What Is This Thing Called e-Service? Interoperability Challenges in e-Service Modelling

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Abstract. Electronic service, or e-service, is a key concept in today's e-Government development. The availability and quality of electronic services are important indicators of e-Government maturity. However, we argue that our understanding of the concept e-service is poor and we show that the ambiguity surrounding the concept creates problems when building ontologies and thus makes it difficult to achieve better interoperability between systems. We thus propose a model for e-services building on a framework for categorizing services using some basic terms. In this way we can describe and model various types of communication between citizens and public agencies based on a consistent set of elementary categories. Our model also draws on EU's proposed Core Public Service Vocabulary (CPSV). The paper is conceptual and is mainly based on a literature review.

Keywords: Service · e-service · e-Government · Interoperability · Semantic web

1 Introduction

The service concept is widely used but involves much confusion. E-service is even worse; it is understood as almost all types of electronic communication between citizens and government [1, 2]. However, is the government offering us a "service" when we are paying taxes or a fine, just because we are using the Internet? In the rather vague terminology used within the e-Government field, almost all types of interaction between public authorities and citizens are regarded as services. Such confusions create difficulties also when defining ontologies that shall support electronic provision of services. Goldkuhl [3] questions the use of service in all governmental tasks, while Alter [4] points to the different definitions of service across communities, and Baida et al. [5] propose an ontology for describing services and service bundling. Following Alter [4] there is thus little consensus on the meaning of the concept e-service, and hence, the literature is full of synonymous terms and concepts as also Lindgren and Janson [2] point out.

Also Papadomichelaki and Mentzas [6] state that the subject of e-service quality is very rich in content of definitions, models, and measurement instruments but although there is agreement on e-service quality being a multidimensional construct, the content of what constitutes e-service quality varies across studies.

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A public service can be solely the electronic communication between a public agency and a user, as e.g. information provision, completing an application form etc., or it may be one part of a longer interaction sequence that also includes the provision of a physical service (e.g. applying for child care). The interaction may have been initiated by a user in order to obtain some value (good, benefit etc.), or it may be to fulfil a responsibility where we are obliged to provide information, e.g. when paying taxes, reporting various types of information to public authorities, etc. An electronic interaction can replace a former paper-based communication, or it can involve a new type of service, where the content in itself has a separate, original value, as e.g. an interactive digital map, an electronic book from the library etc. What is called an e-service can also include a set of separate interactions including case handling. On the other hand, public sector also has many functions which imply electronic interactions that should not qualify as services, as e.g. mandatory collection of information from businesses.

The research objectives of this paper is

- *to provide a better understanding of the e-service concept by analysing the relation between physical and digital parts of a service*
- *propose a model for describing (e-)services*

We do not intend to arrive at a definition of the concept e-service. Rather we will try to improve our understanding of the concept by analysing the different characteristics of the interaction between the government and its citizens and businesses, and by looking at the relation between physical and digital parts of a service and try to model these.

When discussing the concept e-service and its implications for interoperability it is important to be consistent in the use of words, and especially the distinction between concept, term and referent, as is described in the semiotic triangle [7].

The concept e-service is the idea or the mental understanding we have of it. The term is the specific label we apply to the concept, the name of the concept so to speak, and the concept e-service has several names (terms), e.g. “e-service”, “digital service”, or “online service”. The referent is the actual e-service representing the concept, e.g. the concrete e-service applying for a student’s grant.

The paper is structured as follows: The next chapter describes our method and we then move on to discuss the concepts of service and e-service and the interoperability challenges that arise. Next, we provide a relevant case from a recent project to shed light on the problems related to different definitions of the e-service concept. Based on the analysis of the service and e-service concepts and the different categories of interactions between government and citizens and businesses, we propose a simplified model for a service, in the form of an ontology.

2 Method

Our paper is primarily conceptual and exploratory, aiming to develop a model for describing public electronic services. The paper is rooted in the e-Government research field, but borrows from more general computer science, specifically semantic technologies and ontology development. The discussion of the concept of service is mainly

drawn from business science and computer science, because there are few references to this in e-Government literature and not many papers rooted in the e-Government field discussing the service concept. As such we do not distinguish between service provision in a G2C or G2B manner.

The paper builds mainly on a literature review from different disciplines. Since the research question is how to understand the concept e-service, and hence how to model an e-service, a study of the use of the concept in different fields of science was seen as the best method. We also analysed a use case in order to bring experience from e-Government practice to the study.

The main source of literature is the extensive e-Government Reference Library, EGRL, which in the latest version 10.5 contains 7,237 of predominantly English-language, peer-reviewed work in the study domains of electronic government and electronic governance [8].

We also searched the Web of Science[1] for the topic phrase "e-service interoperability" which resulted in 60 papers of which seven was found to be relevant judged by the title and the abstract.

We have also used a case study approach and studied the Los case explained in Chap. 4 as an example of interoperability problems caused by the lack of understanding of the central concept e-service.

3 Understanding Service and e-Service

3.1 What Is a Service?

Service is a concept loaded with different meanings in different circumstances, mostly depending on who uses it. There exist a number of definitions of the concept service, both lexical and from other sources. Starting with encyclopaedia the word service comes from the Latin word "servus" which means slave [9]. A first definition of service is the occupation or condition of a servant, corresponding nicely to how service is understood in computer science: A program that offers a service to other programs through a well-defined user interface, as e.g. in service–oriented architecture (SOA).

From the above definition we can see that the concept service is used to indicate an action and also the type of action (the act or method). The definition also covers the output of a service (the quality) and the organization acting to carry out the service. Service first came into use in the 1930s in the U.S. Department of Commerce's Standard Industrial Classification (SIC) codes [10].

The European Parliament passed the Service Directive, also known as the Bolkestein Directive [11] in 2006. The directive refers to article 50 of the (Lisbon) Treaty [12] for a definition: "Services shall be considered to be "services" within the meaning of this Treaty where they are normally provided for remuneration, in so far as they are not governed by the provisions relating to freedom of movement for goods, capital and persons. "Services" shall in particular include: (a) activities of an industrial character;

[1] https://webofknowledge.com/.

(b) activities of a commercial character; (c) activities of craftsmen; (d) activities of the professions."

Hill [13] defines service this way: "A service is a change in the condition of a person, or a good belonging to some economic entity, brought about as the result of the activity of some other economic entity, with the approval of the first person or economic entity". Although not very precise, this definition has been adopted by the U. S. government. This definition puts weight on the action rather than the substance or the quality. Chesbrough and Spohrer [10] have called for a unified Service Science to integrate across academic silos and to advance service innovation. They also stress the conceptual confusion of 'services'. They argue that the change from products and tangible goods to more and more intangible assets calls for a broader perspective and the need for each party in the process to know the other party's knowledge in negotiating the service exchange. They also argue that service innovation is different from product innovation.

Maglio et al. in [14], also points to the diversity of perspectives involved in the understanding of what service is. They understand the term "services" to mean "service processes" and tries to bridge the different understandings of the service concept in his Unified Service Theory (UST). The UST defines services as production processes wherein each customer supplies one or more input components for that customer's unit of production The input dimension is considered to be unique to services. However, Sampson does not distinguish between e-services and services.

Baida [15] makes a distinction between an "elementary" service element and a "service bundle". A service bundle is a complex service element, including one or more service elements, any of which may be either elementary or a bundle. Service bundles can also be called compound services. A service element may be decomposed into smaller service elements, as long as the smaller elements can be offered to customers separately or by different suppliers. Once a smaller element represents a non-separable service element that is offered by one supplier, we call it an elementary service element.

Without fully adopting Baida's definitions, we believe the basic idea of elementary service elements is fruitful, and suggest that we make similar distinctions, which imply that we can develop an ontology of elementary public services, which may include both online and physical services and also make a distinction between the two, as indicated in the Los ontology shown in Fig. 1.

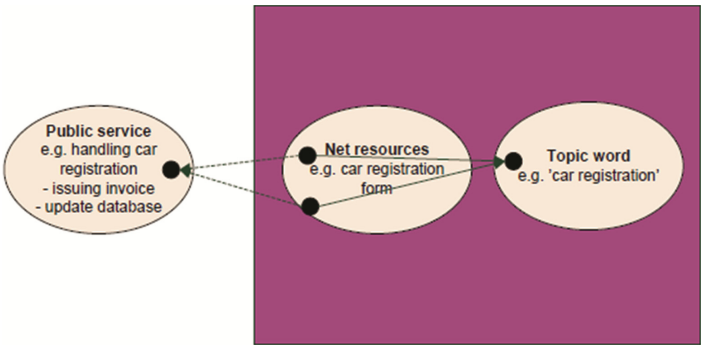

Fig. 1. Simplified Los ontology showing the example of registering a car.

3.2 What Is an e-Service?

Moving from the real world to the electronic representation, we question whether we can use the same definition of e-service as for service, the only difference being the means of how the service is delivered to the user? Is it just to add an "e"?

Goldkuhl [3] questions the use of service in all governmental tasks and he asks whether the service perspective is compatible with all kinds of public authority. More precisely, he questions whether a public e-service is a real service to the citizen, in a strict sense: in what ways is a citizen served through an e-service? A next question is what we mean by e-services. He ties these questions to a study of a child care service and the work with a requirement specification for an electronic child care service. He shows how the lack of a proper understanding of e-service led to problems with the requirement specifications and ultimately the e-service application itself. The citizen was mainly seen as an information provider and not as someone to serve.

Rust and Kannan [16] define e-services as general as "the provisioning of services over electronic networks", whereby electronic networks include not only the Internet but also electronic environments as ATMs. They discuss the e-service concept from a business science view and their e-service concept is tightly coupled with e-Commerce. They do not make any attempt to distinguish e-services from services and do not discuss the possible differences between services and e-services.

In an analysis of the e-service literature, Rowley [17] acknowledges that theory and practice of e-services is still in its infancy and that the result being the absence of an agreement on the definition. She thereafter goes on to define the concept 'e-services' as "…deeds, efforts or performances whose delivery is mediated by information technology. Such e-service includes the service element of e-tailing, customer support, and service delivery". Also this definition is based on a business science view, and it reflects the three main components involved: service provider, service receiver, and the channels of service delivery. However, she does not say anything about services and thus makes no attempt to relate or differentiate the two concepts.

O'Sullivan et al. [18] also ask "what is a service?" and recognize the difference between physical services and e-services, but without discussing them in depth. They assert that e-services exhibit minimal constraints on the time and location of request, contrary to most real-world services. They also emphasize the need to describe the non-functional properties (availability, channels, pricing strategies etc.).

Service quality is an important aspect of services and has also been attempted used to clarify the concept of public e-services, as pointed out by Buckley [19] and Zeithaml et al. [20]. But as Goldkuhl [3] points out, most often the underlying premises for the service concept seems to be taken for granted and not problematized.

Baida et al. [5] try to bridge the different definitions and approaches to the concept service from the three different communities of business science, information science, and computer science. Service and e-service as used in business science has a very different meaning than the same concepts used in computer science. The former community naturally puts weight on business transactions and see 'e-services' as a natural outgrowth of e-Commerce. From a strict technological point of view, (e-)services are web-delivered software functionality, often described as "web services".

Alter [4] also refers to three different disciplines, each with their own definitions of service: marketing, operations, and computer science. He proposes a service system as a useful fundamental unit for understanding, analysing, and designing services in all three disciplines. When discussing automated and non-automated services he emphasizes that the proposed frameworks for a service system does not make any assumptions about whether ICT is involved or not. From Alter's point of view ICT, or other technologies, can be part of the service system.

This is in line with this paper's view that although parts of a physical service are carried out online, that does not make the service necessarily an e-service. That is not to say that complete online services do not exist. In Norway the State Educational Loan Fund provides almost complete automated handling of most applications for grants and loans. Similarly, on-line declarations to the police, purchase of digital maps or retrieval of online books from a library are other examples of online services. Thus, many functions available from public websites are examples of "true" e-services in that they do not have a specific physical part.

3.3 e-Services and Interoperability Problems

A web service is, unlike the service and e-service concepts, fairly well defined. It denotes "a software system designed to support interoperable machine-to-machine interaction over a network" [21]. It is thus a much more precise and narrow definition than e-services. Tightly connected to web services is the Service Oriented Architecture, SOA, a popular framework in computer science. OASIS defines SOA as a paradigm for organizing and utilizing distributed capabilities that may be under the control of different ownership domains [22]. Furthermore, in SOA a service is understood as "as the capability to perform work for another or the specification of the work offered for another or the offer to perform work for another" [22].

Much effort has been put into developing more systematic vocabularies (ontologies) for describing public services, which is necessary to achieve better interoperability e.g. Wimmer [23], W3C [24], and OASIS [22]. In such work, there is a clear need for more precise definitions of the key concepts that can describe and model the different activities and processes involved, in other words develop an ontology. Shadbolt et al. define ontologies as "attempts to carefully define parts of the data world and to allow mappings and interactions between data held in different formats" [25], or as Gruber [26] puts it, "a specification of a conceptualization".

Semantic technologies call for a greater precision in defining concepts and their relations, what is usually called vocabularies or ontologies. Without such definitions machines will be unable to act on the information because of ambiguities in the definition of concepts. The service and e-service concepts are clear candidates for such ambiguities, which the case of Los described below clearly shows.

The Semantic Web is W3C's proposed method, based on the Resource Description Framework (RDF), for making machines on the Internet interpret and "understand" information so as to be able to act without specific instructions from the users [24]. The Semantic Web and semantic technologies in general are thought to

have a profound influence on the future development of the Internet [27]. It will thus also have a significant influence on the future development of e-Government, not at least the challenging interoperability issues recognized as one of the major barriers to more seamless electronic applications and an area with a substantial gap between plans and realities [28].

The work with establishing a common model for public services has been brought about partly as a result of the work with a European Interoperability Framework (EIF). The first version of the EIF presented the much used three-level interoperability model with the technical, semantic, and organizational interoperability levels [29]. Version 2 of the EIF was published as an annex to the report "Towards interoperability for European public services" [30] and added the political and legal levels to the existing three levels of interoperability. It also put forward specific recommendations regarding the work with interoperable public services, among these:

> *Public administrations should develop a component-based service model, allowing the establishment of European public services by reusing, as much as possible, existing service components (Recommendation 9)*

Following up this recommendation, EU's programme for interoperability solutions (ISA) established a working group for the Core Public Service Vocabulary to develop a conceptual model for public services. A modified version of this model is shown in Chap. 5.

Our literature review shows that there is no coherent understanding of the service and 'e-services' concepts. Baida et al. [5] also underline that understanding the various interpretations of service is not enough to facilitate reasoning about services, as done in Semantic Web initiatives. They call for a shared conceptualization and formalization of describing services to allow for development of appropriate software. The important word here is "shared", and as we shall see in the next chapter problems arise when concepts that should be shared, are not understood in the same way.

4 Lost in Translation: The Case of Los

Los is the name of a system enabling automatic exchange of information between public organizations[2] [32]. The information exchange is based upon a controlled vocabulary (list of keywords and their relation) describing public services. The vocabulary is organized as a thesaurus following the ISO 2788 standard for monolingual thesauri construction [33] and expressed in Topic Maps, an ISO standard for structured metadata [34]. An important aspect of Los is the underlying semantics and the description of the key concepts. Experiencing interoperability difficulties as described above, it has been important to handle concepts like service and e-service carefully in Los and try to break these down into service elements and giving them unique names, e.g. a *service description*, a *form for printing*, a *form for electronic submission* etc. This is in line with Baida's

[2] The system is owned and developed by the national Agency for Public Management and e-Government in Norway (Difi – http://www.difi.no).

suggestions of separating the elementary services from a service bundle [15]. It also reflects the different categories of interaction between the Government and its citizens and businesses, as showed by Jansen and Ølnes [35].

The problems that can occur with ambiguous definitions were encountered during the test phase when the Los ontology was merged with the ontology for the Bergen municipality web portal. The municipality of Bergen, as one of the pilot users of Los, used a different definition of service than Los, which then caused a failure in the information integration process and resulted in a compromised system.

The municipality of Bergen's web portal was based on Topic Maps technology, as was the Los system, and the implementation of Los was therefore straightforward. An important feature in Topic Maps is that two concepts (called *topics* in Topic Maps) must be merged if they have the same name. The topic service from the Los vocabulary was therefore merged with the Bergen's own topic service and the result was a compromised system because the two systems relied on different definitions and understandings of the concept service. This is an interoperability conflict classified by Peristeras et al. [31] as a schema-isomorphism conflict.

In order to correct the situation, the Los ontology was revised, replacing the (e-)service concept with a new concept 'net resource' which is information about a service or methods of obtaining a service, e.g. an electronic form. Instead of naming everything a service (or e-service), a differentiation between different parts of a service was done, e.g. the service description, the electronic form(s) in use, other transaction types and so on.

The example above is from the public service of registering a car on a new owner. It shows the distinction and connection between online resources (inside purple box) and the physical part of a service provision (outside the box). This service could in principle be a complete e-service. However, in Norway only the registration form of the service is available online for citizens. The other interactions between the governmental agency and the citizens have to be carried out manually.

The Los case shows that a seemingly small detail in the definition of a concept can cause major problems when it comes to interoperability issues. In everyday language we can get away with imprecise use of concepts because of the pragmatic nature of human communication. Most often, we as humans will understand the meaning even if the concepts we use are not completely agreed upon at the beginning. However, when working with semantic technologies and making machines "understand" and act upon the information they process, unambiguity is an absolute necessity. Without having consistent terms and definitions we cannot solve the interoperability challenges when different systems are interacting. The lesson learned from the Los case is that we must define key concepts in consistent ways, which we will outline in the next section.

5 A Model for Conceptualizing e-Services

We most often fail to see the distinction between a physical service and an e-service, or at least any in-depth discussions. Also in measuring or benchmarking e-Government,

e-service concepts are rarely discussed but taken for granted, as we can see from core e-Government reports from the EU and corresponding reports from other countries, e.g. Norway.

In striving for greater precision it is necessary to examine the different parts of a complete e-service and then identify and name these parts according to what they really are. We have to distinguish between the interface of a service, e.g. a form to apply for a service, and the service itself. If we call both things an "e-service", as is often the case today, we will face great challenges and difficulties when trying to achieve better interoperability.

Our model builds on a framework for describing e-services that has several dimensions [35], among them: (i) the purpose of the interaction such as execution of authority, fulfilling obligations as a citizen or a business, applying for a benefit or to provide information, (ii) the content or structure of the interaction, and (iii) the result or effect of the interaction. By using the ISA working group on public service vocabularies [36] as a starting point and incorporated the understanding of the categories of interaction between government and citizens and businesses, we propose this simplified model of a service (Fig. 2).

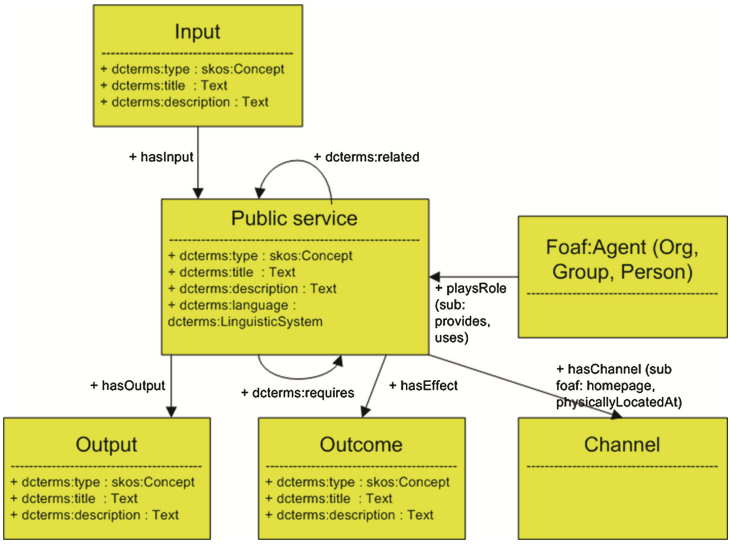

Fig. 2. A simplified service model expressed as a UML class diagram, based on CPSV

The different classes and relations of the UML diagram above are described in more detail in the table below (Table 1).

Table 1. Description of the different classes in the model

Class	Description
Input	The prerequisite for obtaining a service; structured information given in a form and often digitally represented
Public service	The physical or digital service offered to citizens or businesses
Agent	Service provider, citizen, business
Output	The information acquired by the client of the service after initiating the process and after the service provider has handled the case
Outcome	Change in status, e.g. if applying for a driver's license and passing the tests, the citizen has obtained the right to drive a car (or a vehicle)
Channel	The medium which the service is provided through. Also used to distinguish between digital and physical delivery

The model above has been simplified to emphasize the most important parts. A service model is more complicated and involves rules for handling a service request, preconditions to be met to be eligible for the service etc. Thus, we have to specify:

- The preconditions (in addition to the prerequisites); the formal and material requirements that have to be fulfilled before a service dialog can be initiated
- Who are the specific agents involved in each individual service
- What output is expected by the receiver of the service (e.g. citizens)
- What outcome is likely to be the effects for the completed service

The distinction between *output*, which we understand as the planned (automatic) result of the "service", while by "outcome" we understand the effect, as e.g. what a client (citizens or business) experiences from the service, e.g. a fulfilment of obligations as paying taxes, a permission as driver's license, a financial support, etc. Outcome may also include consequences for the provider, e.g. the update of a register, a reporting data from a business, the payment of a fine, etc. This is also in line with Jansen and Ølnes [35] in their distinction between service result and service effect.

6 Conclusions and Further Research

This paper has demonstrated that the various definitions of e-service are confusing and troublesome, as most often service or e-service are used without any further definition, especially in public documents where these concepts are crucial. We also find very different definitions both within and across research disciplines, not least within the e-Government domain.

Our Los case shows that lack of common definitions may create inconsistencies in our electronic systems. Consistent definitions are particularly important in the development of more semantically enhanced systems, and properly use of semantics is a prerequisite to increase levels of interoperability. There is thus a need to agree on key concepts and their definitions, as well as the relationship between them when building ontologies. The gap between plans and realities [28] shows us that this is not an easy task as little alignment, adoption, and adjustment has been done between the many vocabularies that exist in different organizations, sectors, and subject domains.

We are thus in line with Goldkuhl [3] who argues for more reflective studies on the service dimension in e-services and will argue that substantial parts of what is now called e-services are rather service descriptions, service interfaces, or service representations. There is an urgent need to properly define the key concepts of e-Government, and e-service is one of these, in order to make progression in the work with interoperability, and we believe our proposed model is a first step.

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