Commitment-Based Modeling of Service Systems

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Abstract. This contribution presents an ontological model of services that describes them as complex temporal entities, constituted by interrelations of states, actions and processes, occurring in a wider service system. Our aim is to establish rigorous ontological foundations for the various basic notions of service science, including service, service system, service process, service system life-cycle, and service value co-creation. A crucial role in our approach is played by the notion of commitment, which allows us to provide a definition of service as generic commitment to guarantee the execution of value co-creation actions.

Keywords: service science, service system, ontology.

1 Introduction

In an earlier paper [1], we presented some first ideas concerning the ontological analysis of the notion of service. As observed in [2], however, such work was mainly focusing on the IT literature, and omitted fundamental conceptual links to the theoretical foundations of service science, namely the Service Dominant Logic approach, originated by [3]. We present here the most recent evolution of such early work, which includes a discussion of the notions of service, service system and value co-creation, which are at the basis of the S-D logic.

In [1], our first ontological claim was that the classic distinction between goods and services can be explained by observing that services are entities occurring in time, while goods are entities lasting in time. In other words, services are (complex) *events* (in the most general sense of this word, which includes in particular static events), while goods are (complex) *objects*. As acknowledged by [4], this is in line with the S-D logic, which adopts the 'service as process' view. Indeed, in [5], the authors clarify that a service is "a *process* of applying resources for the benefit of another".

In our view, it is exactly the temporal nature of services which explains why they are radically incompatible with goods: objects and processes (or events, in the most general sense of this term) are just two disjoint ontological categories. Objects *participate* to events, but are disjoint from them [6]. In our paper, we also discuss how this ontological analysis explains Hill's distinction [7] between

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goods and services, based on the fact that services are transactable but not transferable; we understand however that such discussion has little relevance in the S-D logic, since it is still based on the G-D view.

Despite this agreement on the basic ontological category to which services belong, and our positive attitude to the radical shift of perspective proposed by the S-D logic, the notions of service and service system as defined by the recent S-D literature still present relevant ontological and terminological problems. Indeed, from the business point of view, we agree very much with the spirit of Alter's observations in [8], and we find his list of "common examples for services" (such as an Internet search engine, an ATM cash dispenser, an emergency service, or a garbage collection service) a very good rough test to verify what people mean when they use the word "service". Our ambition is to provide a formal definitional framework that, while grounded in rigorous ontological distinctions, yet reflects as much as possible the everyday business language, without imposing unnecessary radical changes in the way people talk (although possibly changing a bit the way they think). In the following, we shall first discuss some of the most crucial terms introduced in the S-D literature, and then we present our own model.

Tension between Microscopic and Mesoscopic Level. A first difficulty we have in understanding the S-D literature is related to the apparent tension between the microscopic and the mesoscopic level of analysis (both considering the time dimension and the number of resources involved). It seems clear that the notion of service is defined at the microscopic level, i.e. at the level of a single value co-creation interaction, while the notion of service system, although also valid in the atomic case, is defined as a dynamic, possibly complex configuration of resources, which has "a beginning, a history, and an end", and "has a unique identity" [9]. But what is the glue that keeps these resources together, guaranteeing the identity of a service system through time? In the everyday speaking, people would say that, throughout its life, a service system produces *the same service*. But it is exactly this generalized, mesoscopic notion of service – as denoting a business activity and not a specific economic interaction – which appears to be lacking in the S-D approach. Our own position, as specified below, is that the glue is a generic *commitment* to guarantee the execution of (value co-creation) actions of a certain kind, according to suitable conditions.

Service as Application of Competences. Independently of the considerations above, Vargo and Lusch's definition of service as "the application of specialized competences (knowledge and skills) through deeds, processes, and performances for the benefit of another entity", although making perfect sense, seems to be inadequate to capture some basic intuitions: according to the latin etymology of the term, enjoying a service presupposes having somebody (the *servus*) at your disposal, ready to do actions for your benefit; in this view, it is not so much the specific action which counts as a service, but rather the commitment to perform some kinds of actions. Consider for instance a telephone

company, which provides – we say – *a* telephone service. Within a specific customer contract, we don't say it provides multiple services, but just *one* service, which is *active* even when no telephone calls occur. So in this case the service is not the application of a specific competence, but rather the commitment to perform some actions in a certain way (even independently from actually having the necessary competence).

Service as Value Co-Creation. A further, serious difficulty concerns what seems to be the most recent evolution of service definition adopted by the S-D logic community:

> Services are value co-creation phenomena that arise among interacting service system entities. [10]

We find this definition very confusing. In the marketing science literature, the notion of value co-creation seems to be mainly focusing on the *customer's* value [11], although the emergence of complex value constellations in modern service-based economy is also acknowledged, as shown for example in the IKEA case discussed in the seminal paper by Normann and Ramirez [12]:

> The work-sharing, co-productive arrangements the company offers to customers and suppliers alike force both to think about value in a new way – one in which customers are also suppliers (of time, labor, information, and transportation), suppliers are also customers (of IKEAs business and technical services), and IKEA itself is not so much a retailer as the central star in a constellation of services [...]. The result: IKEA has succeeded, arguably, in creating more value per person (customer, supplier, and employee) [...]

Now, what is value co-creation in this case? Does it focus on a single value experience (the customer's one), or does it also take into account the supplier's or employee's experience, including the whole value constellation? It seems that Vargo and Lusch have the latter view in mind, when they write:

> Although S-D logic is inherently customer-centric – that is, the beneficiary is considered the determiner of value – value co-creation does not focus solely on the beneficiary. This perspective would neglect to recognize the benefits the firm receives from an exchange. Value co-creation implies that value created through exchange is based on the mutually beneficial relationships among service systems and each system makes a decision for whether or not the result of the exchange is valuable, based on context and experience. [5]

This could also be the view Maglio, Kieliszewski and Spohrer have in mind, when they introduce service science as the study of value co-creation:

> The bank cannot exist without the funds customers store and the customer cannot have the convenience of access through various mechanisms (checking, automatic tellers, bank branches) without the capabilities the bank provides. Value is co-created by the interaction of the two. [13]

Clearly the question arising from the above statement is "who's value?" The bank's value of being able to invest the customers' funds seems to be clearly a result of the interaction process, as well as the customer's value of exploiting flexible payment means. So, it seems clear that a constellation of *values* (plural is crucial here) is (co-)created by the interactions described in the examples above. The point is how the notion of *service* is related to those of *value co-creation* and *interaction*.

Indeed, these interactions are *service exchange* interactions: at the origin of the S-D logic there is Bastiat's idea that people *exchange services for other services* [14], so "Service is at the basis of all exchange" [5] (notice it is service, not value that is exchanged, because value is subjective). Now, each of the two services exchanged implies some value co-creation, but also the overall service exchange results in value co-creation, and such global value co-creation is not a service in itself! If we *define* service just as value co-creation, we have no way to understand *what* is exchanged on each side, and so, for example, we cannot describe how a certain service can be negotiated. So, clearly, a service *implies* a value co-creation process, but it is too simplistic to collapse the two notions, saying that service *is* value co-creation. In other words, the notion of service is necessarily asymmetric, since it focuses on a value proposition on the provider's side and a value experience which is inherently customer-centric, while the notion of value co-creation as emerging from interaction processes is clearly symmetric (unless we eliminate the ambiguity saying "*customer's* value co-creation").

Service System Boundaries. Finally, a further concern is the notion of service system. The simple question is: is the customer part of the service system? If the customer is involved in value co-creation, the obvious answer should be yes! Otherwise, if a service system is just one party of the service interaction, how does a service system differ from a system? Yet, according to the leader proponents of service science [9], service systems are just, as observed by Alter [8], "complementary components of economic exchange". We find this view in contradiction with the very basic assumptions of the S-D logic for the reasons above, and we share Alter's concerns regarding its understandability and practicality. In our opinion, Alter's notion of work system is much more useful to clarify what a service system is. In particular, we find the idea of considering a single person as an atomic service system very strange and unintuitive. In our view, a single individual can be *part* of multiple service systems, depending on responsibility patterns (commitments) which may appear or disappear at different times. For example, the same person could be involved in different service systems (as a worker and as a volunteer).

2 A Commitment-Based Service Model

Starting from 2008, we have begun to explore the ontological assumptions behind the notion of service [1,15,16]. The initial motivation behind our approach was to develop an ontology of services suitable to be used in the e-government domain,

where interoperability is particularly crucial, and multiple understandings of the word 'service' co-exist. By looking at the computer science literature, it was immediately evident that most of the available models adopt the *black box view* of services, describing them as transfer functions from an input to an output state, with a strong focus on the external service interface. Under this view, the internal details concerning *how* the service is performed are kept hidden, despite their relevance from the business point of view. Business applications need not only specify what the service does, but also how the service is performed and when the various processes involved in a service occur. Moreover, contracts and service level agreements need to refer to internal and contextual details (i.e., how the service interacts with its environment). In other terms, one needs to be able to look both *inside* and *outside* of the box, i.e., we need to adopt a *glass box view*, where the box is in this case, as Alter (cf. [17,18,19,20]) suggests, the whole service system.

However, adopting a glass box view to model a service system forces us to face some fundamental questions: what is there inside the box? What's the difference between a service system and a service? And what is a service, after all? Our main contribution is that a service — as opposed to a good — always develops in time, i.e, it has an essential temporal nature: ontologically speaking, services are complex *events*, while goods are *objects*.

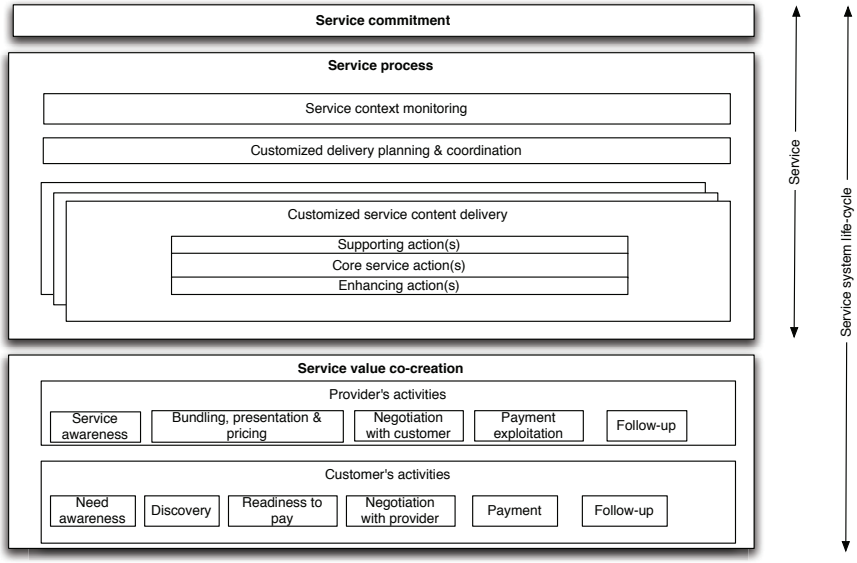

Fig. 1. Service and Service system life-cycle

The internal structure of a service, as well as its relationship with the broader service system, is depicted in Figure 1, which is a revised version of a similar figure presented in [1]. The picture clarifies Alter's idea of the service system

life-cycle, presenting it as a complex temporal entity involving three main components, that are necessarily always present: the Service Commitment, the Service Process, and the Service Value Co-creation. In terms of the DOLCE [6] ontology of temporal entities, the Service Commitment is a *state*, holding as long as the provider is willing to offer the service; the other components are dynamic *processes*, involving a number of different activities. An ontological dependence relation holds between the service commitment and the service process, in the sense that the latter cannot exist without the former. The interplay between service commitment, service process and service as a whole is described by the following informal definitions, adapted from [1]:

*A **Service Commitment*** is an agent's explicit and enduring commitment to guarantee the execution of some type of *core actions*, on the occurrence of a certain triggering event, in the interest of another agent and upon prior agreement, according to a certain specification (*service description*) which constrains the way service actions will be performed. We see an agent's commitment as the state resulting from an act of engagement to assume an obligation for a specified period in the future. In such period, the agent is in the commitment state. In most cases, two kinds of service commitment need to be distinguished: a *generic* commitment towards potential customers, whose service description is intended to facilitate service discovery, and a *specific* commitment towards a particular customer, where the service description takes the form of a binding *contract*, resulting from a negotiation process.

There are important differences between generic and specific commitment. Generic commitment is a state resulting from an act that is in a sense unidirectional, as it does not imply an explicit agreement. As generic commitment is directed towards a generic, potential customer, it is not strictly speaking binding for the provider. Until there is at least one specific, actual customer, the provider cannot be directly sanctioned for not having respected his or her commitment. So not honoring a generic commitment can obviously result in a loss of credibility or reputation, but not in a direct sanction. The content of generic commitment is the service description, i.e. a description of the types of action that will constitute the service process, including constrains on such actions and possibly also on the type of customer whom the service is addressed to. For commercial services such description can be assimilated to the service offering.

Specific commitment, on the other hand, is the state in which both the provider and an actual customer are after a mutual agreement, most of the times consisting in the signature of a contract. The contract describes how the service will be implemented for the individual customer, so normally it specifies the service description in more detail. Two relevant differences with the generic commitment are given by the fact that the contract commits both parties, not only the provider, so it is the result of an agreement with a greater binding power, whose violation usually entails a sanction, that may be described in the contract itself.

Service Process is the actual implementation of a service commitment, consisting of a number of interdependent actions including those necessary to monitor the triggering events, the core actions mentioned in the commitment, and any further actions aimed at supporting or complementing the successful execution of such core actions. What actually happens in the service process is partly constrained by the *service description*, and, more importantly, by the contract, which defines and constrains the type of actions that must and/or can be executed in the service process.

Service is a complex temporal entity (a *complex event*)[1] consisting of a service commitment and the corresponding process.

Service System is defined as the mereological sum[2] of all the objects anyhow involved in a service (through a *participation* relationship). In other words, while a service is a complex *event*, a service system is a complex *object*, consisting of all the objects somehow participating to any of the sub-events, processes or states constituting the service: typically, a service system includes the provider, the customers, the resources used to produce the service, and so on[3].

Service System Life-Cycle is a temporal entity corresponding to the dynamics of a service system. So the difference between a service system and its life-cycle is like the one existing between a person and his/her life.

Service Value Co-Creation is a crucial part of the service system life-cycle. It is a complex process involving two symmetric value experiences: the customer's experience accounts for the service's benefits and the corresponding costs on the customer's side, while the provider's experience accounts of provider's benefits and the corresponding costs in implementing the service process. Such value experiences are also events, and, altogether, service value co-creation is also ontologically dependent on the commitment. Note that service value co-creation is not part of the service itself, since it involves activities occurring at the customer's side: it is rather part of the service system life-cycle.

In our opinion, it is necessary to distinguish service value co-creation from both service commitment and service process. It should not be considered as equivalent to service process, first because value is in part produced by the interaction between service and the surrounding environment, and also because the service execution is not by itself sufficient to determine its value.

[1] Generic temporal entities are called *perdurants* in DOLCE, and include *events, states,* and *processes*.

[2] We refer here to the notion of mereological sum as defined by Achille Varzi in the entry "Mereology" of the *Stanford Encyclopedia of Philosophy*: "[. . .] whenever there are some things there exists a whole that consists exactly of those things – i.e., that there is always a *mereological sum* (or "fusion") of two or more parts." [21].

[3] To stress that the notion of service system really includes the context it is embedded in, the expression *service ecosystem* might be appropriate.

The more the actual service execution complies with the service description and the specific contract signed, the more the value of a service increases. However, in some specific examples it is not even necessary to have the service executed to determine its value. Take for instance a car insurance service: the customer pays for having someone who guarantees to intervene in case of an accident and arguably he or she hopes that the core actions of the service process are never to be performed. Now let's consider a very familiar example in the services literature: car washing. Relating Figure 1 to such example, the service commitment starts when the car wash owner goes to the chamber of commerce to attend all the bureaucratic practices that are necessary to start the commercial activity. Among these practices, there will be some signed official declaration in which the main features of the service are described. In this description, the car wash owner commits to certain business intentions (to be integrated with the content of the ads he or she publicly posts).

The service process is composed of various events and sub-processes, including the events that trigger the service, e.g., a request by the customer who brings his or her car to the car wash. After the initiating event, we find the customized delivery planning and coordination; here we can imagine that the car wash offers a range of different possible service implementations, such as washing only the outside of the car, cleaning the inside, using particular products such as specific shampoos or waxes, etc. In the customized delivery planning phase, the customer and the car wash personnel agree to all these details.

With respect to the service delivery, the core action is washing the car; singling out supporting actions is a bit harder in the example, as there are many actions that are necessarily preparatory to the service but are not explicitly mentioned as constituting it. For instance, we could say that the activity of removing loose items from the car in order to be able to clean the inside could be considered a supporting action, as well as buying the cleaning products. Enhancing actions are actions meant to augment the value of the service. Here we could think of an additional service that is connected but not strictly included in the service, such as replacing air filters or, alternatively, we could think of a luxury service in which someone picks up the car at the customer's location, takes it to the car wash, washes it and then brings it back. The picking up and bringing back would be in this case enhancing actions.

Finally, all the activities connected to value experiences, including negative as well as positive experiences on both the customer's and the provider's side constitute the complex event of service value co-creation. In our example, negative value experiences on the customer's side include the payment as well as the time spent to drive to the car wash, wait for the car to be washed and drive back, while they include labor and materials used in washing the car on the provider's side. We should not forget that the whole service experience is deeply influenced by all the phases of the service system life-cycle, so for instance, the fact that the car wash was well advertised makes the customer's experience more enjoyable than if he or she had to wonder around the city for hours looking for a car wash.

A UML diagram of our model is shown in Figure 2. There are three main classes: *Service system, Service system life-cycle,* and *Service system description.* The elements of these classes have a different ontological nature (not shown in the figure): service systems and their parts are *objects*, service system life-cycles and their parts are *events* (generic temporal entities), service system descriptions and their parts are *informational objects.* We adopt specific relations to account for the way an object participates to an event, called "thematic relations" in linguistics [22,15]. Typical thematic relations are:

Agent	pointing to what plays an active role in the event
Theme/Patient	pointing to what undergoes the event; the patient changes its state, the theme does not
Recipient/Beneficiary	pointing to what receives the effects of the event
Instrument	pointing to what is used to perform the event

Starting from the center of Figure 2, we see that a service system life-cycle has two mandatory parts, the service itself and the service value co-creation process. In turn, a service has two essential parts: a commitment, and a process that realizes it. The commitment's theme is a *service description* that says what the service is supposed to do. In particular, such description constraints the *core actions* to be performed during the service process. The service description is part of a more general *service system description,* which accounts for the *constraints on service value co-creation* such as (among other things) the price policy and the legal constraints which limit or regulate the service's range of applicability. Participants to the service system life-cycle are all the parts of the service system, including the service system context (for instance the surrounding economic, legal, and social systems) and the various actors, such as the service provider, service customer, service producer, and service consumer[4].

The picture explicitly shows the thematic relations characterizing the structure of *service commitment.* The commitment's agent is the *service provider*, while the beneficiary is the *service customer.* In the car wash example, the service provider is the car wash owner, and the beneficiary is a generic (possible) customer, while the chamber of commerce is, in a sense, acting on behalf of these possible customers. The service description is possibly contained in a document that is stored at the chamber of commerce and includes an explanation of the service. What is written there is what the owner of the car wash is promising to deliver and is what can eventually be handled by the customers in case what was promised is not then realized. In very simple terms, if the description only says that the service merely consists in washing cars, the customer can protest just in case his or her car is dirty after the execution of the service; but if the description specifies, for instance, that only ecological products will be used and the customer finds out that other products are used, he or she can claim that the

[4] We implicitly assume that participation is distributive with respect to parthood, so if the service system participates to the service system lifecycle all its parts do the same.

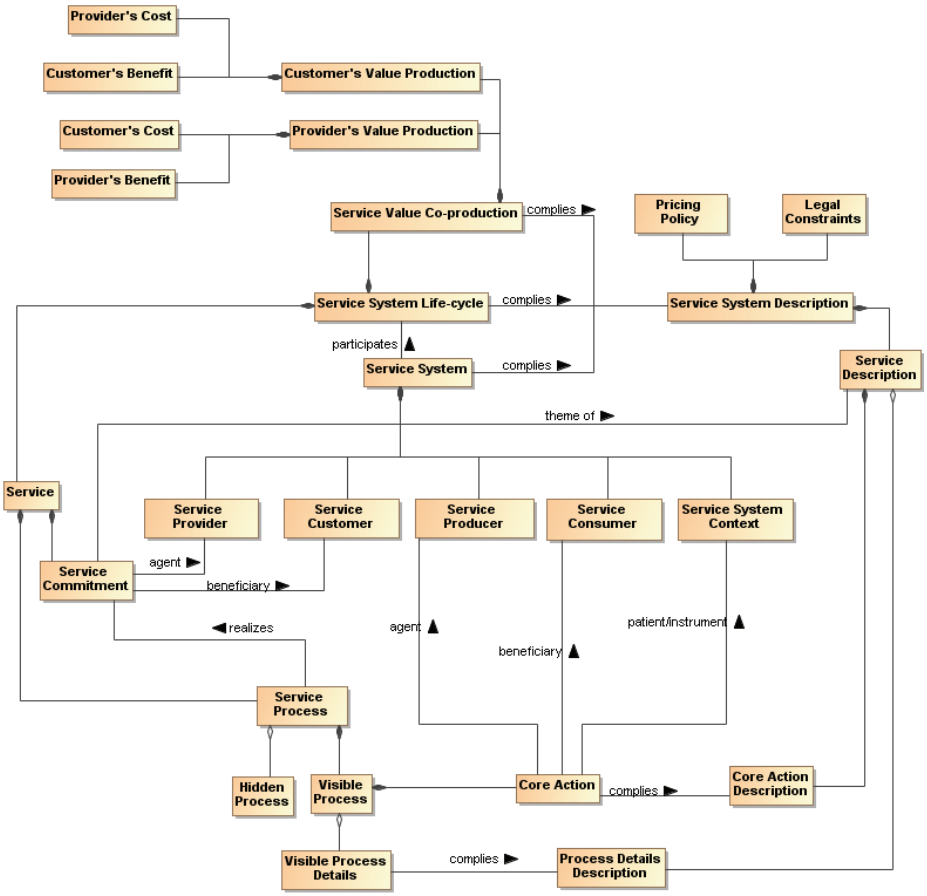

Fig. 2. The Commitment-based Service Model (revised version from [16])

commitment has not been honored. The service commitment has also a duration and location, which are the period and place where the owner guarantees that the service will be available. For the duration, usually it starts the first moment in which the car wash is open and lasts until the activity is ceased, i.e., the car wash will finally be closed. According to the modeling choices, one could decide to restrict the availability of the service to the opening hours of the car wash, but, as usual, this depends on what is written in the service description. In this example the commitment location is not particularly meaningful as it is identified with the car wash location, but there are more interesting examples, such as fire extinguishing, where the area in which the service is active must necessarily be specified beforehand.

The *service process* realizes the commitment, i.e., it is the execution of the actions described in the service description, according to the constraints there stated and is composed of two parts: the visible process (mandatory) and the

hidden process (optional); these two can be roughly identified with the front end and the back end processes. The visible process has some mandatory core actions (those that in a sense define the service for what it is, i.e., the core action is what the service fundamentally does) and some optional visible process details[5]. These are usually enhancing or supporting actions, that may equally be visible or invisible. Also, the core action has to comply with the core action description, while the visible process details have to comply with the process details description. The core action description and process details description are both part of the service description (though only the former is necessary). The hidden process does not have a correspondent in the description because it contains all those actions that are performed but not constrained by the description, i.e., the provider is free to perform such actions as he or she wishes since they are not ruled by the commitment.

Note that the core action's agent and beneficiary are the *service producer* and *service consumer*, respectively, who may or may not coincide with the provider and the customer, depending on the kind of service. In the car washing example, the core action is the washing itself, whose agent is the worker who actually washes the car; this may or may not coincide with the owner; the consumer is the guy who goes to the car wash for having the car washed (also this may or may not be the owner of the car: in the former case he or she is also the customer, in the latter case he or she is not, think about someone who goes washing the car that a friend has lent him or her for a period who, though being the customer, is not the final beneficiary, i.e., the consumer).

The duration of the core action coincides with the time that is taken to actually wash the car and the location is again the car wash itself. The instruments here are the water system, the sponges, the brushes, shampoo, wax etc.

Finally, the upper part of Figure 2 describes the service value co-creation process, which is constituted of two symmetric value experiences, as described above. Consider again the car washing. While the physical action is performed, there is in parallel a cost event on the side of the provider, while there is a benefit event on the side of the customer, starting from the time the washing is completed, and lasting for a while. Symmetrically, there is a cost event (a sacrifice) on the side of the customer at the payment time, corresponding to a benefit on the side of the provider. Modeling sacrifices and benefits (negative and positive value experiences) as temporal entities having a non instantaneous duration allows us to account for different kinds of service, depending on how value is produced at different times. So we can say that, for instance, paying for having your car washed is a bad deal if the roads are muddy, so that you can enjoy your car clean only for a short time.

3 Service Life-Cycle and Service Value Co-creation

In this section we will specify the process of service value co-creation in more detail, clarifying how all the other components of the service system life-cycle

[5] Here "visible" and "hidden" refer to the customer's perspective.

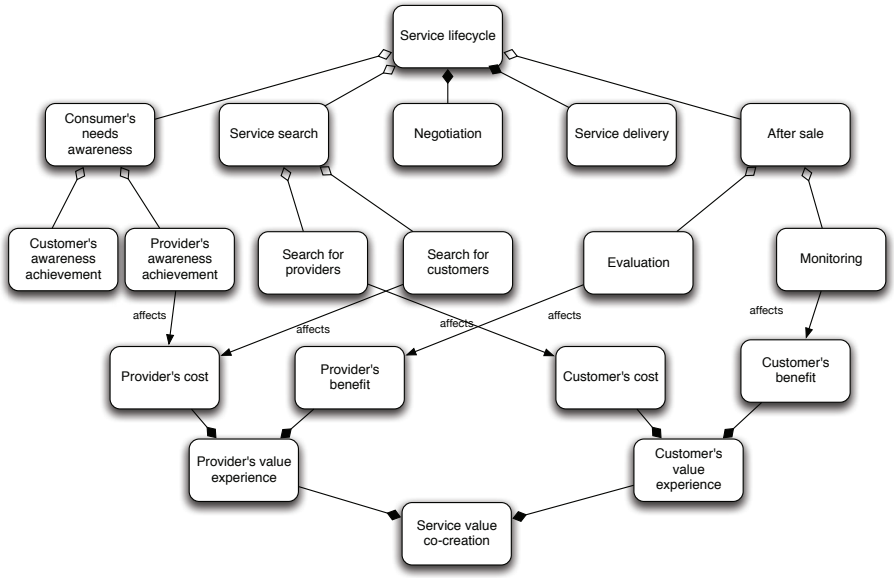

Fig. 3. Service Life-cycle and service value Co-creation

contribute to constitute value, even if intended as partly subjective (the value someone ascribes to a particular experience) and partly socially determined (influenced by trends and practices).

Figure 3 describes the *value co-creation process* composition, showing how the various phases of the service life-cycle contribute to determine costs and benefits, the main components of the value co-creation. The figure should also help in figuring out how value emerges from the interactions between providers and customers, and how these interactions characterize the whole chain of events that constitutes the service life-cycle.

Such life-cycle begins when the premises for instituting a service are created, namely when the awareness of the potential costumer's needs for such a service is achieved. And this can be achieved either by the customer (and this is what advertisement and marketing are for), or by the provider. In this latter case, achieving such awareness of the customer's needs can have a cost for the provider, as he or she may pay for some market studies enabling him or her to understand what the consumers need. It is interesting to notice that, in order for the service to be instituted, it is sufficient that one of the two agents acquires the awareness. Nonetheless, it is necessary that at least one of the two does.

The second phase is that of service search, that can be either search for providers (performed by the customer) or search for customers (performed by the provider). As for the previous phase, at least one of the two is necessary. The agent performing the search affords a cost.

After the search, a negotiation phase follows, in which both provider and customer are involved.

Then there is the service delivery phase, to be intended here as a customized delivery. This is what mainly determines the service value co-creation, i.e. the subjective value that will be ascribed to the service by provider and customer.

Finally, the after sale phase consists on one side of the evaluation of service on behalf of the customer, and on the other side of monitoring activities performed by the provider. The former affects the provider's benefit, as it allows, based on the customer's suggestions and complains, to make the service more valuable and, thus, more profitable; the latter contributes to the customer's benefit, because the provider goes on monitoring the service effects and performance even when it has already been paid for, and the customer may thus be helped with issues emerging afterwards.

Another point to be highlighted here is the relationship between the service value co-creation and the distinction we have introduced between visible and invisible parts of the service process: though it is reasonable to suppose that the commitment mainly relies on the visible process (the front-end), the value co-creation is heavily concerned also with the invisible process (the back-end).

If we go back to consider the service process, and in particular we look at the customized service delivery, there is an interesting similitude, as there we had core actions (that determine what the service is) and supporting and enhancing actions, that contribute to better characterize the service, determining how it is delivered. Similarly, in the service life-cycle some phases are mandatory and necessary to determine the value ascribed to a service, like negotiation and service delivery, while others are in a sense accessories, possibly contributing to determine such value, as consumer's needs awareness, service search and after sale.

As already explained, service value co-creation is part of the service system process, not of the service itself. The components of the service value co-creation, e.g. pricing, depend not only on elements which are intrinsic to the service, but also on things belonging to the service system context, such as laws that regulate the service or particular cultural and social traits that can make the result of a service more or less desirable. Moreover, we have to take into consideration the fact that intuitively we would like to be able to talk about the increase or decrease of the value of a service through time even in cases in which the producer executes actions of the same type. How would these variations in value be possible without considering the whole service system? What happens when the price of a certain service suddenly changes? Probably something in the (economic, social...) environment surrounding the service has changed.

It is interesting to notice how both costs and benefits can be expressed in terms of gain or loss of resources and labor. More precisely, costs translate in loss of resources and/or deployment of labor, while benefits translate in gain in resources and/or labor's saving.

In the car washing example, the service life-cycle starts with the consumer's needs awareness, in this case probably identifiable only with the provider's awareness achievement; we can imagine an entrepreneur who wants to start a commercial activity and makes a market survey and discovers that in a place where many

cars circulate there are very few car wash services. This activity has a cost for the car wash owner. The other case, that of customer's awareness achievement is very difficult to tackle for commercial services, much easier for social services, where citizens (that can be considered as customers, as tax-payers) may require lacking services for themselves or for other citizens that are close to them.

For the service search phase we can see as providers search the activity that someone that is looking for a service to wash his or her car performs, for instance by looking at yellow pages or over the internet. On the other hand, we can think about advertisement, telemarketing etc. as activities performed by the car wash owner as customer's search. Clearly these latter activities have a cost for the car wash owner, but also the search over the internet and in the yellow pages have a cost for customer in terms of time spent in the search. Sparing some time because the service is well advertised augments the value attributed to the service.

Negotiation in this case can be visualized as the event in which the car wash owner and the customer sit at a table and discuss in order to reach an agreement on what should be paid and what should be delivered (and how).

The delivery phase is in this example when the car is washed and the way in which this action is performed and how much such action complies both with the original service description and with what specified during the customized delivery planning determine the service exploitation and thus how much cost in terms of labor and possibly resources for the car owner and how much benefit for the customer will result. At the same time this also determines the payment and thus the amount of resources (in the car wash case most of the times just in terms of money) that will be transferred from the customer to the car wash owner. As already pointed out, though such amount is mainly determined by the delivery phase, all other phases also contribute in such determination.

Finally, the after sale phase is probably not very common for a car wash service, maybe one could think as something like customer's satisfaction questionnaires as evaluation, something that can help the car wash owner to better understand the desires of his or her customers and eventually to ameliorate the service. More difficult is to think about a monitoring activity, given the short duration of the benefits of the service (even the cleanest car gets dirty after few minutes in the traffic!), but for other services, like car repair, we can think of successive controls of new pieces that have substituted old ones after a repair.

4 Concluding Remarks

Service science is just at its beginning, and a lot of work still needs to be done in order to properly understand service systems, which can be seen nowadays as complex socio-technical systems, where the interactions among humans, technical artifacts, organizations, and norms play a crucial role. We strongly believe that using the formal tools of ontological analysis – i.e., systematically asking yourself questions concerning identity, dependence, constitution, and similar basic notions – can help a lot to come up with well-founded, understandable,

transparent models. In the current global crisis situation, achieving such kind of transparency is a key for participated governance and overall resiliency [23].

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