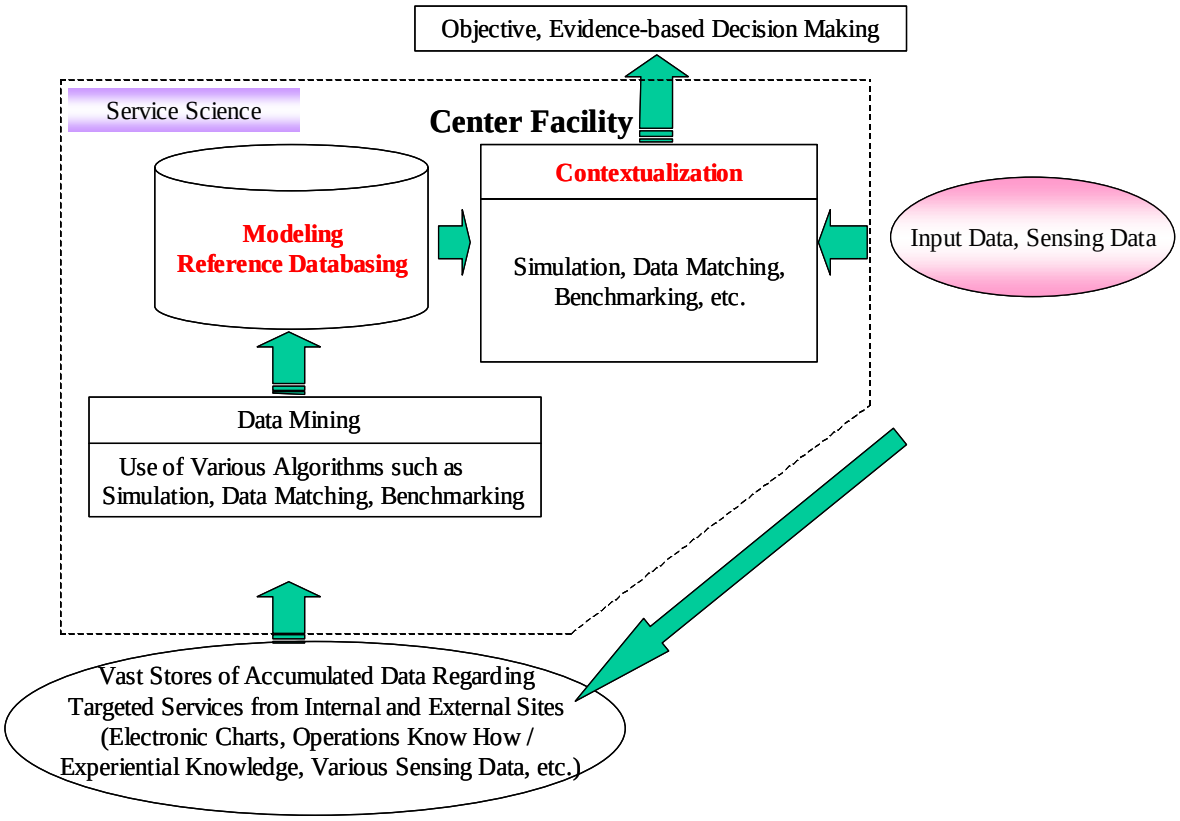
Examples of these new services are numerous. For instance, SaaS—Software as a Service—is a recently emerging trend where companies provide their independently developed software functions through networks. In another new service, companies shed non-core elements in their business processes by outsourcing them over the Internet. The concept of modularization is yet another envisioned service, where the standardization and modularization of all aspects of a business—from product, to company organization, to business process—allow for individual, standardized processes to be conducted over the Internet.

At the conference titled "The Architecture of On-Demand Business" hosted by IBM in May 2005, IBM senior vice president and director of research Paul Horn also emphasized the movement toward services. According to Dr. Horn, the progress of standardization, increasing ubiquitousness and growing trust in the Internet has allowed companies to conduct both intra-corporate and inter-corporate transactions at lower costs, while advances in technology have made possible new types of services both within and between companies. Dr. Horn also noted that software is becoming increasingly componentized and distributed over networks, and says that the evolution of SOA (Service Oriented Architecture) has made this possible.

Service over the Internet has only just begun, and we are in the beginning phases of transferring existing services onto the Internet. As services mature, however, it is anticipated that the openness and extensiveness of services available will grow far beyond current levels, which will inspire more and more businesses to shift their focus from products to services. One arena in which this shift can be seen is IT. In the past, IT providers offered IT services as merely a tool to carry out client companies' operations. As IT continues to advance, however, it has grown beyond such merely supportive roles, and must now be used as a way to propose new business models based on scientific evidence and to standardize and modify business processes. IT must be used to judge and assess which business processes are a company's core processes and which are not, and to outsource non-core processes over the Internet. In other words, IT has become crucial as a total service that should offer consulting and other services and handle clients' business issues effectively, increase business results, and lower risk.

With the advent of the ubiquitous age, sensors and computers have been installed in a host of locations, leading to the massive flow and usage of diverse information. As a result, various services that were previously processed, handled, and separated as merely "mass services" have now become possible to provide as individually targeted and personalized services. In order to carry out these individualized services, a decision-making system is necessary that can use massive amounts of data as a scientific base to conduct datamining and mathematical modeling, construct reference databases, create benchmarks and attach meaning to individualized information (Figure 5).

FIGURE 5. New Scientific Evidence-Based Services



Source: FRI.

2.1.5 The Demand for Service Innovation

As shown above, the importance of the service sector is growing on multiple fronts. This is evidenced by the trend toward services within the national industrial structure, the business-service orientation of the service industry in a narrow sense, and in the increasing role of services in the composition of sales for IT providers, which is one of the most important sectors of the service industry's business services. In the field of IT in general—and the advancement of Internet technologies and ubiquitousness in particular—heretofore nonexistent services are springing up in growing numbers. For products outside of the service industry as well, intensifying competition means that mere increases in product development capacity and productivity are not enough. Instead, differentiation through added services is becoming crucial.

Despite the increasing importance of services, however, R&D activities for promoting innovation in services have been sluggish. For example, data from Japan's national R&D expenditure on the service sector in 2003 shows that the manufacturing industry had 3.71% of R&D expenses as a percentage of sales, whereas software and

information processing industries—i.e. the IT service provider sector—saw only 3.13% (MIC Statistics Bureau, 2005).

Looking at the raw numbers themselves, the value of R&D expenses as a percentage of sales for the software and information processing industries is not terribly small. However, this value primarily consists of R&D costs for software development, and it is thought that the R&D expenditure for services is in fact extremely low. This is because companies in the software and information processing industries are characterized by shrinking R&D expenses as a percentage of sales as capital increases, in contrast to trends within manufacturing and other industries. Specifically, with capital funds of less than 100,000 yen, R&D expenditure as a percentage of sales is 5.52%; at 100,000 yen to 1 million yen it drops to 1.03%; at 1-10 million yen, 1.43%; and at 10 million yen and above, 0.99% (MIC Statistics Bureau, 2005). It is thought that the ratio of service operations for large companies is high, whereas software development forms the backbone of small companies. As a result, R&D efforts toward services tend to be relatively small for large companies.

In Japan, service itself has not been widely regarded as an object for scientific analysis. Most service companies still focus much more on instinct and the experience-based know-how of employees rather than on R&D and scientific analysis for innovation and service development, such as in the methodology presented in Figure 5 above. In fact, many efforts (where they exist) to incorporate a scientific knowledge base in services have been driven by the manufacturing industry.

Failure to treat services as a subject of scientific analysis has resulted in a difficulty in quantitatively analyzing the effects and risks of service investment, leading to ambiguity in the effects and risks involved. As a result of this perception in Japan, client satisfaction in the service sector is often still low. Even in the U.S., documents from large IT providers, for example, reveal that 10-50% of general service business contracts do not meet client expectations. In Japan, over the last few years, even the operating profit margins for the entire business-services industry have declined much more than in other industries (Figure 6).

FIGURE 6. Profit Margins by Industry in Japan

Operating Profit On Sales	1990	2000	2003
All Industry	3.5	2.6	2.8
Manufacturing Industry	4.8	3.8	3.9
Service Industry	3.9	2.8	2.9
Business Service Industry	4.0	3.0	2.7

Sources: MOF (1990, 2000, 2003). *Finance and Fiscal Statistics Monthly Report: Business Corporation Statistics Annual Report Special Issue*. Compiled by author.

As is clear from the above trends, despite the fact that the importance of services is rising, the inability of the service sector to meet these growing demands due to low productivity is becoming increasingly apparent. In response to this, service innovation is not only gaining attention among industrialized nations as a common topic for the years to come, but it is also being hailed as a new business opportunity. To seize upon this opportunity, however, we must understand how to treat "service" as a target of innovation.

2.2 How Should We Perceive "Service" as an Object?

Generally speaking, the concept of service science tends is somewhat murky. A major reason for this is that the meaning of service is itself extremely broad, and which kinds of services are objects of service science is not easy to ascertain. At various conferences concerning service science as well, the question of "What are service science's target services?" is often raised. This section presents several common answers to this question, and investigates how we should perceive the "services" that are implied in service science.

2.2.1 What Are Services?

According to Kiyomizu (1994), services can be classified in the following categories. (Note: some services may fit several categories simultaneously.)

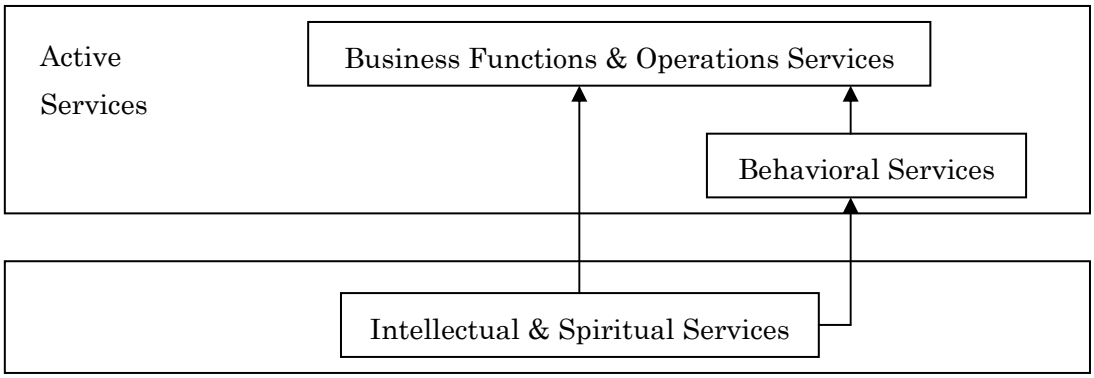
① Intellectual and Spiritual Services
- Ideas, Principles, Concepts
- Basis for business activities and client interaction

② Behavioral Services
- Expressions, gestures, creation of atmosphere for client interaction

③ Business and Operational Services
- Provision of Intangible Goods
- Direct Economic Value Creation

More specifically, the composition of services is as follows: intellectual and spiritual services form the foundation, which in turn have a deep effect on behavioral services; both of these categories influence the various individual services targeting functions and operations. Out of these three categories, the third kind of services—services that have economic value in and of themselves and provide clients with intangible goods in the form of specific business functions and operations—are the direct subject of service science (see Figure 7). The foundation of services targeting business functions and operations are intellectual and spiritual services and behavioral services, which are deeply tied to aspects of social and cognitive nature. As these personal aspects are crucial to service innovation, existing disciplines that handle questions of understanding the human mind and behaviors comprise a vital, integral part of service science.

FIGURE 7. The Three Categories of Services



Source: FRI.

Kioymizu further divides the services that target business functions and operations in the following ways.

① Services centered on work service, specialized skills, and human knowledge and information, with little connection to commodity goods
- Personal services dealing with physical labor (e.g. porters)
- Personal services dealing with specialized skills (e.g. hairstylists, gardeners)
- Personal services dealing with specialist knowledge (e.g. teachers, lawyers, accountants)

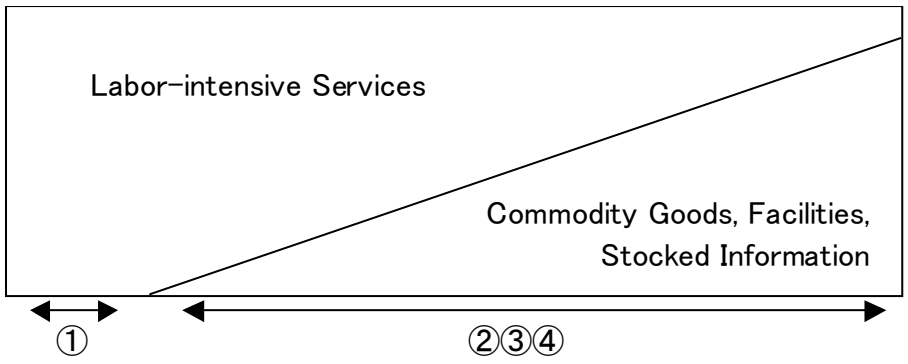
② Services that provide commodity goods/equipment: commodity goods that provide intangible value
- Commodity goods/facilities (e.g. museums, bridal facilities, meeting/conference facilities)
- Physical service establishments (e.g. services that use facilities such as aquariums, zoos, theatres for conducting/performing sports, music, etc.)
- Laundromats, karaoke facilities, ATMs, and other services with purely physical elements
- Commodity goods/facilities provided exclusively for rental or lease

③ Services handling money (financial)
- Financial services, credit services

④ Services handling information not provided by a human being
- Specialized information-services for information gathering
- Specialized information-services for information processing
- Specialized information-services for information storage
- Specialized information-services for information transmission
- Specialized information-services for information production

These services cover a wide range, extending from those dealing purely with human/social capacities to those related to commodity goods and facilities (Kiyomizu (1994)). Specifically, services under ① are provided independently, but services provided in ②～④ are tied to commodity goods, facilities, and stocked information. Graphically, this can be represented in the following way (Figure 8).

FIGURE 8. Services Dependant on Labor-intensive Services and Commodity Goods



Source: FRI.

In the cases of ②～④, there are several key points: First, how are prices stipulated for total services between clients and companies? In conjunction with this, within the

total price of services, how should costs be divided amongst commodity goods, facilities, stocked information and labor-intensive services—e.g. those services that require human labor? For these kinds of services, the construction and purchasing costs of commodity goods, facilities, stocked information, and other such elements are known, but the added value of services is more difficult to parse and is not readily apparent to clients. As a result, the cost (value) of labor-intensive services is usually buried in the costs of commodity goods and facilities, and man-month based assessments are common. The fact that clients do not readily recognize the value of these labor-intensive services is one reason for low productivity in services. Overcoming this issue is itself an important theme for service science, and thus "the elements distinct from commodity goods and facilities within services"—i.e. know-how and other factors related to labor-intensive service—and the relevance of commodity goods and IT to these aspects are the primary objects of investigation in service science.

Before proceeding, it is important to clarify the differences between commodity goods and services. Services are generally characterized as:

① Intangible
② Ownership rights are not transferable
③ Difficult to compare/assess before purchase
④ Production and consumption occur simultaneously

Here, the characterization of services in ③ (Difficult to compare/assess before purchase) is particularly important in the pursuit of service science. Generally speaking, the reason for this difficulty stems from challenges in assessing proffered services prior to their purchase; this challenge makes it difficult for the accurate appraisal of the price of services on the provider side, which in turn elicits the fear of unknown risk on the part of the client. As mentioned above, this difficulty in appraisal is connected with low productivity for providers and discontent for consumers. Thus, particularly important objects of study for service science are those services for which the level of pre-purchase comparison and assessment is very difficult and complicated.

In its most simple form, services are essentially "value jointly created through the interaction of providers and clients". This value creation is a complex process consisting of a myriad of clients and providers, and thus many services are especially difficult to compare and assess before purchase. Such services are usually referred to as a "service system," and these are the primary objects of service science. Thus, services falling under category ① (Services centered on human knowledge, information, skills, and work service, with little connection to commodity goods) have a low priority within service science. Instead, service science is more concerned with services that deal with a

number of participants and that are conducted through multi-phased business processes. IT services are a common example of this kind of service, due to their complex nature and use of IT.

As previously mentioned, service science does not deal exclusively with those services conducted within the service industry. Currently the manufacturing industry also employs a variety of services as part of offers to clients, such as repair, maintenance and other activities. Even though such behaviors do not fall within the category of industry known as the "service industry," they are still within the bounds of the field of service science.

2.2.2 Differences between Japanese and Western Perceptions of Services

Perceptions, conceptions, and the level of importance of services differ between Japan and other nations. Ignoring these differences runs the risk of misunderstanding the correct meaning of the concept of service science in the original American sense, as well as the risk of misapplication in Japan.

Kondo (2004), who examined research regarding service science in the U.S. and Japan, remarks that the subject of service management (sometimes called service marketing) had already been in place within many business administration programs in European and U.S. schools, whereas these subjects were uncommon in Japan. Kondo stresses that in Japan, the sense of traditional Japanese spirit—that service provided should be free—is emphasized in jobs related to interpersonal relations, such as in the service sector, which has resulted in the neglect of services as economic assets. Services are viewed entirely as the attitude and posture of service providers, and the concepts of "service as activity," "service as the production activity of value," and "service as economic assets" are still underdeveloped. Rather than seeing service as an economic asset, there is even a trend to regard service as a form of self-sacrifice for which little or no remuneration should be received.

Furthermore, within Japanese businesses in the distribution industry such as department stores and supermarkets—where services should be treated as products—most interest is focused on the object of distribution, e.g. commodity goods. Within public transportation such as railways and airlines as well, management's emphasis is primarily on equipment such as installations and mechanical systems. Service—the actual object of transaction in these businesses—is being concealed in the shadow of the commodity goods and systems that produce it. In this way, the concept of service in Japan is not clearly defined, and academic disciplines dealing with services

have not progressed. Thus, it seems that in corporate Japan, more so than in other countries, there is a need to be fully aware of the difficulty in rational price setting for service itself, and in order for service science to take root in Japan, a clear definition of the term “service” is a prerequisite.

The new academic discipline of service science is built upon the existing European and U.S. disciplines of service management and service marketing. In Japan, it seems the discussion of service science has proceeded without understanding the essential gap and differences between service management and service science. In Niwa (2005) for example, it is suggested that the service science debate must first investigate the relevance of the pre-existing discipline of service management. As previously mentioned, though service science was the original term for the discipline, it has grown to encompass services science, management, and engineering (SSME) as well, which includes service management. Niwa’s observation that, despite similarities, service science and service management are in fact different on a certain level is a very important point. By drawing attention to consulting as an intellectual service-based industry, Niwa expects service science to progress along a different path from previous service management. Certainly, consulting differs from standard services in numerous aspects, as it is “a new field within the service industry,” “a developing field,” and “a high value-added field,” and it is one field that highlights the characterization of service science as a learning system that is different from conventional service management. IBM is also currently emphasizing consulting activities as an important link between IT and business, and in this way IBM seems to hold some common ground with Niwa.

2.3 What is Service Science?

2.3.1 The Emergence of the Concept of Service Science

As previously mentioned, the concept of service science grew out of the increasing importance of services set against the backdrop of low productivity in the service industry. In response to this, the goal of service science was to promote innovation in services and increase service productivity. In essence, service science focuses on those services that: handle multiple providers and clients (i.e. service systems), are conducted in multi-phase business processes, and necessitate the frequent use of IT.

In the past, the field of services was treated as nothing more than one aspect of business administration, marketing, or operations research, and an emphasis was placed on human experience and intuition. Service science has risen as a backlash against the previous status quo, and aims to analyze services from a scientific

perspective and to stimulate innovation. In other words, it aims to research services in the same scientific manner that spurred success in the manufacturing industry, and to make it easier to increase productivity through a scientific approach to modeling. At the same time, service science also aims to make it easier for both clients and providers—the joint creators of value within services—to forecast the future effects and risks of introducing services, and to allow rational sharing of these effects and risks.

The concept of service science dates back to 2002 as the brainchild of the collaborative research team consisting of IBM's Almaden Research Center and UC Berkeley's Professor Henry Chesbrough, who set about researching service from the viewpoint of social engineering systems (Morimoto & Sawaya, 2005). The team, based out of IBM's Almaden Research Center, was established as a service research group within IBM Research in December 2002.

In December 2004, the concept of service science stepped into the limelight when IBM's CEO and chairman, Samuel Palmisano, published an article in the U.S. Council on Competitiveness journal *Innovate America*, in which he called for promoting research into "service science." (In July 2005 this term was replaced with Services Science, Management and Engineering (SSME).)

In particular, the report emphasizes that innovation is key, and that it is born from the intersection of different kinds of knowledge. To this end, promoting an interdisciplinary approach is crucial. Service science embodies this, as it is the fusion of the pre-existing fields of computer science, operations research, industrial engineering, mathematics, management sciences, decision-making theory, social and cognitive sciences, and legal sciences. According to Palmisano, service science will transform all businesses, and will spur innovation through the intersection of business and technological expertise. He goes on to write that service science should be seen as a new academic discipline with a curriculum drafted jointly by universities and the corporate world that will cultivate human resources, and that this new academic discipline will transform service and business.

2.3.2 What is Service Science?

Currently there is no commonly accepted theory that answers the question, "What is service science?" The concept of service science has only just emerged, and there is no consensus as to what the concept implies. The forerunners of service science—those connected with IBM and American university instructors—talk about service science with a variety of images, and the content of their commentary also differs from time to

time, but it seems that ideas are gradually converging.

The following section presents the common conceptualizations of service science. Viewpoints that combine academic aspects and business aspects are particularly common.

① According to the *Innovate America* article mentioned previously, service science is a new discipline that encompasses the interdisciplinary study of computer science, operations research, mathematics, decision-making theory, social and cognitive sciences, and other fields. This new discipline seeks to tackle the core problems of innovation in the 21st Century, including how to restructure organizations, how to manage technological innovation, and how to simulate systems with complex behaviors. Service science seeks to develop the knowledge base necessary to solve problems in the design of business processes as well as organizational issues, and to provide a foundation for the analysis of decision-making and leadership.

② According to Paul Horn, head of IBM Research, service science is the interdisciplinary application of science, engineering, and management for the purpose of improving services. Service science also contributes to systematic innovation and improved productivity, and is the guiding force for the improvement of services through improved predictability in the productivity, quality, performance, compliance, development, reusability of knowledge, and operational innovation in services. Further, service science probes the value of service providers and clients within collaborative activities and risk sharing (paraphrased from IBM Research documents).

③ The views presented by IBM at the conference they hosted in May 2004, "The Architecture of On-Demand Business," describe service science as the tangent of business and expertise, and a new approach for fostering innovation (paraphrased from IBM Research documents).

The discussions at the May 2004 conference highlight four main fields as the focus of service science: business strategy, business process, human resources, and fundamental technology. The details of these discussions can be summarized as follows:

A) Business Strategy: There is already a great deal of research regarding business strategy, but this research was technological and artistic rather than based on scientific investigation. In service science it is crucial to examine how to convert business strategy into formula in a scientific manner, how to conduct modeling, how to introduce quantitative forecasting and reasoning, and how to transform business strategy into something with high future predictability.

IBM's CBM (Component Business Model, see Figure 9) is useful for understanding this framework. Service science is expected to facilitate business structuring and quantitative modeling by combining IT, economics, and business strategy research.

B) Business Process: For the business process, service science is seen as a way to optimally apply mathematical models for demand analysis, supply planning, price setting, and other aspects of recurrent business. Business processes are not conventionally subject to modeling, but service science aims to utilize applied mathematics, operations research, management sciences, computer science and other fields in order to optimize business processes. Specifically, business processes targeted by service science include revenue projection, contract price setting and personnel allocation.

The formulation and diffusion of industry standards is also an important aspect of optimizing the business process. To this end, service science seeks to investigate various topics, such as business models, the optimal methods of adopting standards, and performance measurement indices for comparable analyses of industry performance standards in vertical and horizontal industrial structures.

C) Human Resources: To achieve management goals within the dynamic business environment, employees who can respond to changes with speed and flexibility are critical. Cultivating human resources is crucial for achieving this goal.

D) Fundamental technology: This field encompasses business performance management, information integration, security and privacy. Business performance management aims to use real-time models as a base to monitor companies' performance and enable consistent, optimal decision-making. Information integration addresses the need for providing decision-makers with the proper context and details necessary for executing decisions amidst the burgeoning volume of information available on the Internet. To this end, information integration offers a variety of tools such as consistent and timely data collection, the collection of unstructured data, technology and methods for search engines and analyses, and communication between relevant groups both outside and inside of the company. For security and privacy issues, emphasis is shifting from a technological concern to a management concern, and is becoming a crucial matter within the service provision phase. Service science aims to contribute to smooth communication between providers and clients.

Spurring innovation, raising productivity, and improving both provider and customer satisfaction, requires examining the previously intuition-based and experience-based cliental business of services (i.e. business strategy and business process) through a multi-disciplinary approach and a scientific lens. In other words, it is imperative to analyze services scientifically from the perspectives of business administration, business strategy theory, industrial engineering, operations research, law, and other disciplines. At the same time, it is important to wield various fields such as IT and computer science, as well as those with a human element such as social and cognitive sciences, as tools to enable scientific methodology such as modeling to direct business strategy, business process design, organizational structuring, and other forms of decision-making and leadership. In this way, the accuracy of future forecasts concerning the investment effects and risks of services can be increased, and providers and clients will be able to accurately grasp the value of services. To achieve this, personnel who are versed in business and IT and who have a high degree of expertise regarding social sciences are indispensable; failure to cultivate such personnel means that the possibilities for developing a highly productive service sector in the future are bleak. As a result, it is necessary for both universities and the nation as a whole to work together to establish the new discipline of service science, which is designed to foster human resources through the synthesis of these pre-existing disciplines.

From a business perspective, it is necessary to acquire new business methods through various means, such as constructing effective IT systems, rationalizing business processes, and exploiting the Internet. This requires creating service assets that are reusable, standardizing services, and conducting modeling in order to make it easier to replicate services and provide them effectively.

The relationship between service and science is another subject that must be addressed. It is important to reiterate that over the course of much discussion the concept of service science has grown from merely “science” to include engineering and management as well. However, as is clear from the various definitions for service science mentioned above, previous forays into service were handled as primarily intuitive and experiential and were not the subject of scientific study, and thus discontent continued to grow as a result of the high level of uncertainty regarding the effects and risks of implementing services. Thus, the common undercurrent in the various definitions of services above is the goal of improving the ability to scientifically forecast and estimate effects and risk with more certainty via modeling—i.e. they all emphasize the element of science. There are many who hold the opinion that services and science do not converge. As a discipline, service science attempts the difficult task of

using scientific theory to improve future predictability by synthesizing the human elements that are an important yet complicated part of services with scientific methods such as modeling as a base for analysis.

3. The Response to Service Science in the U.S.

3.1 The Development of Service Science: IBM-University Partnership

3.1.1 The Background behind the IBM-University Partnership

IBM has been the primary leader of service science in the U.S., and has been active in promoting the concept through joint efforts with universities.

Behind IBM's partnership with universities in the field of service science lies the company's past experiences with university cooperation during the formulation of "computer science." IBM played a major role in the development of computer science during the 1950s. At the time, the field of electronics was already established, and the necessity of a new field called computer science faced a certain degree of skepticism, but through the donation of computers to universities IBM established the study of computer science. By supporting the creation of this new discipline, IBM provided great contributions to industry and society through its subsequent business development. Through the new topic of service science, IBM is once again hoping to contribute to the promotion of innovation in services in the same manner as before, by linking up with universities and cultivating personnel who can lead new services on a global level.

A concrete example of this IBM-university partnership can be seen in IBM's relationship with UC Berkeley. According to documents provided by IBM Research, the genesis of this partnership dates back to a debate regarding service science at the April 2003 IBM-UC Berkeley Day. Following up on this debate, IBM began hosting numerous conferences regarding service science at its research center, inviting university professors to participate. In May 2004 IBM hosted a particularly large-scale conference, and during this same year the company selected service science as a primary theme for information exchange and cooperation between 35 U.S. universities by participating in joint workshops and creating the future curriculum for service science. IBM also offered an IBM Faculty Award to the professor who accomplished the greatest achievement in service science research.

Furthermore, in May 2005 IBM presented its service science course to universities through the IBM Academic Initiative. IBM is scheduled to supply the participating universities with the course material stipulated in the curriculum.

3.1.2 Service Science Curriculum in U.S. Universities

There are currently a number of instructors who are in the planning phases of establishing service science courses in conjunction with IBM materials. At present, however, no universities have finalized a service science curriculum. There are thought to be dozens of U.S. universities that are planning to adopt service science as a program, with the following five schools being the curriculum's foremost representatives:

- UC Berkley
- MIT
- Stanford
- Rensselaer Polytechnic Institute (RPI)
- Northwestern

Among these, UC Berkley has made the most headway in introducing service science, with a service science program scheduled to begin in 2006. This program will combine a variety of newly created service science-related courses with existing courses, and the program's overarching vision is to provide the students (masters-level) with "service science qualifications."

3.2 Connections with Business

Service science is, in the end, intended to be linked with business, and it is anticipated to raise productivity for service businesses on the provider-side as well as increase the future predictability of business effects and risks on the client-side, thereby improving business' capacity for steady growth.

Once again, IBM is the leader in linking service science with business. In 2003 IBM inaugurated the research of service science at California-based Almaden Research Center, and according to an article by Almaden researcher James Spohrer, carried in Japan's *Nikkei Business Daily* (28 September 2005), there are currently about 60 full-time researchers dedicated to service science at the center. Improving the efficiency of services with productivities that are difficult to measure numerically is a common global issue, and IBM's intentions are thought to lie in strengthening service science research for the IBM Group as a whole and expanding its business information systems.

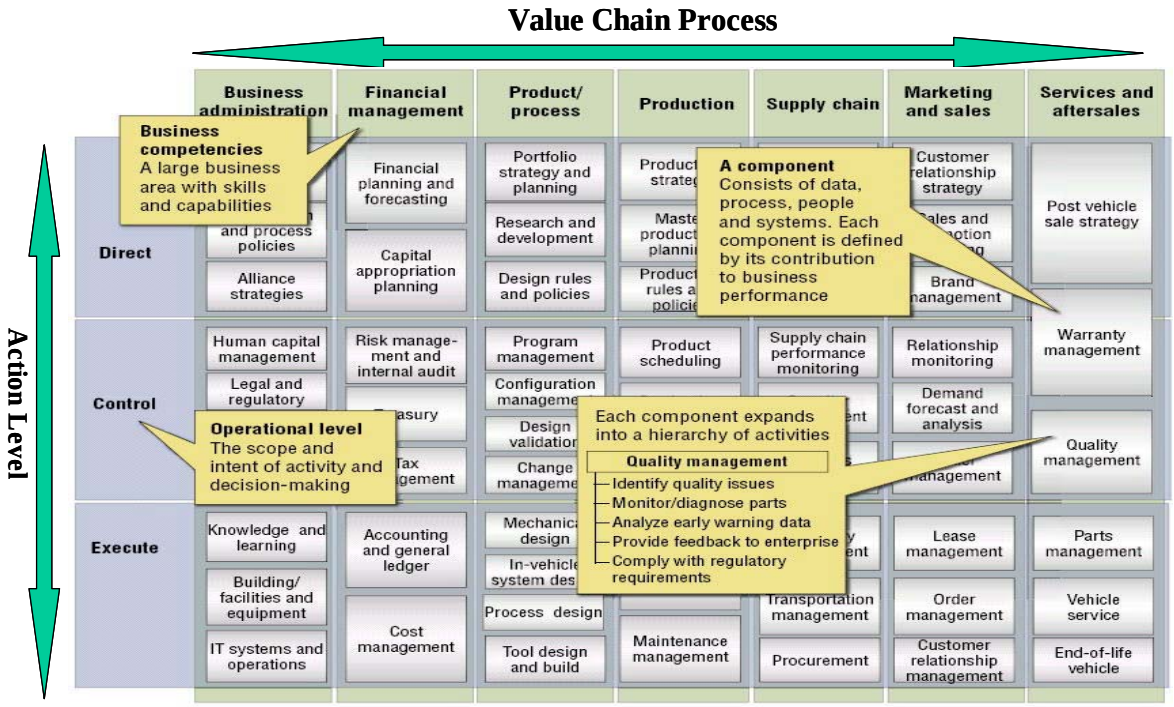
According to IBM's website, there is a deep connection between service science and IBM's BPTS (Business Performance Transformation Service) department. BPTS is a service field for the support of IT-based corporate change through consulting and subcontracting. This field is expected to have annual growth of around 9%, and service

science can be seen as playing the supporting role.

Further, in the actual field of consulting the business process is broken down into component parts (componentized) in order to facilitate strategic analysis of each process based on performance indicators. More specifically, the field of consulting aims to make companies more flexible and adaptable to changes in the business environment by acquiring competitive superiority. This is achieved by componentizing/modularizing the business process into individual components/modules to determine which components should have priority, and constructing superior decision-making models for each component. This is the very trend that service science is moving towards, and there is growing awareness that this is the pivotal direction toward which technology is moving in the years to come.

CBM (Component Business Model) is one instance of componentizing the business processes for common industries that is already being tested. CBM visualizes the structure of business models and is being hailed as a concrete example of how service science can support the appraisal and improvement of the structure of business processes.

FIGURE 9. An Example of Componentizing the Business Process: Car Warranty



Source: IBM homepage.

Furthermore, it is possible to see the relationship of service science with business through service science-related patents. IBM researchers are already in the middle of applying for a number of patents in the service science field. One such patent is the "Business Practice Alignment Method," which describes systematic methods for sifting through conflicting business customs when two companies merge.

4. The State of Service Science in Japan

4.1 Efforts by Japanese Companies

4.1.1 IBM Japan's Approach

In Japan, the most active proponent of service science is IBM Japan. The aforementioned September 2005 issue of the *Nikkei Business Daily* reported that the field of service science had been designated as a new priority research field at IBM Japan's Yamato Research Institute. The article goes on to mention that service science will join supercomputing research, digital consumer electronics software development, and autonomic computing research (i.e. computers that resolve errors automatically) as one of IBM's four priority research fields. The article's description of service science is somewhat mistaken, however. The article explains service science as "A new academic discipline focused primarily on the analysis and research of the service industry, such as healthcare, retail, and finance. It is connected with improving productivity and technological innovation through the scientific analysis of methods of organizational operation and quality control. In addition, the report on the U.S. Council on Competitiveness's December 2004 National Innovation Initiative Summit hails the stepped-up commitment to service science." That service science targets the analysis and research of the *service industry* seems to be the newspaper company's misunderstanding; the subject of service science is not limited to the service industry.

Out of the four priority research fields raised by IBM Japan's Yamato Research Institute, the new research field of service science is highlighted as being an area of particular emphasis for the coming years. One example illustrative of Yamato Research Institute's intentions for service science is its use in analyzing whether or not internal reorganization is connected with positive results by mathematically analyzing inter-office mailings, thereby facilitating effective reorganization. In this way, IBM's Yamato Research Institute has already raised business organization as a topic for scientific analysis through service science.

In order to strengthen the research and development of service science, Yamato Research Institute has appointed 20 full-time service science researchers to its Tokyo

Research Laboratory. Additionally, the institute has declared its intentions to pursue partnerships with various companies' research institutes and universities in order to establish a methodology for service science.

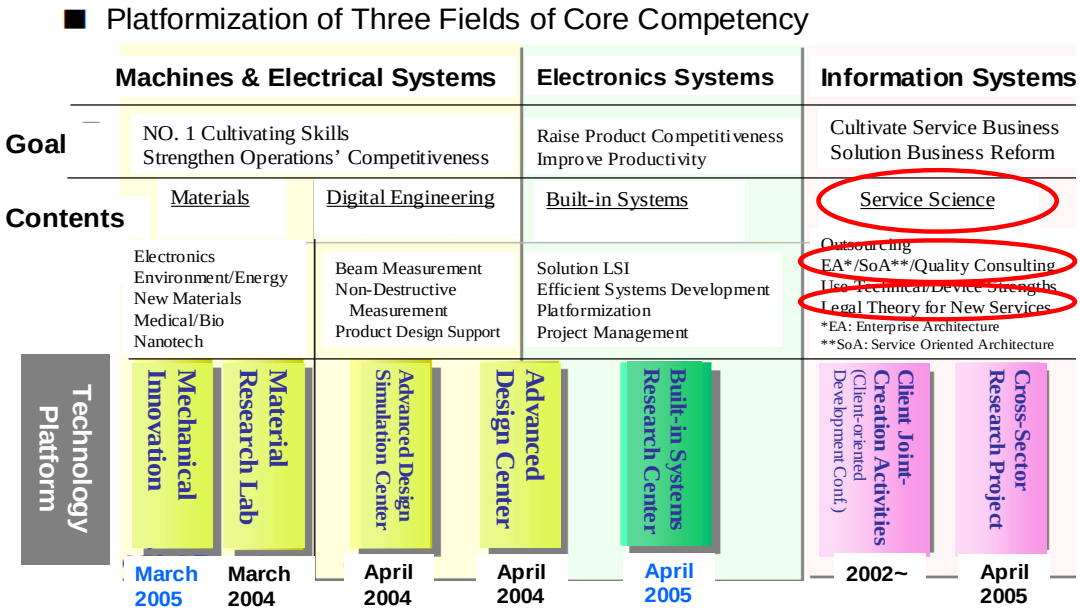
On September 9, 2005, IBM Japan's Tokyo Research Laboratory took concrete steps toward realizing this goal by bringing together MBA and Management of Technology (MOT) instructors from Japanese universities with the hope of conducting joint research. IBM hosted the Service Science Symposium at its Hakozaki office, inviting approximately 40 experts from various graduate institutions (Tokyo University, Tokyo Institute of Technology, Hitotsubashi University, Waseda University, Keio University, Japan Advanced Institute of Science and Technology, and Miyagi University) and companies (Hitachi, NEC, etc.).

At the conference, James Spohrer, director of services research at IBM's Almaden Research Center, defined services as "the creation of value between provider and client." Spohrer stressed how service science can enable the forecasting of effects and risks in services, and how it can also improve forecasting capabilities in all aspects of performance—i.e. productivity, quality, and behavior—and in compliance, growth, and the effects of education as well. He also emphasized the importance of information systems in service science: he visualized information systems as the core, surrounded by technology, management, and organization. According to Spohrer, a new level of cooperation and integration with third parties is crucial. He noted that the roles of these core information systems will themselves change as a result of third party interaction, and presented an analytical framework for understanding service science within this dynamic relationship. Spohrer depicted the elements of information systems, technology, management, and organization as forming a large-scale service system. He also pointed out that service operations are the compensation for jointly created value between providers and clients, and that, in practice, the question of how to convince both sides to accept the price of services will become an important theme for service science.

4.1.2 Hitachi's Efforts

Hitachi is currently moving in the direction of platformization, and divides fundamental core competency for the coming years into three fields: machines and electrical systems, electronics, and information. The goals of the field of information are 1) the cultivation of service business, and 2) solution business reform. Service science is presented as the actual content of the efforts in this field.

FIGURE 10. Position of Service Science within Hitachi, Ltd.



Source: Hitachi Ltd.

4.2 University Efforts

In the Japanese academic world, Japan Advanced Institute of Science and Technology, Hokuriku (JAIST) is proactively engaging the issue of service science. Centering on Professor Akio Kameoka, JAIST actively participated in IBM's conference on service science, and is currently engaged in collecting and analyzing information related to the field. In addition, there were also several presenters affiliated with JAIST at a conference hosted by the Japan Society for Science Policy and Research Management.

JAIST also recently announced the syllabus for a graduate level course on the theory of service science, and the school is scheduled to begin lectures very soon. The syllabus stresses the importance of the service sector as an industry within the knowledge society, and also emphasizes the significance of providing services for a company's corporate competitiveness. Viewing service science as the major field for the next generation of MOT, the syllabus tackles the basic concept and newest theories of services, vows to deepen understanding of how to apply these concepts, and promises to cultivate innovative human resources with broad, pragmatic knowledge of service innovation.

The actual details of the lecture are as follows:

①What are Services? An overview of the basic concept of services

②The Fundamentals of Service Science: Why Service Science is important and

where it is headed
③The Structure and Issues of the Service Industry and Service Society
④"Innovation Is Something You Can Feel"—The innovation process in the service industry—"Service Innovation"
⑤Efforts and Theories of Service Science I
⑥Efforts and Theories of Service Science II
⑦Service Science Research in Europe and the U.S.
⑧Case Study: An Empirical Example of Service Innovation
⑨A Discussion of Service Science by Field (legal sciences and services, service management)
⑩ Service & Property Research: Learning from companies with service excellence, Lecture I: Hotel
⑪ Service & Property Research: Learning from companies with service excellence, Lecture II: Food Manufacturer (call center)
⑫The Service Innovation Process (group discussion)
⑬Group Research Topic Presentations I
⑭Group Research Topic Presentations II
⑮ Issues and Policies for Service Science and Service Innovation (comprehensive discussion)

4.3 Efforts by Institutes and Societies

The Japan Society of Science Policy and Research Management (JSSPRM) is an organization dedicated to the research of how companies' manage R&D and technological development, as well as national and local governments' science and technology policies. In the JSSPRM's MOT Subcommittee, service science is a current topic of debate. Just as service science began as a part of MOT and MBA in the U.S., in Japan it started as a topic for MOT within the JSSPRM.

At the JSSPRM's October 2005 research report session, a large number of reports concerning service science (such as regarding knowledge management) were presented, indicating that interest in service science is growing in Japan as well.

4.4 Issues facing Service Science Efforts in Japan

In Japan, research and education regarding service science has finally entered into the preparation phase. In addition to the common needs for service science that it

shares with the U.S., there are other factors that lie behind its emergence as an important topic in Japan. One such factor is the stubborn trend of viewing services as simply a psychological topic, or in other words as a sacrifice that the company must make, such as offering low prices. Due to the inaccuracy of this view of services, the need to treat services as an object of scientific inquiry is particularly strong. However, efforts toward service science in Japan face several issues and difficulties. These challenges are outlined below.

4.4.1 Lack of Effort in Treating Services Scientifically

In Japan, there is a strong practice of perceiving services less from a functional or operational perspective than as a spiritual and attitudinal aspect of business, or as a sacrifice that must be provided for free or at very low cost. As a result, the development of academic disciplines such as service management or service marketing—fields that analyze services from functional and operational viewpoints—has lagged behind Europe and the U.S. More directly, Japan has a very ambivalent attitude in regards to treating services as an object of scientific inquiry.

To remedy this deficit it is crucial that services are analyzed scientifically through the diffusion of service science. To this end, it is necessary to start by raising awareness of the functional and operational facets of services, to learn from service management, service marketing and other fields, and to examine where the gap is between these existing fields and the new discipline of service science. As a result, a good deal of time will be required for the concept of service science to diffuse throughout Japanese society.

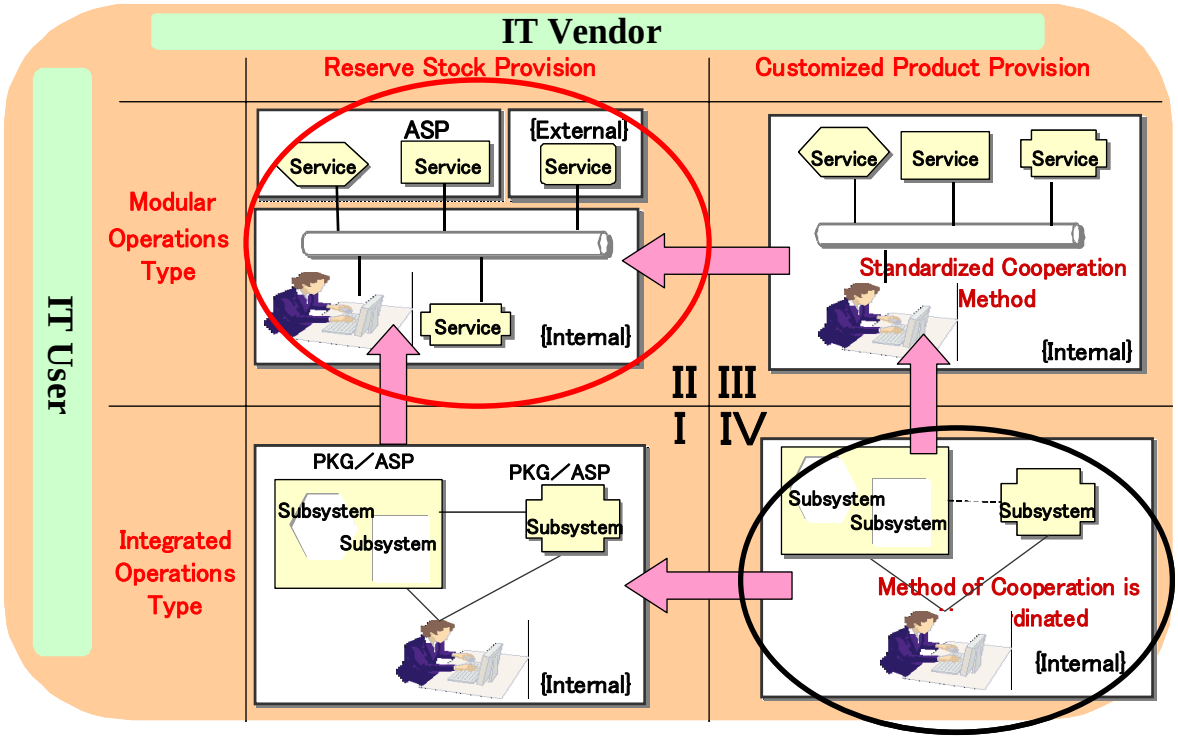
4.4.2 Lack of Effort in Componentization/Standardization of Business Process

In practice, Japanese businesses don't like to break up their business processes into component parts and utilize modularization and standardization in order to conduct multipurpose, mathematical modeling. Furthermore, there are very few Japanese businesses that examine the nature of their everyday business processes by commercializing their core processes and offering them to other companies, or by outsourcing their non-core processes to companies offering best practices.

Client businesses can be placed within four different quadrants. The vertical axis contains two categories of client-side operational structures: modularized or integrated. The horizontal axis contains two categories of client-oriented provision styles on the provider-side: standardization or customization of service products. Generally speaking, major U.S. companies fall into the first quadrant, U.S. venture firms fall into the second,

Japanese medium and small companies fall into the third, and major Japanese companies fall into the fourth. Service science is oriented toward modularization of business operations and standardization of service products—in other words, quadrant two. In the U.S., companies with a high potential for absorbing service science already exist: venture firms. At the same time, major U.S. companies in the first quadrant can become a relatively easy target for service science by moving from customization to standardized products. On the Japanese side, it doesn't seem very difficult for medium and small Japanese companies currently residing in quadrant three to shift to quadrant two. The real problem lies in quadrant four companies, i.e. major Japanese companies, for which the transition to quadrant two seems particularly challenging. This is because such companies must undergo a multi-phased reform process of first converting their operations from integrated to modularized, and second replacing customized products with standardized products. As a result, Japan does not have an environment where the concept of service science can be readily accommodated (see Figure 11).

FIGURE 11. Compatibility of Service Science for Japanese and U.S. Companies



Sources: Based on data from Professor Takahashi (Miyagi University) and FRI. Diagram by FRI.

4.4.3 Educational Infrastructure in Japanese Universities

The target of the new service science discipline within the Japanese educational world is, like U.S. graduate schools, MOT and MBA courses. However, service science demands the integration of a high level of expertise in business knowledge, IT knowledge, and cognitive and social knowledge. The success of service science therefore hinges on whether or not courses that can fulfill these three fields simultaneously exist in Japan, and whether or not such courses can be established. Though the service science conference hosted by IBM Japan featured lectures by Japanese professors from MOT and MBA courses, there is a great need to expand such opportunities in the future, and to make sure that the content and level of awareness live up to the demands of university-level research.

4.4.4 Lack of Openness in Business

The field of service science is the interdisciplinary integration of fundamental IT technical bases and cognitive and social science bases. When cultivating an interdisciplinary field, if each discipline does not present and exchange information there can be no progress—in other words, a world of open innovation is necessary. IBM's posture of openness is highly acclaimed on this point. Individual activities resulting from such efforts are indispensable to the future of the service industry, and are based upon accurate and strong awareness. Many Japanese companies must also wake up to the realization that this kind of open posture holds the key to not only a new academic discipline but also to the development of new industries.

4.4.5 Cooperation between Consultants and Researchers

The field of service science requires the cooperation of universities and the business world coupled with the cooperation of consultants, IT researchers, and cognitive and social science researchers. In Japan, however, joint efforts between such groups have been very weak. The key to service science lies in how the cooperation of these diverse groups will proceed. Miyashita et al.'s (2005) report on an empirical survey regarding cooperation between consultants and researchers at IBM Japan was the first step in this direction.

It is clear that Japan has not been gifted with an environment that is positively oriented toward the development of service science. In spite of this, or perhaps because

of this, the importance of service science in Japan is very high. It is crucial for Japan to overcome its handicap in service science and cultivate the wisdom and effort needed to develop this field.

5. Conclusion

The elusive concept of service science was born in the U.S. and is now spreading throughout Japan. There have, of course, been numerous individual studies of service in Japan, but various fields always conducted such research individually, and thus there had been no systemization of service as an academic discipline. However, service—up until now a subject of intuition and experience, and a field very difficult to study scientifically—is now becoming one of the most important sectors in industrialized nations throughout the world. Furthermore, service innovation, the improvement of productivity, the forecasting of effects and risks, the proper distribution of value co-created by providers and clients, and other issues have become increasingly important topics. For these reasons, service science has become a much-anticipated field in recent years.

Unfortunately, Japan is not blessed with an environment that is as conducive to promoting service science as the U.S. Since the need for service science is higher in Japan, however, it is thought that the benefits of service science will be that much greater.

Service science is still in the beginning phases, and thus it is still too early to predict what benefits it will bring in the future, or whether it will simply stall. However, just as in the field of hardware, this field also aims for standardization, and if Japan sits idly by, there is a strong danger that it will suddenly find itself forced to submit to U.S. standards. The importance of cultural and human elements in services is so great that they are virtually incomparable with hardware, and thus it is crucial that Japan conduct standardization in line with its own conditions. In this way as well it is critical that Japan promotes service science at its own initiative, carefully considers the conditions of services in Japan while continuously improving its shortcomings, and presses steadily forward while weighing the peculiarities and characteristics of service development that are unique to Japan.

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