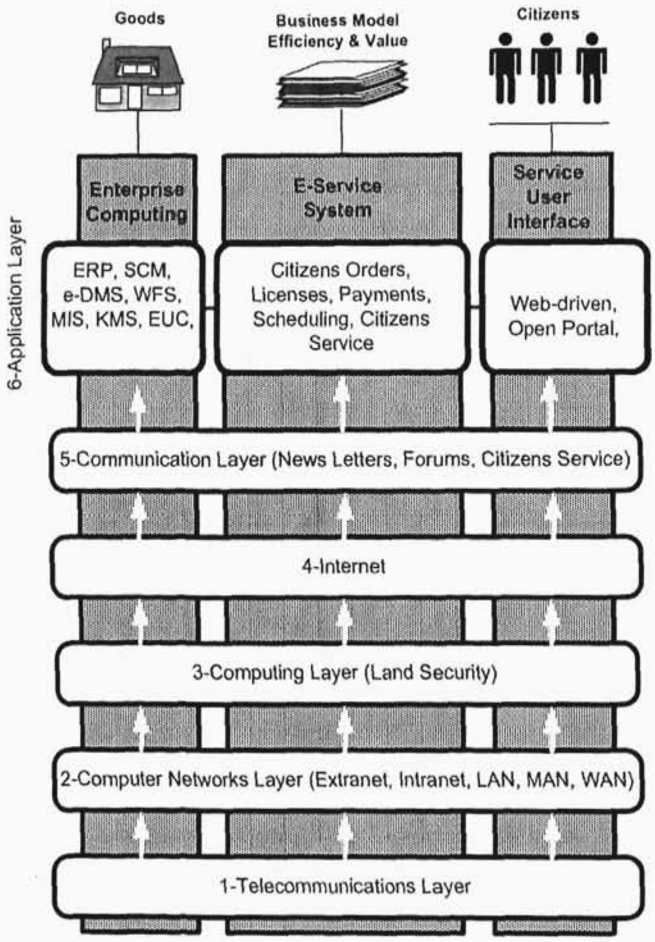
Figure 11-5. The architecture of a citizens and community e-service system (ERP - enterprise resource planning, SCM - supply chain management, e-DMS - electronic document management system, WFS - work flow system, MIS - management information system, KMS - knowledge management system, EUC - end user comupting)

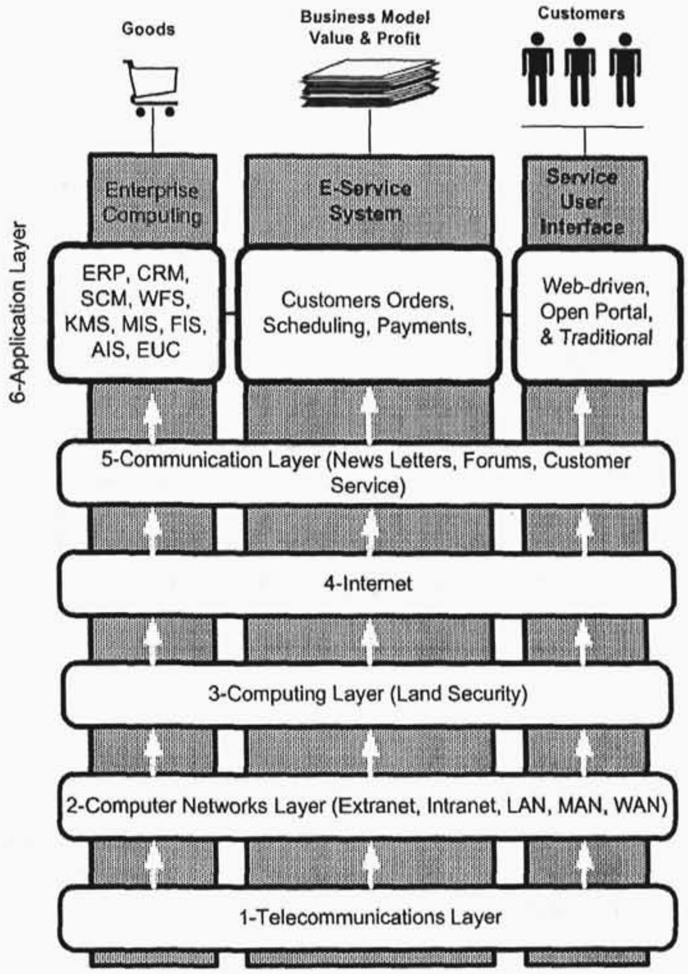


- MIS–management information system, composed of transactions processing system (TPS), enterprise data base management system (EDBMS), enterprise performance management system (EPMS), and executive information system (EIS)
- EUC-end-user computing
- LAN-Local Area Network
- MAN-Metropolitan Network
- WAN-Wide Area Network
- GAN-Global Area Network
- Other

THE GENERIC ARCHITECTURES OF E-SERVICE SYSTEMS (E-SS)

Based on the application requirements provided in Table 11-2, two generic architectures are defined for the citizen and community e-service system

Figure 11-6. The architecture of a personal e-service system (FIS - financial information system, AIS - accounting information systems)

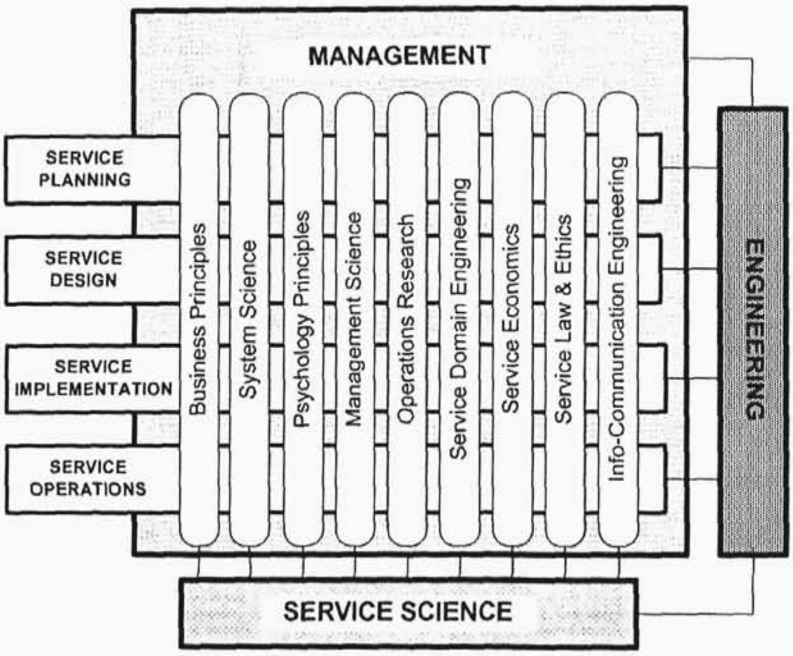


(Figure 11-5) and for the person e-service system (Figure 6). This is assumed that the enterprise system and end-user-computing are included in the e-SS.

Figure 11-5 illustrates the architecture of the citizens and community e-service system category. It indicates that the e-service system and service user interface vertical segments are new additions to the enterprise computing vertical segment. Furthermore, these segments are built from six horizontal layers: telecommunication, computer networks, computing, Internet, communication, and applications. These six horizontal layers are typical for enterprise computing. It indicates that if possible, a successful e-service system should be based on the previously developed enterprise computing.

Figure 11-6 illustrates the architecture of a person e-service system category. It also indicates the same regularities in the layer complexity as it was shown in Figure 11-5, reflecting a different e-service system category. However, the major difference between these two e-service system categories is in their application layers, where different kinds of services are provided in online processing.

Figure 11-7. The relationships among service science, management and engineering (SSME) approaches within the context of developmental and operational service stages



The presented e-SS architectures are generic and their system/network components should be tailored for a given kind of e-SS. Based on the provided architectures and application requirements provided in Table 11-2, one can develop generic architectures for other four types of e-SS.

Technology also affects the relationship between service providers and consumers in areas previously unthinkable, such as healthcare, where the need for personal contact to diagnose and treat ailments is becoming less essential. Internet-based banking, real estate, retail and financial services provide other examples where personal or on-site contact with service providers is no longer essential for the services to be performed. In many instances, such services can, in fact, be provided far more efficiently via the Internet or through other remote communication modes.

One of the most critical components of the e-SS in customer service is the provision of service to customers before, during, and after a purchase. Its importance varies by product, industry and customer. For example, an expert customer might require less pre-purchase service (i.e., advice) than a novice customer.

In many cases, customer service is more important if the purchase relates to a "service" as opposed to a "product." Customer service may be provided by a person (e.g., sales and service representative) or by automated means called self-service. Examples of self service are Internet sites. Customer service is normally an integral part of a company's business model. An example of a service delivery system for the Best Buy chain is shown in Figure 11-7 (the application layer of previous models is expanded). This model indicates that if enterprise systems are well developed then e-service system is a natural addition to them. The most critical systems for e-service are: portal, e-catalog, e-customer orders, supply chain management (SCM), customer relations management (CRM) and document management system (DMS). Such sub-systems of CRM not shown in Figure 11-7 are: e-customer service (Web-driven), call center, e-customer support (Web-driven), e-store, e-payment, e-field service, contact management, Internet relationships management, telemarketing, and so forth.

TOWARD THE SERVICE SCIENCE SCOPE

The second goal of this study is to define a scope of service science based upon the generic service systems offered in the previous sections.

The key to defining service science is the understanding of the nature of service. Nowadays, *service* is a complex system which is characterized by the following attributes:

1. It is aimed to satisfy a customer/citizen/society
2. It is a system composed of customer/citizens, service providers, service-oriented technology, and control-oriented technology (IT)
3. It is driven by value, time, cost, and profit
4. It is a "product," which is planned, designed, implemented ("produced"), operated, and managed

Based upon these attributes, one can define a matrix of developmental, operational, and management activities within a framework established by the IBM discipline named SSME (Glushko, 2008). Supporting the IBM framework are theoretical disciplines which include a set of theories and approaches integrated and called service science (Figure 11-7).

Table 11-4 defines key outcomes of service science areas within the framework of service stages.

The discipline of *service science* is the systematic study of the theoretical foundations of service development, operations, and management. These foundations are perceived as complex systems which are service-technology-oriented and service managing technology-driven for the benefits of a society, person, and property in the scope of tangible and intangible services.

A *mission* of service science is to pursue the interdisciplinary theory (verified in practice) based on selected rules of business, system science, psychology, management science, operations research, service domain engineering, service economics, service law and ethics with information-communication science (ICS) in order to apply them in service, planning, design, implementation, operations, and management.

As such, service science's *aim* is to integrate these particular disciplines into a *coherent whole*. In fact, IBM relabeled its initiative in this area as "service sciences, management, and engineering" to highlight the interdisciplinary nature of the effort. Furthermore, HP created a center for service and systems science for the same reason. Universities have also begun to act on the need or service science (SSME) as well. For instance, UC Berkeley has created an SSME program. North Carolina State University created an MBA track for service and a computer engineering degree for services well. In both cases, the schools recognize the interdisciplinary character of the field and incorporate content from a variety of disciplines. Other schools with interdisciplinary interests in SSME include the University of Maryland, Arizona State University, Northern Illinois University, UC Santa Cruz, MIT, RPI, and others.

Academic publications in SSME are also starting to appear. For instance, one can recommend the special issue of the *Communications of the ACM* (July 2006) focused entirely on service science. *The International Journal of Services Operations and Informatics* issued its first volume in 2006. One can expect that the mentioned strong supporters and universities' faculty will pursue the interesting and inspiring task of supporting the

Table 11-4. Key outcomes of service science

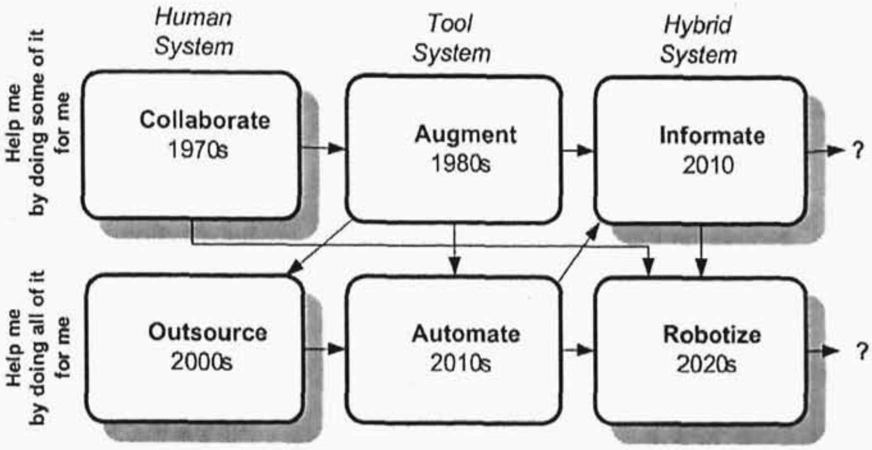
SERVICE SCIENCE AREAS	SERVICE STAGES				
	SERVICE PLANNING	SERVICE DESIGN	SERVICE IMPLEMENTATION	SERVICE OPERATIONS	SERVICE MANAGEMENT
Business Principles	Business Model	Business Model Revised	Business Model Implemented	Business Model Practiced	Service Project Defined
System Science	Service Model	Service Model Tested	Service Model Prototyped, Piloted, Implemented	Service Model Maintained & Improved	System Project Management
Psychology Principles	Customer Behavior Expected	Customer Behavior Updated	Customer Behavior Tested	Customer Behavior Updated	Customer Behavior Analyzed
Management Science	Decision Optimization Criteria	Decisions Optimized	Decisions Structured	Optimal Decisions Applied	CPM Applied
Operations Research	Service Optimization Criteria	Service Flow Optimized	Service Flow Established	Service Flow Operated	Service Flow Simulated
Service Domain Engineering	Service Processes Scopes	Service Processes Designed	Service Processes Implemented	Service Processes Maintained & Improved	Service Engineering Project Management
Service Economics	Expected Economic Impact	Economic Impact Verified	Economic Impact Tested	Economic Impact Updated	Local, National, Global Impact Managed
Service Law & Ethics	Ethics & Compliance	Ethics & Compliance Assured	Ethics & Compliance Observed	Ethics & Compliance Revised	Ethics & Compliance Controlled
Information-Communication Engineering	Architecture of CIS	CIS Tested	CIS Prototyped, Piloted, Implemented	CIS in Operations	CIS Project Management

U.S. service economy by theory-based service science.

THE SERVICE SCIENCE STARTEGY FOR INNOVATIONS

Perhaps the lack of academic involvement in systematization and innovation in the service economy put it in crisis. Gutek and Welsh (2000) write that "we are not thrilled with the quality of customer service today. Dissatisfaction with service has reached epidemic proportions in America—a sad state of affairs for a so-called 'service economy.'" According to authors Barbara Gutek and Theresa Welsh, this is because service businesses are not adapting to the changing nature of service delivery. Instead, they are trying to

Figure 11-8. The paradigms of service evolution



impose traditional aspects of customer service on completely new breeds of service. These tactics simply do not work and result in feelings of alienation, resentment, and cynicism in both customers and providers.

A role of universities in service innovation is to research the evolution of service delivery and teach students how to assure social and corporate responsibility in planning, developing, operating, and managing service systems. Figure 11-9 depicts a model[1] of service evolution by six stages and their paradigms.

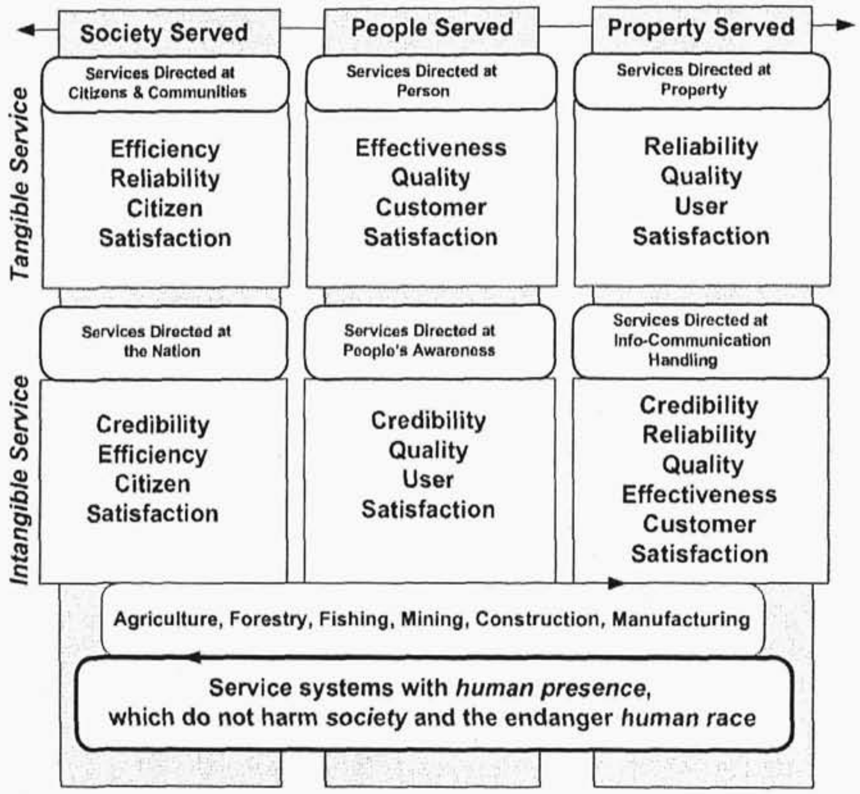
The *Collaborate Model* (1970s) is staffed with experts who can troubleshoot and easily explain to the service users all the problems with service since they created that particular service. Even today this is the case for start-up companies whose developers provide first-hand help to service recipients in areas such as software.

The *augment* model (1980s) applies service communication tools answering to the service users the most frequently asked questions (FAQ). The first FAQ system was initiated by phone and later was applied to Web sites. A service user must still find out by how to use a service by him/her.

The *outsource* model (2000s) delegates servicing to a third party located on-shore or most frequently off-shore (e.g., India). This model was triggered by the strategy of restructuring and cost-cutting by allocating manufacturing to China and IT projects and customer service to India as both countries provide low-cost labor. This model leads to the decline of middle class in developed nations and as far as customer service is concerned, is not embraced by the American customers because the level of help and expertise provided is rather low, perhaps due to the physical distance from the places of action.

The *automate* model (2010s) is supported by high-tech companies which need to engage their available (idle?) resources in the next wave of technology development. This model eliminates humans from service processes and generates market demand for advanced technology. This is a very controversial strategy first, in terms of a right technical solution and second, in terms of the right social solution. As far as the former is concerned, automation of *complex* service systems cannot be a reliable solution since many factors are not known for designers. For example, the FAA does not allow pilots to use an auto-pilot system in bad weather. If we look at the control

Figure 11-9. The developmental paradigms of six categories of services



rooms of many process installations, we see a lot of instrumentation, but we also wee operators who do nothing since the process control has been automated. In the case of an emergency, these operators very often do not know what to do because they are without practice of how to handle crisis situations. As far as the latter is concerned, service automation should not lead to the drastic decline of employment as it has occurred in agriculture and manufacturing. People should have something to do and have the necessary income to support their lives and the society (including the demand creation for high-tech companies), even with the cost inefficiencies! Particularly if the population is constantly growing! Technology, particularly computers, may merely further automate blue- and white-collar jobs, achieving unprecedented speed and consistency, robbing workers of whatever skill and gratification they may retain, and increasing the impersonality and remoteness of management.

The *informate* model (2010) empowers ordinary working people with overall knowledge of service processes, making them capable of critical and collaborative judgment about service. This model assumes some sort of automated information-communication infrastructure. However, it is operated and supervised by humans supported by e-information which leaves room for the human to conceptualize status (change) and required decisions filtered by human knowledge (very often under the form of given business knowledge, coming from data mining) leading to wise decisions finally made ultimately by humans. This model is particularly appropriate for semi-ill and ill-structured decisions under uncertainty.

This model to a certain extent co-exists with the automate model. A pilot who lands a plane by hand in a bad weather and a policeman who directs traffic when traffic lights fail (but is still in wireless communication with the command center) are good examples of this model.

The *robotize* model (2020) is a combination of the collaborate, automate, and informate models, particularly in a case of Japan. In some countries, there is a shortage in the supply of labor for industrial work, which drives up investment in robotics. With the present demographic trends, this shortage will be even more pronounced in years to come, which will further stimulate robotics investment in repetitive lifts involved in handling materials such as parts, beverage crates, and so forth. The number of robots is constantly increasing in manufacturing industry: Japan 280 per 10,000 people; Singapore 148; Rep. of Korea 116; Germany 102; Sweden 69; Italy 67; Finland 51; Benelux 49; United States 48; France 48; Switzerland 46; Austria 44; Spain 41 Australia 25; Denmark 24; United Kingdom 23; Norway 16 (UN/ECE NEWS, 2000). It is interesting that in Japan a robot does not replace a worker; rather the worker serves as its "master," taking care of it.

"Organizations that take steps toward exclusively automating strategy can set a course that is not easily reversed. They are likely to find themselves crippled by antagonism from the workforce and the depletion of knowledge that would be needed in value-adding activities. The absence of a self-conscious strategy to exploit the informating capacity of the new technology has tended to mean that managerial action flows along the path of least resistance—a path that, at least superficially, appears to serve only the interest of managerial hegemony" (Zuboff, 1988, p. 391).

The automation strategy of service creates the environment of jobbers, who are also required to act "automatically," leading in its conclusion again to deadliest, most sterile passivity history, which has been known since the fall of the Roman Empire (476 A.D.). This strategy will push humans into the bifurcation stage when complex systems designers will be very sophisticated people and the users of this systems will be very simple people. It has occurred in the history of the human race, when language-speaking *Cro Magnions* replaced the *Neanderthals*, who could only "bark" about 40,000 years ago in Europe.

The current role of universities is to launch service-oriented programs, whose systemic components to certain degrees are available and technologically are in the reach of the faculty and students. However, the most important role of the university is to research and teach the social, corporate, and personal responsibility in developing and managing ethical complex service systems!

In order to fulfill this noble task, the three laws of service systems cannot be violated by their developers and operators. These laws are similar to Isaac Asimov's approach to robotization but directed towards service automation and should be a subject of broader discussions among specialists in ethics, law, and other appropriate disciplines:

Law I - Do not develop service systems without human presence.

Law II - Do not develop service systems which harm society.

Law III - Do not develop service systems which endanger human race.

Law I protects people against passivity. Law II protects society against structured unemployment. Law III protects the human race against the bifurcation into two kinds of species. It would be necessary for governments, scientific, professional, trade and industrial associations to sign the service systems agreement based on these laws to be sure that service systems are developed and managed in a responsible manner.

Figure 11-10 depicts a model of six service categories and their developmental paradigms.

The role of service science is to constantly update these paradigms and implement into research, reaching, and consulting.

CONCLUSION

1. Service economy is a fact, which has not been yet noticed by IT developers and operators, which is still involved in enterprise systems, supporting steadily disappearing manufacturing systems, which are being outsourced off-shore.
2. The e-SS does not replace an enterprise system. Rather, it is the next layer above the layer of the enterprise system, and both layers are entered through the service user interface which is Web-driven and can be open or entered by the rxtranet.
3. Web technology is key solution for the e-SS, which has become an online-interactive information-communication tool for service users (citizens and customers).
4. Service science must support practical e-SS projects, which due to their complexity require a strong theoretical foundation.
5. The state of the art service systems' components are advanced which allows for the development of relatively complex service systems.
6. The development of service systems must comply with the three laws and with social, corporate, and personal responsibility.
7. To secure the right development of complex service systems, the *service systems agreement* should be signed by appropriate stakeholders.
8. The future trends in e-service development will probably oscillate between fully automated and automated with human touch. The latter should be the preferred trend.
9. Further research may focus on how the implemented e-service systems are complying with the ideal architecture-based solutions, sketched in this chapter.

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ENDNOTE

1 This 6 stages model is the author's improvement of the 4 stages model developed by J. Spohrer and P. P. Maglio, from the IBM Almaden Research Center.