Properties of Services

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A service is realized by the service system through the relationships of service system entities that interact (or relate) in a particular way to deliver the specific service via a service level agreement (SLA). Current management frameworks typically only focus on the interfaces of single service system entities. Meanwhile, SLAs are mapped to the respective customer requirements. These policies are provider-specific means to express constraints and rules for their internal operations. These rules may be independent of any particular customer (Theilmann 2009).

Services not only involve the interaction between the service provider and the consumer to produce value, but have other attributes, like an intangible quality of service (e.g., an ambulance service's availability and response time to an emergency request). The demand for a service may have varying loads dependent on the time of day, day of week, season, or other unexpected needs (e.g., natural disasters, product promotion campaigns, etc.). In the US for instance, travel services have peak demands during Christmas week; Mother’s day is usually the highest volume handling day for a telecommunications provider and tax services peak during extended periods (January through mid-April). Services cannot be inventoried; they are rendered at the time they are requested.

Additionally, for a business enterprise, delivering the service at the minimum cost while maximizing its profits may be the service objective. In contrast, for a non-profit organization the objective may be to maximize customer satisfaction while optimizing the resources required to render the service (e.g., during a natural disaster). Thus, the design and operations of service systems “is all about finding the appropriate balance between the resources devoted to the systems and the demands placed on the system so that the quality of service to the customer is as good as possible” (Daskin 2010).

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Service Level Agreement

A SLA is a set of technical (functional) and non-technical (non-functional) parameters agreed among customers and service providers. SLAs can and do contain administrative level (non-functional) business related parameters, such as SLA duration, service availability for the SLA duration, consequences for variations, failure reporting, priorities, and provisions for modifications to the SLA. However, for service level management, the service level (technical) parameters need to be defined, monitored, and assessed; these parameters may include such things as throughput; quality; availability; security; performance; reliability, for example, mean time between failure (MTBF), maximum downtime, and time-to-repair; and resource allocation.

An SLA represents the negotiated service level requirements (SLR) of the customer and should establish valid and reliable service performance measures since it is usually the basis for effective service level management (SLM). The goal of SLM is to ensure that service providers meet and maintain the prescribed quality of service (QoS). However, care should be taken since in some domains the term QoS refers only to resource reservation control mechanisms rather than the achieved service quality (e.g., internet protocol (IP) networks). Some terms used to mean the “achieved service quality” include quality of experience (QoE), user-perceived performance, and degree of satisfaction of the user; these other terms are more generally used across service domains.

Non-functional properties fall into two basic categories: business properties, such as price and method of payment, and environmental properties, such as time and location. Business and environmental properties are classified as “context properties” by Youakim Badr (Badr et al. 2008). QoS properties are characteristics such as availability, resilience, security, reliability, scalability, agreement duration, response times, repair times, usability, etc. Therefore services evaluation measures are customer oriented and include not only traditional performance metrics (productivity, quality, etc.), but also require a comprehensive analysis of the service system from an end-to-end perspective. Service evaluation typically includes customer demand-supply to ensure economic viability across the lifecycle of the service system. Furthermore, the service delivery is evaluated using the key technical performance metrics listed above, adding also Service Process Measures (provisioning time, time-to-restore/repair, etc.) and Technical Performance Measures (end-to-end response times, latency, throughput, etc.). Finally, the service system’s SLAs are then the composition of these categories evaluated on a systemic level to ensure consistency, equity, and sustainability of the service to assure that the desired/contracted SLA for customer satisfaction, value co-creation, and high system robustness are realized. (Spohrer 2011; Tien and Berg 2003; Theilmann and Baresi, 2009)

Service Key Performance Indicators

Service key performance indicators (KPI) are defined and agreed to in the SLA; the service KPIs are decomposed into service process measures (SPM) and technical performance measures (TPM) during the analysis stage of the service systems engineering (SSE) process. In the design process, the KPIs and TPM are allocated to service system entities and their components, as well as to the business processes and their components so as to ensure compliance with SLAs. The allocated measures generate derived requirements (SLR) for the system entities and their relationships, as well as for the service entities' components and the data and information flows required in the service systems to monitor, measure, and assess end-to-end SLA. These allocations ensure that the appropriate performance indicators apply to each of the links in the service value chain.

TPMs are typically categorized by the number of defective parts in a manufacturing service, data transmission latency and data throughput in an end-to-end application service, IP QoS expressed by latency, jitter delay, and throughput; SPMs are typically categorized by service provisioning time, end-to-end response times to a service request (a combination of data and objective feedback), and quality of experience (QoE verified by objective feedback). Together, the KPI (TPM combined with SPM) and perception measures make up the service level management function. A quality assurance system's (QAS) continuous service improvement (CSI), processes, and process quality management and improvement (PQMI) should be planned, designed, deployed, and managed for the capability to continuously improve the service system and to monitor compliance with SLAs (e.g., PQMI, capability maturity model integration (CMMI) (SEI 2007), International Organization for Standardization (ISO) Standards 9001 (ISO/IEC 2008), Telecom Quality Management System Standards (TL 9000) (QuEST Forum 2012), Information Technology Infrastructure Library (ITIL) v. 3 (OGC 2009), etc.).

As discussed earlier, QoS needs to correlate customer perceived quality (subjective measures) with objective SPM and TPM measures. There are several techniques available to help monitor, measure, and assess TPM's, but most are a variation on the theme of culling information from TPM's using, for example, perceptual speech quality measure (PSQM) and perceptual evaluation of video quality (PEVQ) and enhancing or verifying this information with customer or end-user perception of service by extending mean opinion score (MOS) techniques/customer opinion models (Ray 1984). Telecommunication systems engineering (TCSE) played an important role in finding methodologies for correlation between perception and objective measures for the services of the twentieth century; SSE should continue to encourage multidisciplinary participation to equally find methodologies, processes, and tools to correlate perceived service quality with TPM and with SPM for the services of the twenty-first century (Freeman 2004).

Subjective (qualitative) service quality is the customer's perceived conformity of the service with the expected objective. Word-of-mouth, personal needs, and past experiences create customer expectations regarding the service. The customers' perception of the service must be captured via surveys and interviews. The customers' perception of the service is then compared with their expectations for the service; this process captures the perceived service quality. Care should be taken to understand that subjective measures appear to measure customer attitudes, and attitudes may be the result of several encounters with the service, as well as numerous encounters with similar services.

In summary, the SLA documents the SLRs and establishes reliable and valid service performance measures, technical parameters, and the agreed performance levels for the technical parameters. The technical parameters are then monitored and continuously compared against both objective and subjective data culled from multiple internal and external sources (service level management). The goal is not to report the level of service in a given period, but to develop and implement a dynamic system capable of predicting and driving service level improvement over time (i.e., continual service improvement (CSI)).

Evolution of Services

The second, third, and fourth decades of the twenty-first century will almost certainly see similar, and probably accelerated, technology development as seen in the prior three decades. Mass collaboration will become an established mode of operation. The beginnings of mass collaboration have manifested in developments such as value co-creation where loosely entangled actors or entities come together to create value in unprecedented ways, but ways that meet mutual and broader market requirements. Further developments in the technology, use, and acceptance of social media will continue to fuel the acceleration of these developments.

The next decades will see the grounding of concepts, such as crowdsourcing, coined by Jeff Howe in a June 2006 *Wired* magazine article; open innovation, promoted by Henry Chesbrough, a professor and executive director at the Center for Open Innovation at Berkeley; and mass collaboration and open source innovation supported by Enterprise 2.0 tools, as conceived by Wikinomics consultant Don Tapscott.

Roberto Saracco, a telecommunications expert specializing in analyzing economical impacts of technology evolution, argues that: “Communications will be the invisible fabric connecting us and the world whenever and wherever we happen to be in a completely seamless way, connecting us so transparently, cheaply, and effortlessly that very seldom will we think about it." The ubiquity and invisibility of these communications will greatly facilitate the creation and destruction of ad hoc collectives (groups of entities that share or are motivated by at least one common issue or interest, or work together on a specific project(s) to achieve a common objective). This enterprise may engender the concept of the hive mind (the collective intelligence of many), which will be an intelligent version of real-life super organisms, such as ant or bee nests (Hölldobler and Wilson 2009).

These models will most certainly give rise to issues of property rights and liabilities; access rights for both the provider and the customer can be owned outright, contracted/leased, shared, or have privileged access (Spohrer 2011). For now, we are on the cusp of a management revolution that is likely to be as profound and unsettling as the one that gave birth to the modern industrial age. Driven by the emergence of powerful new collaborative technologies, this transformation will radically reshape the nature of work, the boundaries of the enterprise, and the responsibilities of business leaders (McAfee 2009).

The service-providing industry in the US is divided into thirteen sectors (Chang 2010):

1. professional and business services,
2. healthcare and social assistance,
3. state and local government,
4. leisure and hospitality,
5. other services,
6. educational services,
7. retail trade,
8. financial activities,
9. transportation and warehousing,
10. wholesale trade,
11. information,
12. federal government, and
13. utilities.

Spohrer (2011) goes beyond the service sectors to propose three types of service systems:

1. ***Systems that focus on flow of things***: transportation and supply chains, water and waste recycling, food and products, energy and electric Grid,

information/ICT & cloud;

2. ***Systems that focus on Human Activities and Development***: buildings and construction, retail and hospitality / media and entertainment industries, banking and finance / business consulting industries, healthcare and family life systems, education and work life / jobs and entrepreneurship; and
3. ***Systems that focus on Governing***: cities, states, and nations.

Categorizing types and sectors of services is an important beginning because it can lead to a better understanding of the emerging rules and relationships in service value chains. This approach can further enhance the value co-creation capabilities of innovative service concepts that contribute to our quality of life. The classification also helps in identifying different objectives and constraints for the design and operations of the service system. Some examples include strategic policies under limited budget: education, strategic with readiness for quick response; national defense; business enterprise, maximizing profit while minimizing cost; etc.

In addition, this classification is being used to determine the overlap and synergies required among different science disciplines to enable trans-disciplinary collaboration and educational programs.

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Additional References

None.

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