Describing Service Systems

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Abstract

There are many different normative frameworks for describing service systems that take a distinct conceptual perspective. They emphasize the physical arrangement or topology, the functions or processes, the chronology of experience, the causality of value creation, the flow of information or people, or other characteristics. These frameworks are deeply embedded in service system research and design practice, but we have not known how useful or natural they are. University students new to service science concepts described a service system they all used—the Bay Area Rapid Transit (BART) system. They identified and categorized the services they encountered or that were involved when they used BART and then created diagrams to depict the system. There was substantial variation in how students described BART in terms of scope, overall number of services, and their granularity. There was also great diversity in the classification of services and in the diagrams or other representations students created. Since most students had little exposure to normative frameworks for describing service systems, their diagrams were often hybrids of different frameworks. © 2012 Wiley Periodicals, Inc.

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1. NORMATIVE FRAMEWORKS FOR SERVICE SYSTEMS

The holistic view embodied in the service system concept makes it possible to describe person-to-person encounters, the service offerings of an enterprise, the services in a city, or even larger components of a national or global service network as service systems. Many disciplines, including design, business management and strategy, operations research, industrial engineering, informatics, and information systems, rely on frameworks that can be used to describe service systems. These frameworks are often normative in that they mandate the constructs that should be used to describe some aspects of a service system, the type of information required to instantiate each construct, and the conventional notations or representations in which to present the system description. The frameworks are often taught in a prescriptive manner, and some are supported by software whose inputs and outputs are highly standardized.

The frameworks are not equally applicable to all service systems because they differ in their organizational scope, the degree to which they capture a conceptual or implementation-neutral model of a possibly hypothetical system rather than a more concrete and physical model of an existing one, and the extent to which they embody quantitative data rather than qualitative observations about the actual or predicted operation of the service system.

Nevertheless, because they share some conceptual and structural abstractions, more than one framework can often be insightfully applied to the same service system to highlight different aspects or perspectives. In particular, many of the frameworks are dynamic or time based to represent interactions between service providers and customers that take place over time,

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often by emphasizing the flow or exchange of resources or information as a mechanism for value creation. Many of the frameworks also capture static properties of the service system by distinguishing visible and invisible components (e.g., front stage and back stage) and have a notion of a point of view or endpoint that defines the perspective from which value creation is calculated.

It is not essential for this article to describe each framework in detail, nor is it even necessary that this classification be exhaustive or optimal; the goal is simply to establish a target for comparison and a vocabulary for making the comparison. We will briefly describe five types of frameworks used to describe service systems and refer the reader to normative or exemplary sources.

1.1. Physical or Topological Frameworks

Physical or topological frameworks describe the physical environment of the service system, distinguishing and describing the regions or locations in which service encounters take place. One type of physical framework is the "Servicescape" (Bitner, 1992), defined as the description of the man-made physical context in which services are delivered. Related concepts for describing the use of features and orienting mechanisms in "the built environment" come from the "Wayfinding" (Arthur & Passini, 1992) literature in urban planning and architecture.

Physical or topological frameworks are widely used to describe service systems in business establishments, hospitals, museums, airports, and other places where the service customer moves through a carefully designed physical environment. These frameworks generally take the service provider's perspective (or a "bird's-eye" one) as they explain how user experiences are shaped by the spatial organization of service locations and the structures that facilitate or constrain movements within it.

For example, the arrangement of waiting lines in banks, supermarkets, and post offices or the use of centrally visible "take a number" systems strongly influence the encounters in service systems (Zhou & Soman, 2003). Physical or topological frameworks have also been used to describe virtual worlds or similar online environments that convey an experience resembling that in physical space or that are designed to complement physical environments (Huang, 2001).

1.2. Experiential Frameworks

Experiential frameworks are similar to physical or topological frameworks because they too describe the environment in which service encounters take place. Many service system designers use the spatial metaphor of a "service journey" (Zomerdijk & Voss, 2010) to describe the typical sequence of service encounters; other similar terms are the "customer corridor" (Meyer & Schwager, 2007) and the "experience cycle" (Dubberly & Evenson, 2008). Experiential frameworks emphasize the service customer or consumer's perspective on the service system, highlighting the "front stage" and its specific points of interaction with service providers. This focus means that services in the "back stage" that are invisible to the service customer are de-emphasized or omitted from the description, even though they can be essential contributors to the service experience.

Service blueprints (Bitner, Ostrom, & Morgan, 2008) are a hybrid description type that emphasize the specific points of interaction between service customers and service providers. However, service blueprints also depict the "line of visibility" that separates customer-facing services from those that invisibly create value through those services and apply an analogous distinction to subclassify the services that are visible and invisible to employees of the service provider.

1.3. Functional or Process Frameworks

Functional or process frameworks describe the service system in terms of functions or organizational components. Sometimes the functions are goal oriented and are described in terms of what the service system hopes to achieve without any suggestion of how it might be done; these high-level descriptions are sometimes called business architectures or business motivation models (Glissman & Sanz, 2010). Goal-oriented functional descriptions are often highly abstract descriptions that capture ideal or best practices in industry "reference models" (e.g., the SCOR reference model for supply chains [Stephens, 2001]). Rouse and Basole (2010) take an even more abstract functional view when they compare the service systems in different domains (e.g., healthcare and aircraft manufacturing) in terms of the relative number of service provider firms, the degree to which they collaborate in service delivery, and other structural properties of the service system.

In contrast to high-level process frameworks, process models more often specify the exact inputs and outputs for a function, and often a high-level and goal-oriented reference model for an industry is augmented with such more detailed process models (e.g., RosettaNet, 2011). Business analysts often compare the descriptions of an existing service system with reference models at low levels of abstraction to identify which functions or processes could be improved. There are a great many varieties of process modeling methods and notations that are applicable to service systems, notably the activity and sequence diagrams of the unified Modeling Language (Booch, Rumbaugh, & Jacobson, 1999) and the Business Process Modeling Language proposed by the Object Management Group (2011).

Potential changes to a service system are very easy to see when the functional or process description is concrete enough to map directly to the arrangement of functions or services in the "organization chart" of the service provider; these are often called "component-based business models" (Cherbakov, Galambos, Harishankar, Kalyana, & Rackham, 2005). In this case, the pattern of capabilities can guide decisions about which services should be treated as core competencies of the firm at the hub of the service system and which services should be obtained by outside firms through an outsourcing contract.

In service systems dominated by technological or computational functions, functional descriptions are often in the form of implementation or software architecture models. These models identify the technological components, software applications, or functions that implement the service system. Many of these models separate the functionality of the system into layers or tiers for the storage of data, the business logic or functions that use the data, and the user interface or presentation components through which users or other applications receive information or the services provided by the system (Ozsu & Valuduriez, 2011).

Information-intensive service systems often include Web-based services, sensors, or devices (e.g., smartphones) that can collect, communicate, and exchange information (Glushko, 2010). These kinds of service systems can often be described as composite services or service choreographies that follow principles of "service-oriented architecture" (Erl, 2005) because the services are interconnected through the exchange of information between the "service interfaces" of their functional components. Numerous XML specifications have been developed to describe service systems composed from Web-based components; the best source is the Web site of the OASIS Open Consortium (2011).

1.4. Value Chain Frameworks

Value chain frameworks describe how value is created in a service system as a result of a standard sequence of causally or logically dependent activities. In this respect of value unfolding over time, value chain frameworks have some similarity to experiential ones, but the distinctive element of value chain frameworks is that they explain how each activity increases the overall value in a causally plausible way. Value chain frameworks are most often applied in product service systems where the tangibility of the product components and their standard life cycles makes it easy to identify both the value-adding steps in the manufacturing process and the opportunities for value-added services, such as financing, installation, maintenance, training, and recycling that can be offered for many kinds of products (Allmendinger & Lombreglia, 2001).

The activities in value chain frameworks and the increasing amounts of the factors or dimensions that cause value to be created are not always directly observable. For example, a highly cited article titled "Putting the Service Profit Chain to Work" (Heskett, Jones, Loverman, Sasser, & Schlesinger, 1994) proposes that a firm's profitability is driven by customers who are loyal because they are highly satisfied by the actions of satisfied, loyal, and productive employees, who become so when the firm is made a good place to work.

1.5. Data-Driven or Simulation Frameworks

Data-driven or simulation frameworks describe the arrangement or movement of information, people, or other resources in a service system. These frameworks include queuing, scheduling, and multiobjective optimization models from operations research and industrial engineering often used to design service systems. Because these descriptions embody precise and computable assumptions about parameters and variables, they can make predictions to support design decisions about the location or layout of service facilities or servicescapes, capacity planning, and scheduling of human or nonhuman resources that provide services and inventory planning, pricing, and yield management (Daskin, 2011).

Systems dynamics models (Sterman, 2001) that depict dimensions or stores of value creation and their dependencies using nonlinear feedback links have been used to model and simulate complex service systems. This approach is widely applicable but arbitrary types and number of parameters make each model very context specific and data intensive.

2. NATURAL FRAMEWORKS FOR SERVICE SYSTEMS

The normative descriptive frameworks summarized in the first part of this article are widely taught in university courses in business management and strategy, operations research, industrial engineering, informatics, and information systems design. But it is worth investigating how natural or intuitive these frameworks are for people when they are first introduced to the concept of a service system. When people are asked to describe something as a service system, will the concepts and constructs they apply be those that are contained in the normative frameworks?

Comparing the "normative" and "natural" frameworks for a domain is a research method designed to overcome the inevitable bias when only one or the other perspectives is employed (Morey & Luthans 1984). The normative (or "objective," "outsider, "observer," or "etic") point of view takes as given the categories and descriptions that are applied to a domain. In contrast, the natural (or "subjective," "insider, "participant," or "emic") point of view expects that people will impose their own potentially idiosyncratic perspective that might or might not resemble the normative one. Given the range of "value co-creating configurations of people, technology, value propositions, and shared information" that characterize service systems (Maglio, Srinivasan, Kreulen, & Spohrer, 2006, p. 82) it would seem presumptuous to assume that all participants in a service system would experience and describe it in the same manner.

2.1. Describing the BART Service System

The first assignment in the Information Systems and Service Design course (Glushko, 2011) I taught at the University of California, Berkeley, is to describe the Bay Area Rapid Transit (BART) system. BART trains interconnect the San Francisco peninsula with the East Bay, and many Berkeley students frequently take BART trains between Berkeley and San Francisco instead of driving across the notoriously congested Bay Bridge.

Most of the students who take this course are graduate students in the School of Information, a highly interdisciplinary program that attracts students with a wide variety of undergraduate degrees, including engineering computer science, business, economics, and user-centered design. As a result, some students have some exposure to one or more of the normative frameworks, but they take on the BART assignment before they have been systematically introduced to design methods or frameworks that focus on service systems.

The assignment asked students to describe BART as a service system from the perspective of people who ride BART trains. This is an intentionally imprecise instruction that does not impose sharp boundaries on the scope of the service system that might bias how it was described. The students were asked to identify at least 10 services and describe their function or value in the service system, to organize or categorize the services, and to depict the service system using one or more diagrams that represented the relationships among the services.

The instruction to "depict" or "diagram" the BART service system implicitly discourages the use of formal or parametric descriptions. In any case, the 1-week time frame to complete the assignment makes it unlikely that students could collect enough data by observing the operation of the BART system to count riders or trains to model the patterns of demand and scheduling that BART implements.

2.2. Results: Identifying Services

Every student identified at least 10 services, and some identified as many as 30. However, this absolute number of services is not the most useful measure because the same service was often given different names ("providing security" vs. "police presence"), and what some people considered a single service was decomposed into multiple more granular services by others ("ticketing" vs. "fare information service, payment service, add fare service, bill changing service, verify ticket balance, cancel ticket service").

Many students described the process of identifying services as a story of a single experience of using the BART system: parking a car or bike at the station, looking at an information board for destinations and schedules, seeing a BART policeman or a musician, buying a ticket, riding the train. This is the natural way in which we experience service systems, and it explains the idiosyncratic or accidental granularity in identifying services noted in the previous paragraph. For example, a student who has a monthly BART pass or a prepaid ticket does not need to use a ticket machine and thus identifies it as a coarse ticketing service. In contrast, a student who does not have a ticket needs to stop at the machine, and the individual transactions carried out there then have more salience.

The BART.gov Website contains information about schedules, fares, station locations, parking availability, planned and unplanned disruptions in service, and makes most of this information available as Web services so that third parties can develop mobile applications or other "mashups" of BART services. Some students identified these services, but others did not mention any of them. Again this most likely reflects the process of identifying services that were encountered in a single experience or service journey; a student who commutes between San Francisco and Berkeley does not need to use the BART Website to find out about schedules, fares, or stations. Given more precise instructions to describe the overall service system, the student could surely create a service inventory that included the online ones.

More interesting is that a small proportion of the students did not mention the core service of the BART system to transport people from place to place. When asked about this omission from the list of services, a student invariably explained it by defining "service" as something offered to enhance the value of a tangible resource, in this case the BART trains. This definition recapitulates the traditional contrast between services and products and makes the omission seem less odd.

On the other hand, other students creatively identified as services a variety of "things that people do when riding trains" that are not services because they are not being offered or hosted by BART. These included "sleeping areas or weather shelters for homeless people," "a place for reading or doing homework," and "a place for people watching."

Whether these activities are services according to service science definitions seems beside the point if people who use a service system find value in doing them, and it demonstrates why system designers need to carefully study their customers when deciding what services to provide. An end-to-end BART trip can take as long as 90 min, which means that regular commuters can spend 3 hr a day in the BART service system. When riders identify their own activities as "services," this is an implicit request to BART to provide services that enable better use of commuting time. Indeed, when BART introduced wireless Internet service on the trains, it quickly became a very valuable part of the service system.

2.3. Results: Scoping the Service System

The service inventories and depictions of the BART service system showed significant differences in its overall scope. Many people treated the BART system as a network of station locations where services are offered, with each station surrounded by some additional services like car parking, bike storage, or flower and newspaper vendors. This description implies a limited scope closely tied to the core service of transporting people from one station to another. This narrow scope seems somewhat inconsistent for people who identified the BART.gov Website and other information services.

Some people, however, depicted the BART service system as extending more broadly in time and space to include remote access to the BART.gov Website from their homes and to include destinations beyond the station where they left the train. Other people viewed BART as just one component of a much larger multimodal transportation service system, explicitly noting that BART enabled connections to the Caltrain system and the San Francisco and Oakland airports.

2.4. Results: Classifying Services

Students used at least 10 different principles to classify the services they identified in the BART system. The most common classifications were based on function (e.g., planning, ticketing, transport, security) or based on the chronology of a service experience (trip planning, ticketing, riding the train). As noted earlier, functional and experiential classifications are similar in many respects, but functional ones are often more abstract and combine services in a category that might not be temporally adjacent (e.g., parking, bike storage, and riding the trains are all services in the "transportation" functional category).

Other classification schemes were based on

- The locations of service delivery;
- The technological context or channel of service delivery (e.g., person to person, static self-service display, interactive self-service);
- Whether the service involves information exchange or physical contact;

- The role or goal of the person participating in the service system (e.g., tourist, commuter, BART employee);
- Whether the service is a required part of the service experience (e.g., collect payment) or an optional one (e.g., information about train schedules);
- Whether the service is visible to the customer (e.g., ticketing) or invisible (e.g., train maintenance);
- Whether the service involves static information (e.g., routes, fares, schedules) or dynamic information (e.g., next train arrival time); and
- Whether the service is provided by BART or by a third party.

2.5. Results: Diagramming or Depicting the Service System

The most common depictions of the BART service system highlighted the user experience or service journey as it unfolds over time and place. For example, many diagrams indicate the "touch points" where customers make decisions or interact with human or computational services. This type of diagram is highly concrete and it seems natural and almost inevitable to arrange the touch points on a spatial or topological canvas that distinguishes different locations or regions of service delivery (e.g., home, outside the station, inside the station, on the platform, on the train). The resulting hybrid diagram depicts the "touch point topology."

However, a very large proportion of diagrams of the BART service system added additional constructs or annotations to the touch point topology. Some of them included a line of visibility like that in service blueprints, others contained an alternate set of touch points for different user types, and others embedded functional or other classifications to subdivide each topological region (e.g., into information-intensive and contact-intensive services; BART and third-party services). One student included a "Q" symbol at the location in the diagram where queuing occasionally takes place. Figure 1 is an example of this kind of hybrid depiction.

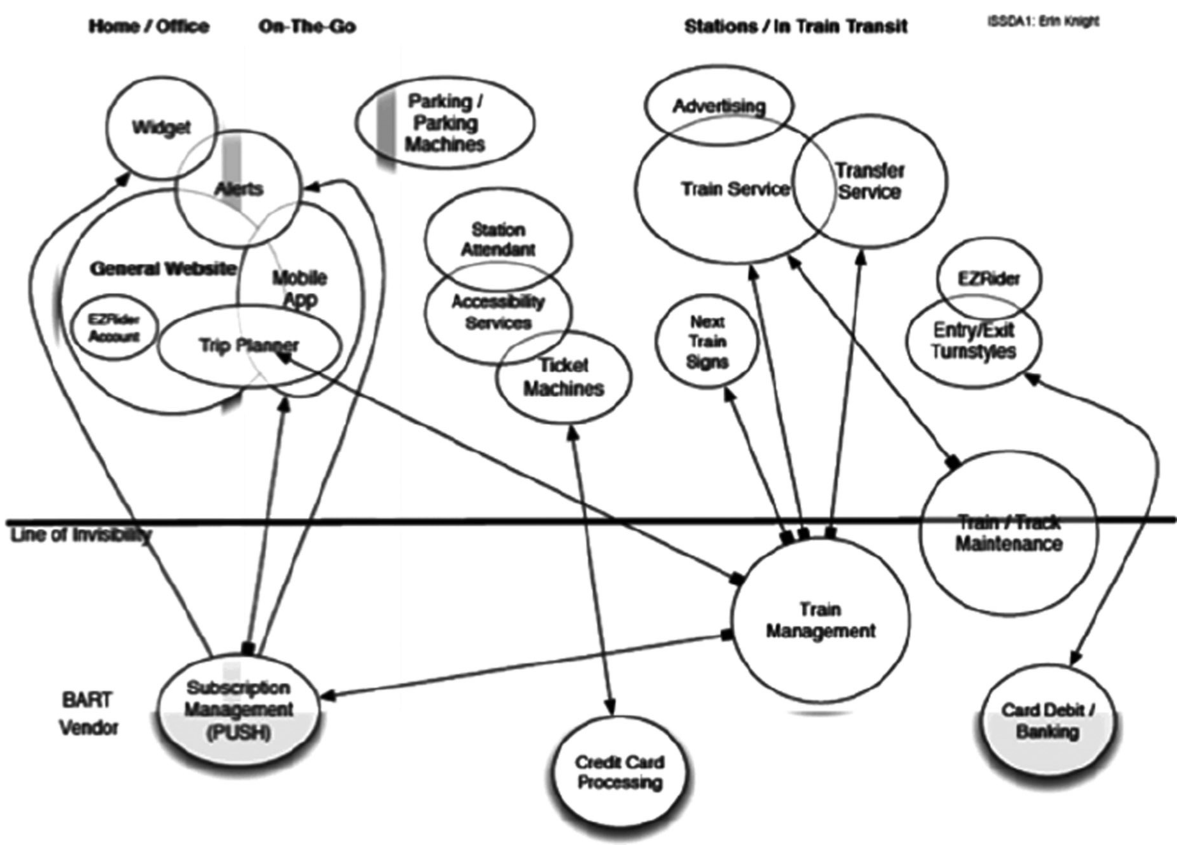

Figure 1 Hybrid depiction of the BART service system, described topologically and temporally from left to right, with functional classification of services and a line of visibility. *Diagram by Erin Knight, 2009.*

3. SUMMARY AND IMPLICATIONS

When university students new to service science concepts described a familiar service system, there was substantial variation in terms of scope, overall number of services, and their granularity. In addition, there was great diversity in how students classified the services they identified and in the diagrams or other representations they created to depict the service system. Instead of the standard representations associated with normative frameworks, the students creatively devised hybrids that contained constructs important to multiple frameworks.

These results reinforce the value of the service system concept, but the contrast between normative descriptions of service systems and the natural descriptions created by students raise questions about how best to teach and communicate service system analysis and design. Descriptive frameworks are often tied closely to particular academic disciplines; it is not surprising that industrial engineers, business process consultants, and urban planners are taught different frameworks. But the complex character of service systems like BART cannot be fully described using a single framework. Perhaps the normative approaches should be taught as a portfolio or palette and students encouraged to create hybrid descriptions from them, depending on the purpose of the description. "Touch point topology" descriptions seem the most natural and intuitive of the hybrids; we should teach them as well.

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