



Ontological Foundations of Services Science

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Towards a *Services Science*?

- Services are everywhere...
- Notion of service still relatively new in the general literature, need of an accurate definition mostly ignored in economy:
 - Serious confusions and inconsistencies in terminology
- The *internet of services* is one of the FP7 priorities. Yet semantic interoperability across services risks to become a *myth*...
- ...unless we realize the need for a *highly interdisciplinary* work, with solid foundations! [Petrie 2008]

Chesbrough & Spohrer, *A Research Manifesto for Services Science*.
Communications of the ACM, 2006

The case of web services

- *C. Petrie, C. Bussler, The Myth of Open Web Services, IEEE Internet Computing 2008:*

*“run-time interoperability is **technically feasible only within service parks**, where [...] services are very constrained, and [...] the semantics will be common because the objects are common”*

“some interoperability among service parks might emerge, but could take a long time”

- *K. Sykara, Unthethering Semantic Web Services, IEEE Intelligent Systems 2007:*

*“current Web services proposals **don't enable the semantic representation of business relations, contracts, or business rules** in a machine-understandable way”, while “current business-process languages [...] are at a low abstraction level and don't provide formal business semantics”.*

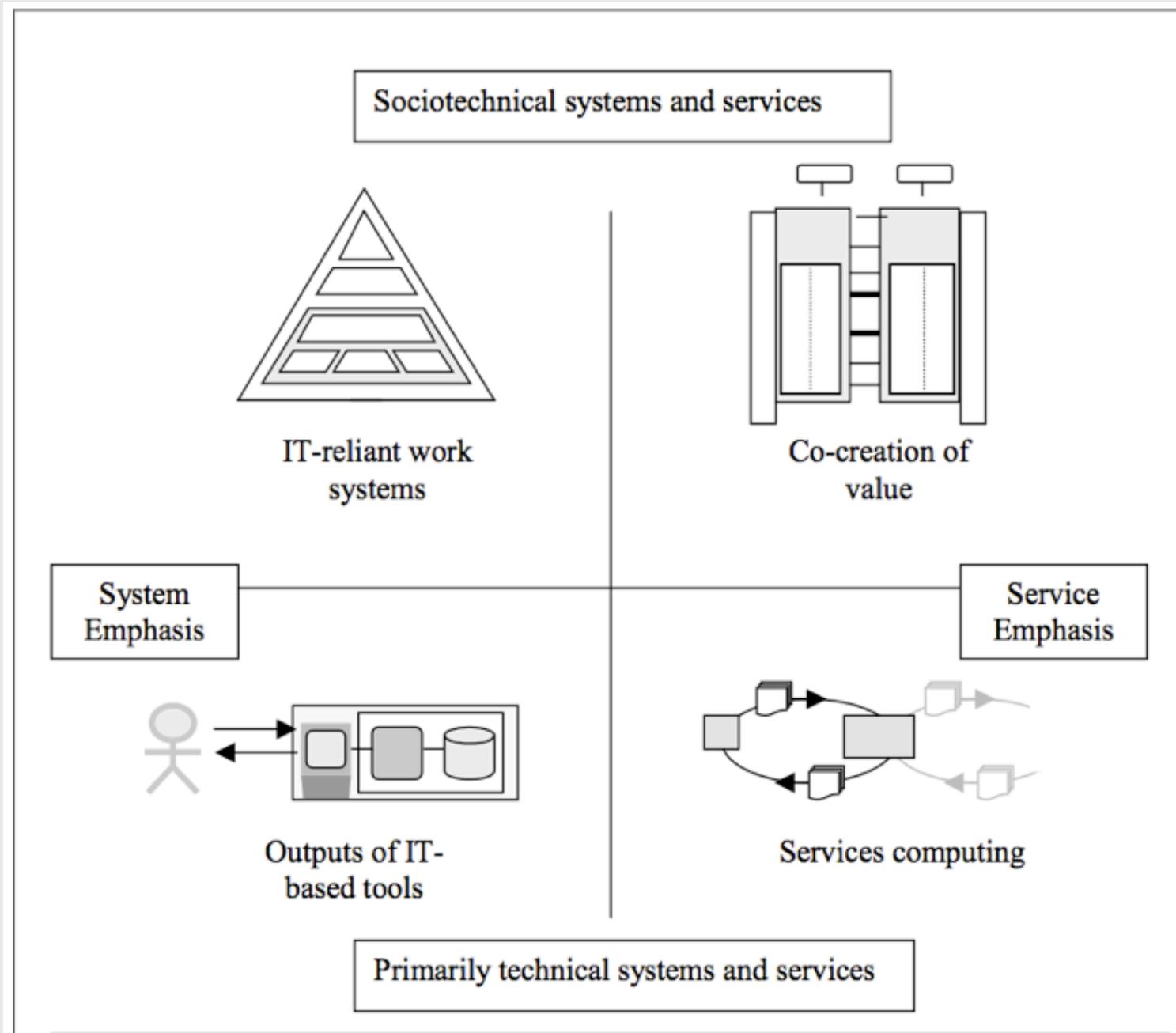
Clarifying the intended meaning of “service”

- What is a **service**?
 - An action
 - A generic type of action
 - The capability to perform some action
 - A computational procedure capable to perform some action
 - An agent in charge of performing an action
 - The result of an action
 - The (subjective) result of an action
- What is a **service provider**?
 - The authority which guarantees the service execution
 - The actual agent who executes the service actions (possibly on behalf of somebody else)
- What is a **service consumer**?
 - The one who requests the service
 - The one who benefits of the service

The need for a global view of services

- Current semantic web services modeling formalisms focus on the *external interface*, advocating its strict separation from the internal view: roughly, a service is described in terms of its behavior (transfer function from an input state to an output state).
 - Yet, business applications need to specify
 - *how* the service is performed at the business level, referring to *internal* details whose nature varies a lot from service to service
 - *when* the various processes involved in a service occur
 - Business applications need to *monitor* and *evaluate* services quality with respect to their actual impact on the whole *service system*, which includes external events, objects, people, organizations... (context-aware services) [example: a directory service]
 - Service Level Agreements need to refer both to *internal* and *contextual* details
 - Well-known gap between business services and IT
 - Need to look *inside the black box* and *out of the box*...
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Steven Alter's Systemic Approach



Three common ways of understanding services

- **Intangible goods:** something “we can buy, with no risk to drop it on our feet”
 - What about copyrights, IPRs?
- Things we pay for, but we **don't own**
 - What about rented cars?
- Sets of **abstract capabilities**
 - Only one service for a given set of capabilities?

Services vs. goods

- Services are not kinds of goods (*immaterial goods*), since there is a radical difference between goods and services [Hill 77]:
 - Goods are **transactable** and **transferable**
 - Services are transactable, buy they are **not transferable**
- Why are they not transferable?

*because services have a temporal nature, they are **EVENTS!***

DOLCE's basic taxonomy

Object (endurant)

Physical

Amount of matter

Physical object

Feature

Non-Physical

Mental object

Social object

...

Event (perdurant)

Static

State

Process

Dynamic

Achievement

Accomplishment

Quality

Physical

Spatial location

...

Temporal

Temporal location

...

Abstract

Abstract

Quality region

Time region

Space region

Color region

...

...

Transferability and Ownership

- Owning an entity implies being in control of its *temporal behavior* (for instance, deciding to destroy it)
- Services are events in our approach
- The temporal behavior of an event is already determined: changing it would result in a different event
- Thus, *events are not ownable*
- In conclusion, it is not possible to transfer the ownership of a service, because services, being events, are not ownable

Two different notions of services as events

- Action-based: *passing the salt* is a service
- Commitment-based: a previous commitment is needed.

- *Paying* for a service vs. *finding* a service
- *Service delivery* vs. *service offer*

- Terminological solution:
 - What is delivered is the service *content*
 - A service implies always a commitment
 - Occasional favors are not services.

Services are based on *commitments*

- How can you tell that a service is present, here and now?
- What do you *pay for*, when you invest in a service?

A *service commitment* is an agent's explicit commitment to guarantee the execution of some *type of 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 constraints the *way* service actions will be performed (*service process*)

A service is essentially (based on) a *promise* [O'Sullivan 2006]
...which involves real people in real contexts
(of which IT systems are only a part!)

Service provider vs. service producer

- Problem: what's the action promised by rental services? Who executes it?
- *Guaranteeing* an action vs. *producing* an action
- Three cases:
 - Service **action** producer = service provider
 - Service **action** producer delegated by provider
 - Service **action** producer = service consumer

Service, Service Commitment, and Service Process

- ***Service commitment***: agent's explicit commitment to guarantee the execution of some type of actions, on the occurrence of a certain triggering event, in the interest of another agent and upon prior agreement, according to a certain specification (the service description) which constraints the way the service actions will be performed (i.e., the service process that will be adopted).
- ***Service process***: actual implementation of a service commitment, consisting of number of interdependent actions including those necessary to monitor the trigger events, the *core actions* mentioned in the commitment, and any further actions aimed at supporting or complementing the successful execution of such core actions.
- ***Service***: the **visible, exposed part** of a service process implementing that commitment, which includes all the activities explicitly mentioned in the service description.

Service commitment

Service process

Service context monitoring

Customized delivery planning & coordination

Customized service content delivery

Supporting action(s)

Core service action(s)

Enhancing action(s)

Service value exchange

Provider's activities

Service awareness

Bundling, presentation & pricing

Negotiation with customer

Payment exploitation

Follow-up

Customer's activities

Need awareness

Discovery

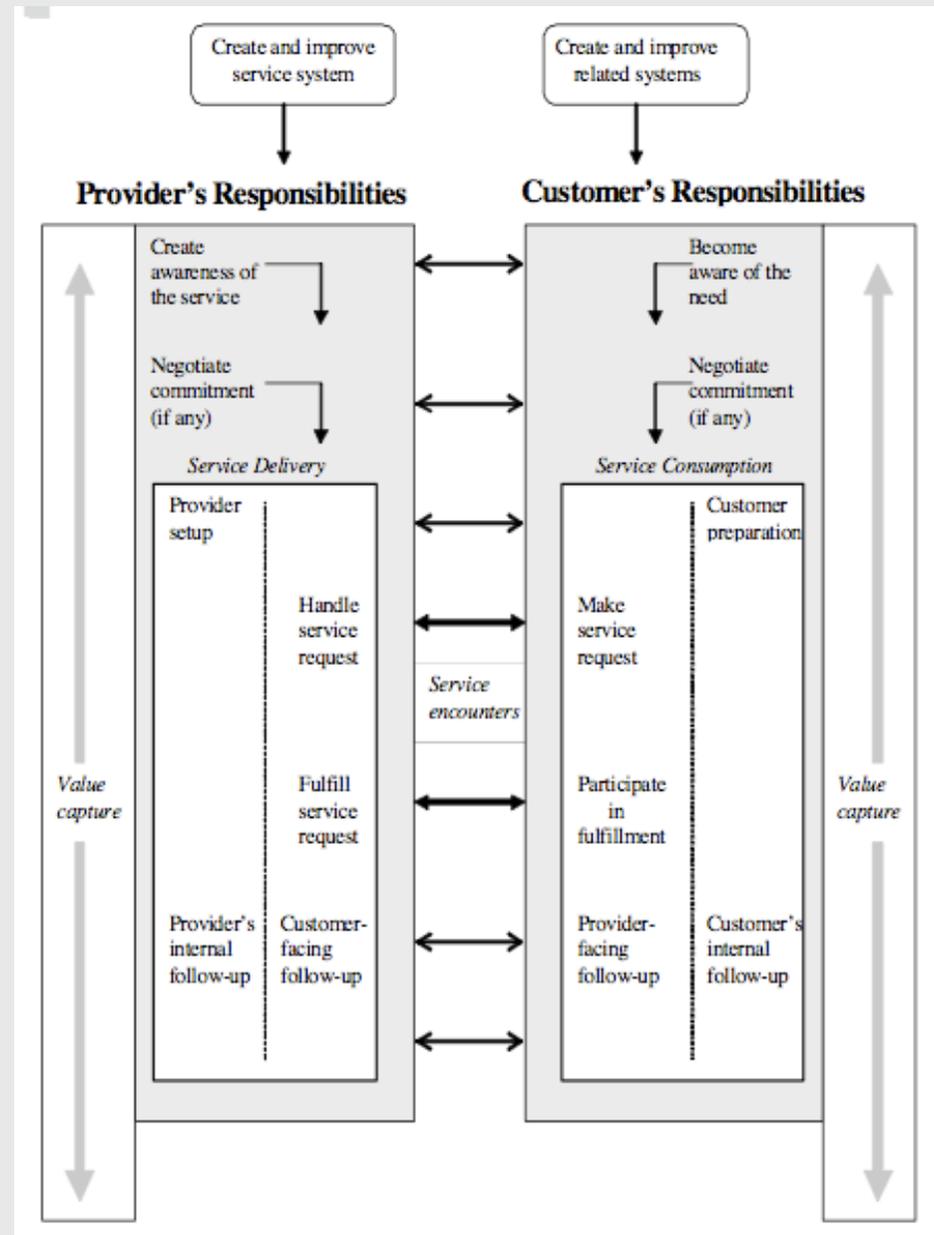
Readiness to pay

Negotiation with provider

Payment

Follow-up

A further key aspect of services: *co-creation of value*



Alter 2008:
When do Services fit in Systems
Analysis and Design?

Thematic Relations

- Agent (the active role, the one who acts in the event)
- Theme/Patient (the one who undergoes the event; the patient changes its state, the theme does not)
- Goal (what the event is directed towards – typically a desired state of affairs)
- Recipient/Beneficiary (the one who receives the effects of the event)
- Instrument (something that is used in the performance of the event)
- Location (where the event takes place)
- Time/duration (when the event takes place, or how long it lasts)

Services and Value Transfer

- Although you can't transfer a service, certainly a service involves *value transfers*
- Internally to a service's value chain (at the interface between the service process and the service consumer), multiple kinds of value transfer may occur:
 - Transfers of goods
 - Transfers of rights
 - Transfers of duties

Example: car rent

- Transfer of right: to use the car
- Transfer of money (if cash): payment
- Further transfer of right: getting the car repaired if it breaks
- Transfer of duty: a third party is in charge of repairing the car

The Normative Dimension: Responsibilities, Rights and Obligations

- Responsibility tables help in indicating a direction for responsibility relations inside a single (sub)event
- **Delegation** relations may indicate responsibility transfer across different (sub)events
- A responsibility relation arises when to someone (the recipient) it is recognized the **right** to receive a service (sometimes this is automatically recognized, like in the case of basic rights, sometimes the right is acquired in virtue of some other event, like when one pays for a service).
- Responsibility can be seen as a sort of **obligation**, thus entailing **sanction** in case the service is not fulfilled
- The right of the recipient to have the service fulfilled and the belief that the agent will be sanctioned in case it is not, engenders an **expectation** in the recipient that the service will be delivered.

Sparse notes based on VMBO contributions and on REA ontology

- Services are not resources:
 - resources can be “stocked”
 - resources can be exchanged
- Sell and buy events are not completely dual (commitment to buy depends on commitment to sell)
- Static vs dynamic events; role of commitment
- Resource flows are not simultaneous

Basic event kinds involved in value chain

- Commitment
 - Resource transfer (+/-)
 - Deontic state (Right/Obligation)
 - Experience (+/-)
- Note: properly speaking, value is not transferred. Value is *ascribed* by an agent, at a given time, to a resource, a deontic state, an experience.

An Example: *car repair*

		<i>Agent</i>	<i>Theme/Patient</i>	<i>Goal</i>	<i>Recipient/ Beneficiary</i>	<i>Instrument</i>	<i>Location</i>	<i>Time/Duration</i>
<i>Service Commitment</i>		<i>Mechanic</i>	<i>Job description</i>		<i>PA (Chamber of Commerce)</i>	<i>Subscription act</i>	<i>Province/ Region</i>	<i>Starting from a fixed date before the opening of the garage and until the duration of the license</i>
<i>Service Acquisition</i>	<i>Discovery</i>	<i>Customer</i>	<i>Mechanic</i>	<i>Car repaired</i>				<i>After opening and before actual repair</i>
	<i>Negotiation</i>	<i>Customer, Mechanic</i>	<i>Service customization</i>	<i>(Agreement)</i>			<i>Garage</i>	
	<i>Activation</i>	<i>Mechanic</i>	<i>Internal execution plan</i>				<i>Garage</i>	
<i>Service Process</i>		<i>Mechanic</i>	<i>Car</i>	<i>Car repaired</i>	<i>Customer</i>		<i>Garage</i>	<i>Period in which the repair actually occurs</i>
<i>Service Value Exchange</i>	<i>Producer's sacrifice</i>	<i>Mechanic</i>	<i>Working hours</i>	<i>Being paid</i>			<i>Garage, bank...</i>	<i>A certain time (usually) after that the car has been repaired</i>
	<i>Customer's sacrifice</i>	<i>Customer</i>	<i>Money, car's unavailability, time to pick up car....</i>	<i>Car repaired</i>				
	<i>Producer's revenue</i>	<i>Mechanic</i>	<i>Money</i>					
	<i>Customer's revenue</i>	<i>Customer</i>	<i>Car repaired/ car availability</i>					

		Agent	Theme/ Patient	Goal	Recipient/ Beneficiary	Instrument	Location	Time/ Duration
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	Activation	Mechanic	Internal execution plan				Garage	
Service Process		Mechanic	Car	Car repaired	Customer		Garage	Period in which the repair actually occurs
Service Value Exchange	Producer's sacrifice	Mechanic	Working hours	Being payed			Garage, bank...	A certain time (usually) after that the car has been repaired
	Customer's sacrifice	Customer	Money, car's unavailability, time to pick up car....	Car repaired				
	Producer's revenue	Mechanic	Money					
	Customer's revenue	Customer	Car repaired/ car availability					

Co-reference needed!

Event-centric business modeling

- What are the basic events (out of the box)?
- Where are they located, in space and time?
- Which are their participants (human and non-human)?
- What are their natural boundaries?
- What's the relevant information concerning their evolution (to be recorded as a "business artifact")?

- E-government example: the central registry of Public Administrations: the service quality crucially depends on the update process...

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Main Results

- *Rethinking of the difference between **internal** and **external** service views: the black box model is too limited*
- *Improvement of the classic **definition** of services coming from economics*
- *Focus on **core actions** instead of pre- and post conditions*
- ***Layered model** based on interdependent events*
- *Comprehensive **business-oriented** approach*
- *Common framework to describe service according to **different views***
- *Detailed account of **non-functional properties***