A Shared Service Terminology for Online Service Provisioning

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ABSTRACT

An extensive literature research in the fields of IT and business science reveals that service-related terms as *service* and *e-service* have multiple interpretations within business science, information science and computer science, resulting in confusion. These three communities take part in the multi-disciplinary process of realizing e-Commerce scenarios for services. Each community has its own role in e-service offering, and uses its own terminology. In this paper we analyze the different perspectives that these three communities have on the online service provisioning concept. We introduce different meanings of service-related terms in the three communities, and use a real-world case study to show how all three perspectives and terminologies need to be joined with each other for the realization of collaborative e-Commerce scenarios for service offerings on the Semantic Web.

Keywords

e-Services, Semantic Web, Information modeling, Ontology

1. INTRODUCTION

Realizing online service offerings requires service suppliers to structure and store information and knowledge about their service offerings in a machine-readable way, so that software can reason about services, for example the configuration of complex services out of more elementary ones. On the one hand, information on what service offerings consist of is business knowledge, possessed by employees of service providers. It is described using concepts from business science. On the other hand, modeling and storing this information in a machine-readable way – for example to configure compositions of services – is mostly performed by information modeling experts. Finally, implementing information systems that use this information is done by technical IT departments.

The required involvement of three different communities in developing e-services is why different interpretations of the online-service concept exist. The two extremes of business experts versus IT-staff are also visible in science: both business science and computer science dig into services but from an entirely different perspective. Our present paper contributes a thorough survey of various interpretations of 'service' to enhance mutual understanding of various disciplines involved during online service development. This mutual understanding is a first step towards a comprehensive approach for online service development that reflects the multi-disciplinary nature of such a development process.

Understanding the various interpretations of 'service' is not enough to facilitate *reasoning* about services, as done in Semantic Web initiatives. It is necessary to conceptualize and formalize how to describe such services, to allow for development of software for e.g. service configuration and delivery.

To illustrate this necessity, consider a customer who wants to compose a service (e.g. a business trip) consisting of a set of independent online obtainable services from various suppliers (e.g. transportation, a room to stay, and a dinner). Supporting such a scenario requires that service offerings are described in a similar machine-readable way, so that software can reason about whether and how independent services can be combined, or which services to offer to a customer. In Information and Computer Science it is then common practice to represent such a formal description by an ontology. In our case, service ontologies describe a, by all stakeholders, shared view on what services are with the aim to compose complex services (*service bundles*, in business terms) out of more elementary services supplied by different enterprises. Thus, once a shared terminology has been reached, the mostly intangible services must be made concrete and formalized, for example by using a service ontology as presented in [6, 8]. Such an ontology can be used by all parties involved for a variety of goals, ranging from a business analysis to the implementation of new information systems. The actual realization of information systems to support the e-service offerings can then begin.

In addition to a survey of various interpretations of the concept 'service', we present a case study in which the differences in service terminologies used by three communities became evident, and we show how the scopes of the three communities overlap in such a way that the terminology of one community becomes important for other communities,

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concluding that the three terminologies need to be related to realize e-service offerings. This is the second contribution of our paper.

In the remainder of this paper we present a deeper overview of how the term *service* (possibly with some prefix) is being interpreted by different academic disciplines. Section 2 presents an overview of using service terminology in various research- and practitioners- communities. Every one of the following three sections discusses a specific community: business science, computer science and information science. After the terminology has been made clear, in Section 6 we shortly discuss how these communities need to cooperate to realize e-service offerings. We demonstrate it in Section 7 with a case study from the music sector. Finally, in Section 8 we present our conclusions.

2. SERVICE TERMINOLOGY

Service has become a term loaded with different meanings at different circumstances, mostly depending on who uses it. Different terms that include the word 'service', e.g. e-services, Web services, commercial services etc, are referred to as just *'services'*. Also the term *'e-services'* is used with multiple interpretations. This paper helps researchers and practitioners from various fields understand how others use their terminology with differing meanings. Such an understanding is required to enable communication and cooperation between experts in different, yet related, domains.

The use of service-related terminology can mostly be classified according to the authors' research domain. A large community within computer scientists devotes a great deal of effort to research on a subject hardly known to business scientists: *Web services*, software functions that can be invoked over the Internet. The same community of computer scientists often refers to *e-services* as functionalities that are delivered via Web services [19, 34].

Services have been subject to research in business science long before the Internet hype came along and technologists 'discovered' Web services. Researchers in business schools have been investigating the nature of *services* in the sense of business transactions for decades [38, 28, 9]. They traditionally refer to 'services', without any prefix, and consider them to be business activities, deeds and performances of a mostly intangible nature [17, 24, 47, 23]. In recent years the term *e-services* has gained ground also in the business community [35, 39, 41], but with a different meaning than the same term has among computer scientists. The difference in interpretations was well expressed by Stafford [39]: "Marketers see e-services as a natural outgrowth of e-Commerce, but they also view services through a product-oriented lens; this is only natural. Technologists naturally view e-services as Web-delivered software functionality, often characterized under the rubric of 'Web services'."

Information science researchers are trapped between these two worlds. In an attempt to bridge the gap between computer scientists and business scientists, the use of any of the above-mentioned terms is likely to fail either in the computer science community or in the business science community. Publications of information scientists often refer to 'services' [4, 33], like in the business science community (thereby possibly creating misunderstanding among readers from the Web services community). Others use the term *Real-World services* to differentiate it from Web services [6, 3], or the term *commercial services* [32].

All these terms – to which we will refer as 'service terms' – relate to the essence of a service. Other terms are common as well, e.g. IT-services, information services, public services, governmental services, and more. These consider the domain-related *contents* of the service, rather than the *definition* of what a service is. Consequently, they are not part of our discussion.

3. SERVICES IN BUSINESS SCIENCE

The term *service* has traditionally been the focus of service-researchers in the business science. In recent years *e-service* research has been emerging; researchers use traditional service research as a basis for this new paradigm, and investigate differences between the "old world" and the "new" one.

Although various researchers (naturally) use different definitions for the term 'service', the service area in business science shows a consensus on many points. Representative definitions of what a service is from the literature often contain the same recurring elements. For example:

- Zeithaml and Bitner [46]: "... services are deeds, processes and performances ..."
- Kotler [24]: "... any act or performance that one party can offer to another that is essentially intangible ..."
- Grönroos [17]: "... activities ... of a more or less intangible nature that normally ... take place in interactions between the customer and service employees and/or physical resources or goods and/or systems of the service provider, which are provided as solutions to customer problems".
- Lovelock [29]: "... economic activities ... bringing about a desired change ..."

In the business science community it is thus accepted that 'services' are business activities that often result in intangible outcomes or benefits; they are offered by a service provider to its environment. We will refer to this interpretation when we use the term 'service' (with no prefix) in the rest of this paper.

As various industries – e.g. manufacturing industries, service industries and governments – have been moving towards a broad use of the Internet instead of traditionally 'physical' processes, the business science community has adopted a new field of research: *e-services*. We identify three views on e-service definition within the business science community. First, several e-service researchers base their understanding of what e-services are on Zeithaml et al. [48]. They consider e-services to be services (interpreted as presented earlier in this section), where the Internet is used as a *User Interface*, a channel to interact with customers [21, 45]. Secondly, De Ruyter et al. [36] compared several conceptualizations of e-services, and concluded that a recurring theme in these

conceptualizations is integration, the seamless incorporation of technology and customer-oriented functions within the firm. They define e-services as "an interactive, content-centered and Internet-based customer service, driven by the customer and integrated with related organizational customer support processes and technologies with the goal of strengthening the customer-service provider relationship." Finally, [35] define e-service as "the provision of service over electronic networks", whereby 'electronic networks' include not only the Internet, but also wireless networks as well as electronic environments such as ATMs and smart card networks, kiosks, and "all touch points with customers". This definition is centered around the statement that this emerging paradigm – e-service – is based less on reducing costs through automation and increased efficiency, and more on expanding revenues through enhancing service and building profitable customer relationships. The first and the second definitions agree on e-services being an Internet-based version of traditional services. The first definition is not as broad as the second one in the sense that it does not mention customer relationships or business processes. The third definition includes the second one, but is much broader, and does not limit itself to the Web.

Web service is not a business term; if used in business science literature, it is acknowledged as a computer science term, and its definition within computer science is adopted [39]. We will define it in the next section. Business science researchers who are not aware of work done by computer scientists on Web services may consider Web services to be services (in their business definition) delivered via the Web.

To conclude our discussion on the business science community, it can be said that:

- There is a broad consensus on ('traditional') *service* definition
- Most researchers define *e-services* as an Internet-based version of 'traditional' services. Broader, and other definitions exist as well.
- *Web services* are not often referred to; when this term is being used, the computer science definition is adopted.

4. SERVICES IN COMPUTER SCIENCE

Three 'service terms' are common in computer science[1]: *Web services, e-services* and *services*.

Web services are a hot item among computer scientists. Publications of Web services and Semantic Web researchers discuss every possible aspect of Web services. Nevertheless, research of the Gartner Group [18] identified "a widespread misunderstanding of what Web services are", leading to the assumption that people mistake Web services for software that is accessed over the Web, rather than software that *"implements coarsely-grained business functions*, and is accessible over the Internet", or "commonly used business processes delivered over the Web". Ample definitions of Web services exist [2, 20, 1, 34, 5, 42]. Some are implementation-oriented (e.g. the W3C defines a Web service as "a software system identified by a URI[2], whose public interfaces and bindings are defined and described using XML. Its definition can be discovered by other software systems. These systems may then interact with the Web service in a manner prescribed by its definition, using XML based messages conveyed by Internet protocols" [5]). Others use a higher level of abstraction (e.g. the Stencil Group defines them as "loosely coupled, reusable software components that semantically encapsulate discrete functionality and are distributed and programmatically accessible over standard Internet protocols" [1]).

Three elements are common to many Web service definitions: (1) software/applications, (2) functionalities and (3) the Internet. Table 1 summarizes which recurring elements appear in representative Web services definitions. All of the definitions agree on the fact that Web services are software/applications to be used on the Internet. Most of them explicitly recognize the existence of functionalities behind the software, but not the existence of business processes or *business* functionalities. Nevertheless, the software is an implementation of generic functionalities, often offered by businesses to other businesses, to realize some business process. These functionalities can roughly be categorized as *information-providing services*, such as flight information providers, temperature sensors, and cameras, and *world-altering services*, such as flight-booking programs, sensor controllers, and a variety of e-Commerce and business-to-business applications [30].

The term *e-services* has a somewhat stronger business flavor than its counterpart *Web services*. E-service definitions are characterized by a lower degree of consensus among those who use them. Govindarajan et al. [16] write that "Web services, or e-services are...", implying that Web services – which were defined as software/applications – and e-services are synonyms. On the other hand, Kotov [25] describes e-services as "the realization of federated and dynamic e-business components in the Internet environment", not putting the emphasis on *how* these e-business components are realized (i.e. by applications).

Both Web services and e-services are often referred to as simply *services*. Many authors first use the terms Web services or e-services, and further refer to them as 'services', or include the term 'service' without any prefix in the title of their papers [11, 37]. Others adopt a business-flavored service definition, considering services as intangible goods [10]. Telecommunication publications often discuss 'services' as well, either in their business interpretation (what does a supplier offer to customers, see Section 3) or as network sessions that realize these service offerings [44, 26].

Business services [14, 22] is another 'service term' used by researchers in the computer science community, although to a much lesser degree than *Web services, e-services* and *services*. Since it is neither used often, nor defined, our literature review yielded no conclusions on how it is interpreted. One could assume that authors who use this term adopt a business definition for 'services', as presented in the previous section.

[1]We refer mainly to the Semantic Web community, where services are a main topic of research.

[2]http://www.ietf.org/rfc/rfc2396.txt

Table 1: Recurring elements in Web services definitions

	W3C [5]	*Stencil Group[1]*	*RosettaNet [2]*	*IBM [42, 20]*
Software / application	×	×	×	×
Functionalities		×	×	×
Business processes			×	×
Internet	×	×	×	×
XML as a supporting technology	×	×	×	×

To conclude the discussion on computer science, we can say that:

- The term *Web service* appears to be well-defined within computer science (see [1])
- *E-service* definition is not characterized by a consensus
- The term *service* is used as a synonym for 'Web service', as well as 'e-service'. Some, on the other hand, give it a business definition: intangible products. Once again, misunderstandings are likely to happen
- The term *business service* is sometimes used, though not defined

It appears thus that the term *e-service* is not well-defined in either business science or computer science. Other terms, on the other hand, are well-defined within one of these communities: *services* within business science (an activity, emphasizing its intangibility and its business value) and *Web services* within computer science (emphasizing technologies).

5. SERVICES IN INFORMATION SCIENCE

As research on Web services is becoming more and more popular among computer scientists, and business scientists dig more and more into e-services, researchers from information sciences try to convey a message to both communities, where the same terms have differing meanings, as we have seen. Researchers from this field often use definitions given by both other communities: when referring to software and to technologies, they use the term *Web services*, as done by computer scientists, and when referring to business activities with mostly intangible results, they use the term *services*, as their colleagues from business schools do. Representative definitions for 'service' are given in [12]: "a simple or a complex task or activity, executed within an organisation on behalf of a customer or organisation", and in [33]: "an action performed by one entity on behalf of another. This action involves the transfer of value". Sometimes authors refer to 'products and services' [4, 31]. By doing so, it becomes clear that they refer to 'services' in their business interpretation, since the comparison of services vs. products (actually meaning *goods*, rather than *products*) stems from the business literature. In other cases [13], the term 'service' is used with no definition.

In an attempt to avoid misunderstandings as a result of the term 'service' being interpreted as 'Web service' rather than as a business activity, Baida et al. [6, 8] introduced the term *Real-World service*, giving it the same meaning as the term 'service' has in the business science community. Others sometimes use the term *commercial service* instead of 'service' [27], although the discussion would be valid in case of governmental services too. Neither 'real-world service' nor 'commercial service' are used often.

Since the term *e-service* is not as mature as 'service' or 'Web service', it comes as no surprise that researchers from information sciences interpret e-services in different ways. On the one hand, some define it in a way similar to the business world: "services that are delivered electronically, typically through the Internet" [31]. On the other hand, others consider e-service to be a synonym of Web service, as often the case in computer science: "electronic services offered over the Internet are also referred to as electronic services, Web services, Internet services, web-based services or e-services" [43].

We can conclude the discussion on information sciences by stating that:

- The term *Web service* is used like in computer science
- The term *service* is mostly used like in business science
- *E-services* are interpreted either as an Internet-based version of 'traditional' services (similar to many researchers from business science), or as Web services (similar to many computer scientists).
- The terms *commercial service* and *real-world service* are sometimes used to refer to services in their business meaning.

6. REALIZING E-SERVICE OFFERINGS

The realization of an e-service business idea requires the involvement and cooperation of a variety of experts, ranging from business-oriented domain experts through information modeling experts to software engineers and programmers. Modeling, storing and managing business knowledge plays an important role in every e-service realization process, but it is of greater importance in multi-enterprise scenarios,

where a group of enterprises develops a bundle of services – each of which may be offered independently by another enterprise (see [7]). Many Internet-enabled business models are multi-enterprise undertakings, in which every company exploits its own strengths to arrive at a competitive offering to the customer [40].

Realizing such multi-enterprise scenarios is then a process that crosses the boundaries of one specific discipline. It involves the three earlier discussed concepts – services, e-services and Web services:

- Businesses wish to offer *services*, as interpreted in the business science (business activities with mostly intangible results, see Section 3)
- These services are to be offered (partly) online, as *e-services* (in their interpretation of 'Internet-based traditional services', as often used in information science)
- E-service offerings are refined into specific processes and tasks, eventually realized by software such as *Web services*.

Let us look at how these concepts occur in a real-world situation.

7. CASE STUDY: MUSIC RIGHTS CLEARANCE

In this section we discuss a case study in which we analyze how the term *service* is used at different levels of modeling the same task. Specifically, we provide a descriptive analysis of how music rights societies are operating and how the services that they offer may be described at different levels. The questions at hand in the music rights clearance case study were (1) which terminology is most dominant in each of the three perspectives/communities, (2) what is the scope of each community in an e-service offering development, and (3) where do the perspectives/communities overlap, requiring cooperation and thus a shared service terminology.

Conventional and Internet radio stations broadcast music to their customers to attract the audience and sell this audience to their advertisers. In other words, they broadcast music to earn money. Commercial music use is bound with several rights reserved by the artists and producers. Specifically, a radio station uses the right to communicate music to public, and has to pay the artists (and producers) for this use.

This process is supported by special organizations called rights societies. These may be special government-appointed organizations (as it is currently done in the EU) or commercial companies (as it is done in US and will be done in EU in a few years from now). They collect fees from radio stations and distribute them among rights holders. With respect to the right to communicate music to public, rights societies provide stations with the service of clearing this right, and the artists with the service of benefiting from this clearance.

Internet stations differ from conventional etherial stations in an important aspect. Conventional stations pay fees based on their estimated audience and the role of music in their repertory. They do not know how many listeners have attended to each specific recording. Practically, they report music use quarterly, each time reporting large blocks of use with substantial fees. In the online case the radio stations may know exactly how many listeners have listened to each specific recording. If they pay fees per recording per user, they may need to report music use for every listener. This may result in numerous reports, each requiring a very small fee.

From the implementation side, Internet radio stations operate online. They provide web services for their listeners and they are willing to deal with the rights societies providing their services online. The non-Web-based technologies and terminology developed for the conventional radio stations needs to be converted to the Web-based situation.

7.1 Business Science Perspective: Services

Legally radio stations are obliged to pay 'reasonable fees' for using music. This definition sounds vague, however this is the only way of defining the fees at the strategic level: the stations have different audiences, they play different music, and music plays different roles in their repertory.

From the business perspective the rights societies provide the following services:

- Assessing the fees to be paid by analyzing the profiles of the radio stations, their expected audience, and even previous court decisions.
- Collecting fees from radio stations.
- Redistributing fees among rights holders in the most fair way possible.

These services are defined without any computer-science terminology. The definition is not affected by the way these services are implemented and it remains the same for both implementations: based on paper and based on Web services.

The term *service* is described in natural language in terms of the actors performing the service and using it, the value flow of the fees (related to the strategic value flow analysis done by radio stations), and a qualitative description of the results of the services (the rights being cleared, payments).

7.2 Information Science Perspective: e-Services

In the case of online radio stations the rights clearance service is provided online. The business definition of a service needs to be re-designed in information-systems terms. Specifically, the definition of a service spans over a large spectrum: from business activities involving actors (suppliers, customers) and value flows to an implementation-biased set of (business) processes.

The business process for rights clearance consists of the activities of identifying the recordings being reported, collecting fees, identifying the rights holders associated with the recordings and repartitioning the fees to the rights holders. The activities may be either performed by the right society

itself or delegated to partner organizations. In the latter case the activities are offered in form of services, e.g. payment service transferring money for a certain fee. These activities and services are organized in a business process that is consistent with the high-level business view, and elaborates it, given the online nature of the services.

On the one hand, the business process consists of the activities that are interpretable from the business side. Each activity has a business meaning, primarily the value-exchange meaning. It does not include pure technical activities, such as 'upload a play report to a database'. On the nother hand, business processes are represented in a machine-readable form.

The machine-*readable* representation may be updated to machine-*understandable* representations that are sufficient for a computer to make inference and conclusions from the model (e.g. to find inconsistencies in the value flow). An attempt to achieve that is done in the service ontology [6].

Machine-processable business models are then converted to an implementable process model. Activities are represented with the details that allow implementing them as Web services in their technical meaning [15].

Accordingly, the *e-services* consist of the business process model and the exchanged information derived from the business analysis. These are then elaborated with details originating from their machine-readable and Internet-based representation and serve as a starting point for a technical process model guiding the implementation.

What is different from the business perspective, is that the information science perspective makes some assumptions about the technical operation environment. The business processes are adjusted to the high-level view on the implementation. The term e-service is not used in the conventional rights clearance scenario. It emerges only in the Internet-based scenario.

Business-level services are decomposed into specific activities. The business model is augmented with some process-level document flow. The value flow is projected on the document flow, e.g. by stating that 'the clearance service receives the play reports where the fees are also reported'.

7.3 Computer Science Perspective: Web Services

Business functionality sketched at the strategic business-level models, conceptualized and formalized, and elaborated with business processes, needs to be (partially) implemented with information systems. (Some of) the activities from the business model are implemented as parts of the information systems. Their functionality is made accessible online via Web services.

The rights clearance service described in [15] is implemented as a Web service that receives the play report messages submitted by radio stations. Then it analyzes them and configures several Web services, needed to perform all the clearance steps. These services are then executed. They receive input messages (e.g. a *play list report* message) and produce output messages (e.g. *payment* messages), finally resulting in payment orders delivering the fees to the rights holders.

The relation between activities from the business models and Web services is twofold. On the one hand, each Web service implements a certain activity from the business model. Several Web services may be necessary to implement one activity, e.g. if a play report describes the broadcast in two different countries then two country-specific repartition services may be needed. On the nother hand, a Web service may implement several activities, e.g. an external clearance service may perform fee repartitioning and payment. Processes are modelled with the purpose of technical consistency of the invocations of the services and smoothness of data transfer between them. They are interpreted as a sequence of service calls and not as business activities.

Web services exchange messages, and not values. The implementation focus lies in the message exchange, storage, and processing. An ordinary Web service developer does not make any difference between document elements that describe values and other elements. To model the value flow, Web services need to be augmented with a link to the e-service model described earlier.

To summarize, at the Web services level the rights clearance task is formulated in terms of remote applications and their invocations, messages, and data compatibility.

7.4 Analysis

As seen by the music rights case study, in e-service realization the business science perspective uses natural language for a high-level description of *services* (defined as in business science, see Section 3), referring to value exchanges between actors. This perspective considers the overall costs and benefits of a complete offering, e.g. a rights society is given the right to make music public (by creative entities) in return for a fee [15]. The computer science perspective, on the other hand, describes coarsely grained processes and tasks, implemented by Web services (see Section 4); these tasks realize the IT-part of the service offering described by the business.

We observed the different aspects addressed by these terms in the case study, as presented in Table 2. Indeed, the different terms for 'service' denote different things at different levels.

Information science bridges the gap between the business science perspective and the computer science perspective by transforming the notion 'service' from a (computationally) ill-defined value-oriented activity to a well-defined concept with concrete tasks that together realize this value-oriented activity. Through making business terminology and logics concerning services suitable for online activity – by concretizing it and making it machine-readable – information science defines *e-service*.

Figure 1 summarizes the scope of each of the communities, and the main terminology they use in e-service discussions. As can be seen from the figure, the three communities we discussed are concerned with various phases or parts of e-service realization, yet their scopes overlap. Furthermore, as seen in the music rights clearance case study, *services*

Table 2: Aspects of the services addressed in the presented case study

Aspects	Services	e-Service	Web service
Complete model?	No. Concentrates on 'who is doing what, in return for what'	No, yet broad. concentrates on transforming business terminology to implementation-suitable terminology	No, Restricted to what is implemented in information systems
Value model	Explicit	Explicit	Implicit
Business process	Not discussed in this case study, yet belongs here (organizational view)	Yes (operational, implementation-view)	Partially, only IT-implemented activities
Data flow	No	Yes, high-level	Yes, detailed
Implementation	No	No	Yes

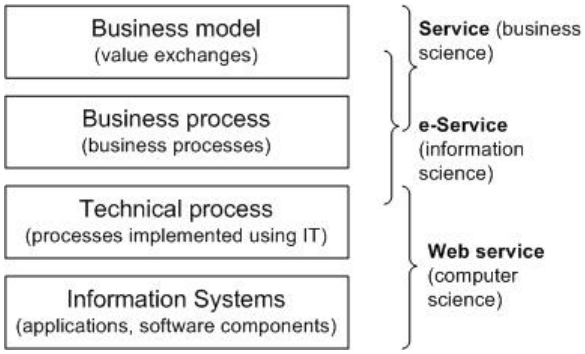

Figure 1: E-service offerings scopes

as business activities are discussed by both business science and information science, and *Web services* are discussed by both computer science and information science. Several issues, mainly the exchange of values and the involved actors, constitute parts of all three perspectives. The business science perspective deals with the actual value objects (fees, rights) exchanged by actors, the information science perpective deals with the formalization of these values, and the computer science perspective deals with actual messages, encoded in an XML-based language, that represent these values.

8. CONCLUSIONS

Many Semantic Web initiatives are based on the need for a shared understanding of concepts and terminology, to facilitate communication between applications and people. A shared understanding of the term *service* and of related terminology is indispensable for business experts and computer/information scientists, working on how to model and store business knowledge for the support of complex online service scenarios. The starting point for a shared understanding is awareness of the existence of differing terminologies among different – yet related – research communities.

Table 3 summarizes the discussion on *Service, Web service* and *e-service*, the three most widely used 'service terms'. As the table shows, a shared understanding of what 'Web services' stand for exists. Misunderstandings are likely to occur when (1) using the term 'services' within computer science or possibly information science; (2) using the term 'e-services' in any research community; and (3) discussing service-related subjects with experts from different communities (computer scientists, business scientists, information scientists).

A first step in avoiding confusions around terminology is being aware of the existence of multiple interpretations for the same terms. Our survey adds to existing research in providing researchers from three communities an overview of different interpretations for the terminology they use, as well as how different terms are related.

As we have demonstrated with the music rights clearance case study, all three perspectives are involved in the offering of e-services. A computer science view on e-services does not consider what is in the heart of every e-service: being a business transaction, driven by business logic and an intertwining of customer demands with supplier goals. In order to realize e-service offerings that truly support a business and its customers, e-services need a dominant business orientation. In other words, the technical frame of reference needs to be joined with a business frame of reference. This task is done by information science, and is facilitated by the use of a shared terminology and ontologies to formalize this terminology. In e-service discussions the business science perspective describes *services* as business activities, and the computer science perspective discusses software called *Web services*. Information science overlaps with both perspectives (see Figure 1), and uses both perspectives' terminologies, to bridge the gap between the two.

Many Semantic Web initiatives for e-services present an offering of services, making use of intelligent knowledge management operations and information processing. Currently, many such operations are performed daily by service personnel that posesses business knowledge and business logic (e.g. pricing strategies), required for reasoning (e.g. matching between specific services and specific customers or customer groups; composing a complex service offering out of more elementary services). By capturing this knowledge and formalizing it we enable automated reasoning about service offerings; these are examples of intelligent knowledge management operations we try to achieve in Semantic Web initiatives. Whereas some of these operations may be seen as purely computational, others require an understanding of the business. For example: if a radio station can provide detailed play lists, indicating the exact number of listeners per tack and their location, it will pay a lower price

Table 3: Service terms usage: summary

	Services	*E-services*	*Web services*
Business science	Well-defined	Core interpretation is shared; interpretations vary in the extent of generalization	Rarely used, definition borrowed from computer science
Computer science	Divergent interpretations	Technical or business definition	Well-defined
Information science	Mostly business definition	Business or technical definition	Well-defined

than a radio station that does not provide this information. Hence, business knowledge needs to be formalized and made machine-readable, so that it can be used for reasoning, and for selecting and managing Web services, to eventually execute business transactions. In short, the business perspective of the term *services* needs to be part of other perspectives involved in e-service offerings on the Semantic Web.

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10. REFERENCES

[1] *Defining Web Services*. The Stencil Group, 2001. www.stencilgroup.com/ideas_scope_200106wsdefined.html, last visited March 2004.

[2] RosettaNet and web services: An executive-level view of RosettaNet and an emerging model for application-based B2B commerce. *Technical white paper*, 2003. Available via www.rosettanet.org, last visited July 2004.

[3] H. Akkermans, Z. Baida, J. Gordijn, N. Peña, A. Altuna, and I. Laresgoiti. Value webs: Using ontologies to bundle real-world services. *IEEE Intelligent Systems - Semantic Web Services*, 19(4):57–66, 2004.

[4] L. Ardissono, A. Felfernig, G. Friedrich, A. Goy, D. Jannach, M. Meyer, G. Petrone, R. Schäfer, W. Schütz, and M. Zanker. Personalizing on-line configuration of products and services. In *Proceedings of the 15th European Conference on Artificial Intelligence (ECAI 2002)*, Lyon, France, 2002.

[5] D. Austin, A. Barbir, C. Ferris, and S. Garg. Web services architecture requirements, w3c working group note. 11 February 2004. http://www.w3.org/TR/wsa-reqs, last visited July 2004.

[6] Z. Baida, H. Akkermans, and J. Gordijn. Serviguration: Towards online configurability of real-world services. In *Proceedings of the Fifth International Conference on Electronic Commerce (ICEC03)*, pages 111–118, Pittsburgh, PA, 2003. ACM.

[7] Z. Baida, J. Gordijn, A. Z. Morch, H. Sæle, and H. Akkermans. Ontology-based analysis of e-service bundles for networked enterprises. In *Proceedings of The 17th Bled eCommerce Conference (Bled 2004)*, Bled, Slovenia, 2004.

[8] Z. Baida, J. Gordijn, H. Sæle, A. Z. Morch, and H. Akkermans. Energy services: A case study in real-world service configuration. In *Proceedings of the 16th International Conference on Advanced Information Systems Engineering (CAiSE 2004)*, pages 36–50, Riga, Latvia, 2004. Springer-Verlag.

[9] L. Berry. Perspectives on the retailing of services. In R. W. Stampfl and E. C. Hirschman, editors, *Theory in Retailing: Traditional and Non-traditional Sources*, Chicago, 1981. American Marketing Association.

[10] H. Chan, R. Lee, T. Dillon, and E. Chang. *E-Commerce*. John Wiley & Sons, Chichester, UK, 2001.

[11] C. Doulkeridis, E. Valavanis, and M. Vazirgiannis. Towards a context-aware service directory. In *Proceedings of the 4th VLDB Workshop on Technologies for E-Services (TES'03), held in conjunction with the 29th International Conference on Very Large Data Bases (VLDB 2003)*, Berlin, Germany, 8 Sept. 2003. http://www.db-net.aueb.gr/stratis/Research/Publications.htm, last visited July 2004.

[12] M. Dumas, J. O'Sullivan, M. Heravizadeh, D. Edmond, and A. ter Hofstede. Towards a semantic framework for service description. In *Proceedings of the IFIP Conference on Database Semantics*, Hong Kong, April 2001. Kluwer Academic Publishers.

[13] D. Edmond and A. H. M. ter Hofstede. Service composition for electronic commerce. In *Proceedings of PACIS-2000 (Pacific Asia Conference on Information Systems)*, Hong Kong, June 2000.

[14] R. J. Glushko, J. M. Tenenbaum, and B. Meltzer. An XML Framework for Agent-Based E-commerce. *Communications of the ACM*, 42(3):106–114, 1999.

[15] J. Gordijn, P. Sweet, B. Omelayenko, and B. Hazelaar. *D7.4 Digital Music Value Chain Application*. Obelix consortium, Amsterdam, NL, 2004. Available from http://obelix.e3value.com.

[16] K. Govindarajan, A. Karp, H. Kuno, D. Beringer, and A. Banerji. Conversation definitions: defining interfaces of web services. *In HP Position Papers for the World Wide Web Consortium (W3C) Workshop on Web Services, Hewlett-Packard report HPL-2001-73*, 3 April 2001. http://www.hpl.hp.com/techreports/2001/HPL-2001-73.html, last visited July 2004.

[17] C. Grönroos. *Service Management and Marketing: A Customer Relationship Management Approach, 2nd edition*. John Wiley & Sons, Chichester, UK, 2000.

[18] M. Hotle. A conceptual evolution: From process to web services. *Gartner Group Research Note TU-16-1420*, 1 May 2003.

[19] R. Hull, M. Benedikt, V. Christophides, and J. Su. E-services: a look behind the curtain. In *Proceedings of the twenty-second ACM SIGMOD-SIGACT-SIGART symposium on Principles of database systems*, pages 1–14. ACM Press, 2003.

[20] IBM. Web services: Taking e-business to the next level, white paper. 2000. http://www-900.ibm.com/developerWorks/cn/wsdd/download/pdf/e-businessj.pdf, last visited July 2004.

[21] S. Janda, P. J. Trocchia, and K. P. Gwinner. Consumer perceptions of internet retail service quality. *International Journal of Service Industry Management*, 13(5):412–431, 2002.

[22] P. Johannesson, B. Wangler, and P. Jayaweera. Application and process integration - concepts, issues, and research directions. In S. Brinkkemper, E. Lindencrona, and A. Slvberg, editors, *Information Systems Engineering Symposium CAiSE 2000*, Chicago, 2000. Springer Verlag.

[23] H. Kasper, P. van Helsdingen, and W. de Vries jr. *Service Marketing Management: An International Perspective*. John Wiley & Sons, Chichester, UK, 1999.

[24] P. Kotler. *Marketing Management: Analysis, Planning, Implementation and Control, 6th edition*. Prentice Hall, Englewood Cliffs, NJ, 1988.

[25] V. Kotov. Towards service-centric system organization, Hewlett-Packard report HPL-2001-54. 21 March 2001. http://www.hpl.hp.com/techreports/2001/HPL-2001-54.html, last visited July 2004.

[26] M. Koutsopoulou, C. Farmakis, and E. Gazis. Subscription management and charging for value added services in UMTS networks. In *IEEE Semiannual Vehicular Technology Conference VTC2001*, May 2001.

[27] K. Lenk. Contracts, multimedia networks and the human interface: Enhancing public and commercial services through small common serviceshops. *Computers, Environment and Urban Systems*, 19(3):193–200, 1995.

[28] T. Levitt. *Your Factories in the Field: Customer Service and Service Industries*, chapter 3, in Marketing for Business Growth, pages 51–70. McGraw-Hill, New York, 1973.

[29] C. Lovelock. *Services Marketing, People, Technology, Strategy, 4th edition*. Prentice Hall, Englewood Cliffs, NJ, 2001.

[30] S. McIlraith, T. Son, and H. Zeng. Semantic web services. *IEEE Intelligent Systems (Special Issue on the Semantic Web)*, March/April 2001.

[31] K. Mohan and B. Ramesh. Ontology-based support for variability management in product and service families. In *Proceedings of the 36th Hawaii International Conference on System Sciences*, Hawaii, 2003.

[32] J. O'Sullivan, D. Edmond, and A. ter Hofstede. What's in a service? towards accurate description of non-functional service properties. *Distributed and Parallel Databases*, 12:117–133, 2002.

[33] J. O'Sullivan, D. Edmond, and A. H. M. ter Hofstede. Service description: A survey of the general nature of services, report FIT-TR-2003-02. 2002. http://www.citi.qut.edu.au/pubs/technical/service_description.pdf, last visited July 2004.

[34] P. F. Pires, M. Benevides, and M. Mattoso. Building reliable web services compositions. In *Net.Object Days - WS-RSD'02*, pages 551–562, 2002.

[35] R. T. Rust and P. Kannan. E-service: a new paradigm for business in the electronic environment. *Communications of the ACM*, 46(6):36–42, 2003.

[36] K. d. Ruyter, M. Wetzels, and M. Kleijnen. Customer adoption of e-service: an experimental study. *International Journal of Service Industry Management*, 12(2):184–207, 2001.

[37] C. Salzmann and B. Schätz. Service based software specification. In *Proceedings of the International Workshop on Test and Analysis of Component Based Systems (TACOS) ETAPS 2003*, Warsaw, Poland, 2003.

[38] W. E. Sasser, R. P. Olsen, and D. D. Wyckoff. *Management of Service Operations: Text, Cases, and Readings*. Allyn & Bacon, 1978.

[39] T. F. Stafford. E-services: Introduction. *Communications of the ACM*, 46(6):26–28, 2003.

[40] D. Tapscott, D. Ticoll, and A. Lowy. *Digital Capital - Harnessing the Power of Business Webs*. Nicholas Brealy Publishing, London, UK, 2000.

[41] S. A. Taylor and G. L. Hunter. The impact of loyalty with e-CRM software and e-services. *International Journal of Service Industry Management*, 13(5):452–474, 2002.

[42] D. Tidwell. Web services – the web's next revolution, IBM tutorial. 29 Nov. 2000. Available via www.ibm.com, last visited July 2004.

[43] M. Tut and D. Edmond. The use of patterns in service composition. In *Proceedings of the Workshop on Web Services, e-Business, and the Semantic Web, held in conjunction with CAiSE02*, Toronto, Canada, 27-28 May 2002. Springer Verlag. Lecture Notes in Computer Science 2512.

[44] A. van Halteren, L. Nieuwenhuis, M. Schenk, and M. Wegdam. Value added web: Integrating WWW with a TINA service management platform. In *Proceedings of TINA Conference, IEEE*, pages 14–23, Hawaii, April 1999.

[45] A. C. R. van Riel, V. Liljander, and P. Jurriëns. Exploring consumer evaluations of e-services: a portal site. *International Journal of Service Industry Management*, 12(4):359–377, 2001.

[46] V. Zeithaml and M. J. Bitner. *Services Marketing*. McGraw-Hill, New York, NY, 1996.

[47] V. Zeithaml, A. Parasuraman, and L. Berry. *Delivering Quality Service: Balancing Customer Perceptions and Expectations*. The Free Press, New York, NY, 2001.

[48] V. Zeithaml, A. Parasuraman, and A. Malhotra. *A Conceptual Framework for Understanding E-Service Quality: Implications for Future Research and Managerial Practice, Report No. 00-115*. Marketing Science Institute, Cambridge, MA., 2000.