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Service Science: concepts, tools and platforms to support digital services for SME

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Abstract. Digital services emerging from Service Science call for research in areas as diverse as business, law, economics, behavior, and psychology to systematically design services. Current research and approaches have mainly developed intricate theories, methodologies, and apparatus to invent, design, engineer and trade services. These solutions are to be used by large organizations since their complexity hinders their use by small and medium enterprises (SME). Based on this observation, this paper provides an overview of research areas which needs to be explored to provide the first building blocks and foundations to enable a widespread trading of services by non-IT professionals and SME.

Keywords: service science, digital services, Internet of Services.

1 Introduction

Services currently govern economies and will unquestionably become even more significant in the near future. This trend is supported by the launch of a proposal for a Directive on Services in the Internal Market [1] from the European Commission. To enable the trading of services within Europe and to emerging economies, the concept of Internet of Services (IoS) proposes new business, theoretical, and technological models that can radically change the way day-to-day services are provisioned and contracted.

Significant investments have already been made to take the concept of IoS into production systems. The TEXO [2] project has invested large efforts to create theories, systems, and tools to enable large companies to engineer, design and publish their services using electronic marketplaces.

The development efforts have been carried mainly to provide large organizations with the necessary systems to capitalize on the IoS. SAP Research, the research division of the largest software developer in Europe, has devoted considerable efforts to develop languages and marketplaces for their services [3]. One of the outcomes

was the USDL[1] language which was used to describe services [4]. While efforts were directed at large organizations, the European Union considers that the IoS is also suitable for SME (Small and Medium Enterprises). Enabling the design and trading of services by non-IT professionals and SME brings a new set of requirements that needs to be addressed, namely:

1. *Graphical description languages.* Current service description languages, such as USDL [5], are suitable to describe complex services made available by companies such as SAP AG, but their direct use is not appropriate for non-IT professionals. For SME, the development of a graphical representation language for USDL (called graphical USDL or gUSDL) that will shield users from complexity is needed.
2. *Design tools for non-IT professionals.* The tools that have previously been proposed, for example the ISE Methodology and Workbench [6-8], are suitable for highly qualified engineers but overly complex for non-IT users and SME. Therefore, new concept tools which implement the gUSDL graphical specification language and provide an intuitive environment to design services are also needed.
3. *One-click service marketplaces.* gUSDL designs need to be uploaded for advertisement in service marketplaces [9] which bring consumers and providers in a "one-stop" exposure of business services through a centralized channel [5]. Large companies use complex marketplaces such as Salesforce.com and Webservicex.net. As such, easy-to-use prototypes are needed to show that non-professional users are able to interact and feel comfortable with marketplaces to publish and consume services on their own.
4. *Comprehensive service use cases.* So far, there is a lack of a systematic validation of the languages and tools proposed for the IoS. For example, USDL only provides a few examples of the use of the language and its engineering workbench [9]. Therefore, there is the need to identify a set of use cases, scenarios, storyboards, and patterns that non-IT professionals and SME can use to learn by example and quickly design their own service solutions.

Achieving these four objectives will enable SME to create new market opportunities for services, outside company "firewalls". The cross-border market access to services will be facilitated at the national and international level. The impact of IoS platforms for businesses and the IT community are enormous since the service sector represents more than 70% of the Gross National Product and the European directive can amplify the consumption of services in the European Union by 37 billion Euros [1].

The remainder of the paper is structured as follows. The second section presents the related work in this area with a special emphasis on graphical description languages, design tools, and electronic marketplaces for services. Section 3 discusses the characteristics and advantages of developing a graphical description language for the USDL specification – which we call gUSDL – to represented business services. Section 4 elaborates on the development of a service design tool for non-IT

[1] http://www.internet-of-services.com

professionals – called gUSDL Design. Section 5 provides a view on service marketplaces and section 6 focuses on the need for a comprehensive service use case set for SME to support the adoption and use of digital services. Finally, section 7 closes the manuscript with our conclusions.

2 Related work

The importance of domain specific graphical description languages to represent artifacts has long been recognized as an important success factor in many fields. SoaML [10] is a UML-based language created for architecting systems of services. The emphasis is on creating architectures, not individual business services, but to produce service architectures that operate according to the SOA model. SoaML overlaps with the graphical USDL (gUSDL) language proposed for the IoS since they both include the notion of service but model distinct types of services.

The ISE Workbench [7] includes a very simple graphical language to describe some properties associated with services. The graphical language is not more than a set of icons related with service properties. It was a first idea to explore forms to express services' properties during service design [11]. Compared to the ISE Workbench, we believe that a sound and complete visual language is needed.

Osterwalder and Pigneur [12] present a canvas to create new business models. While some of the concepts used overlap with the concepts to describe a service, such as pricing and customer [6], the solution proposed is directed at managers looking for new business models and not for the development of individual services. Furthermore, the models are not developed to be later mapped to a specification language to be used to advertise services in marketplaces.

In the area of business process management, the BPMN [13] was developed as a visual language to represent business processes of organizations. Our proposal is similar in the sense that we also envision the existence of dedicated visual languages for service modeling as it has been done with BPMN to visually model business processes.

Having a graphical representation language for services (i.e., gUSDL) is a first step, but its benefits can be amplified when suitable tools are available. Design tools for non-IT professionals, such as a gUSDL Design tool do not exist yet. The current reference environment for service description is the ISE Workbench [8], developed in the TEXO/THESEUS project [2]. This is a powerful but complex tool, meant to be used by IT professionals, much like IBM's Rational Rose Enterprise for UML modeling [14]. SME end users usually do not have such technical expertise, so they need simpler tools with a closer tie to business concepts. Products such as Visual Rules [15] illustrate how a complexity in the field of business rules similar to service modeling can be tamed for non-technical people.

Shostack [16-17] has developed tools to support service blueprinting methodologies to allow for a quantitative description of critical service elements, such as time, logical sequences of actions and processes. Wilson et al. [18] uses blueprinting as a tool for simultaneously depicting the service process, the points of

customer contact, and the evidence of the service from the customer's point of view. Unfortunately, the tools and languages used by Shostack and Wilson et al. were not developed to describe services that would later be interpreted, searched, and executed by automated means. While the concepts developed are important, they need to be reframed in the context of the Internet of Services.

When service designs are ready, they can be published in a service marketplace for consumption. Software-as-a-Service marketplaces [19] like Salesforce.com, Workday.com and webservicex.net use WSDL to provide technical interfaces, most of the remaining description is presented as structured and unstructured text. Structured text includes a categorization of the service, pricing or provider information. Unstructured text is used to point out the benefits, usage scenarios and policies of the service offer [5]. Other business service marketplaces [20], e.g. American Express Intelligent Online Marketplace (AXIOM), Intel Business Exchange or IBM SmartMarket, are centrally governed by a dominant commercial player focused on differentiation. As the range of services on these marketplaces is quite diverse, descriptions are mostly free-text in addition to basic attributes like price, provider details, reputation and categorization [5]. The IoS and digital services require a stronger systematization, formalization and structuring of service descriptions to enable, for example, a high precision and recall when searching for services.

3 Graphical description languages for services

Although interface descriptions for automated Web services (RESTfull or WSDL services) are in widespread use today, the same cannot be said for the description of business or non-functional components of services, which are often described in free form text (see [21-22]). While textual representations may be very rich, direct automatic handling of such information is hard.

Design methods and methodologies for software design, such as Structured Design from Constantine and Yourdon, Jackson System Development, or OO design from Rumbaugh and Booch are not sufficient to design services. While they have been applied successfully for years to software development, new approaches, notations, rules, and design guideline are needed to represent service designs. For example, how can a service' business model be formally represented using a structure which obeys domain dependent rules and constraints, and is understood by computer systems? Data-flow models, entity-relation models, inheritance and interaction models are not sufficient when the pricing or the legal regulations of a service need to be formalized.

The concept of service from the areas of marketing and management has produced several tools that have been used for service analysis and design. For example, Blueprinting captures the multiplicity of dimensions involved when a service is provisioned [23]. Nonetheless, existing proposals are decoupled from formal notation systems and disconnected with the consumption of a service [24].

As a new approach, the USDL (Unified Service Description Language [5]; see Fig 1) specification language has been developed to describe complex services which are made available in marketplaces by companies such as SAP AG.

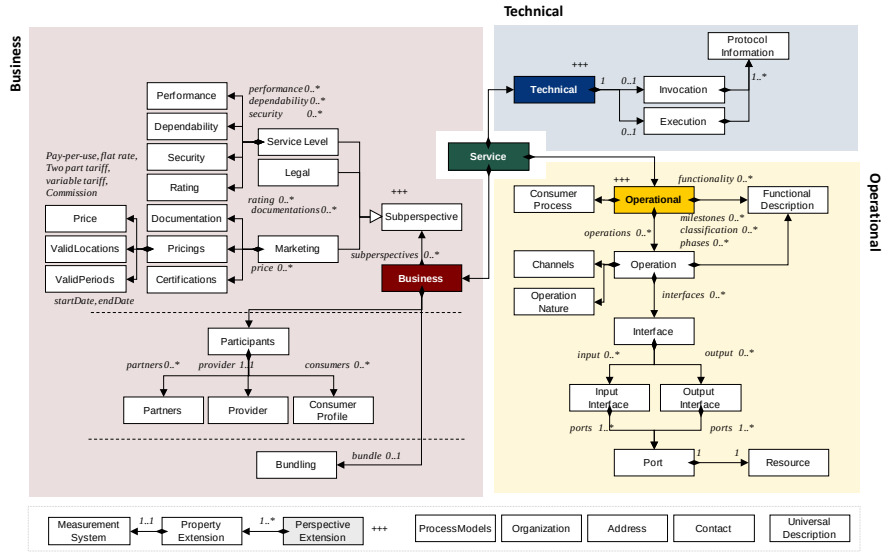

Fig. 1. Early version of the USDL model

The direct use of the models developed is suitable for technical personal, but not appropriate for non-professional users. Instead, and for SME, there is the need for the development of a graphical representation language for USDL that will enable an easy way to describe services by relying on a similar approach to the BPMN visual language devised to design business processes. Therefore, it is indispensable to increase the level of abstraction of the USDL language and provide a simple, easy-to-use, graphical language – called gUSDL – that will interface with the USDL model.

To develop a suitable graphical language, it will be advantageous to explore the use of metaphors to organize and structure a visual service description framework and give insights into the represented information through the key characteristics of the metaphor (graphic facilitation, knowledge maps, and cognitive mapping). In particular, the following service design issues need to be considered:

- *Design issue 1.* There should be an unambiguous translation from the visual service description gUSDL to the specification formalism USDL.
- *Design issue 2.* The design of gUSDL needs to take into account the human factors of individual users, particularly the characteristics of non-IT professionals from SME.
- *Design issue 3.* Each graphical construction used in gUSDL should have a well defined business, operational, and technical meaning that can be simply explained and applied in several situations involving services.

– *Design issue 4*. gUSDL needs to take into account the need for modularity such that service structures may be split and recombined to enable a divide-and-conquer approach to service design.

The graphical language needs to be later validated and evaluated taking into account several scenarios. Small scale test-beds with selected services need to be identified to validate the business, operational and technological perspectives of USDL. In addition, validation must also be done with more complex and long-running service models to describe more advanced business services.

4 Service design tools for non-IT professionals

So far the tools implemented to develop services for the IoS were overly complex and directed at IT professionals. For the development of IoS-based services, the Integrated Service Engineering (ISE) Methodology [6] was proposed and implemented as the ISE Workbench [7-8]. The ISE Workbench embodies a total number of 20 editors to model services (Fig. 2). Clearly, the tool is suitable for highly qualified engineers, IT professionals and technical people but inadequate for non-IT users and SME.

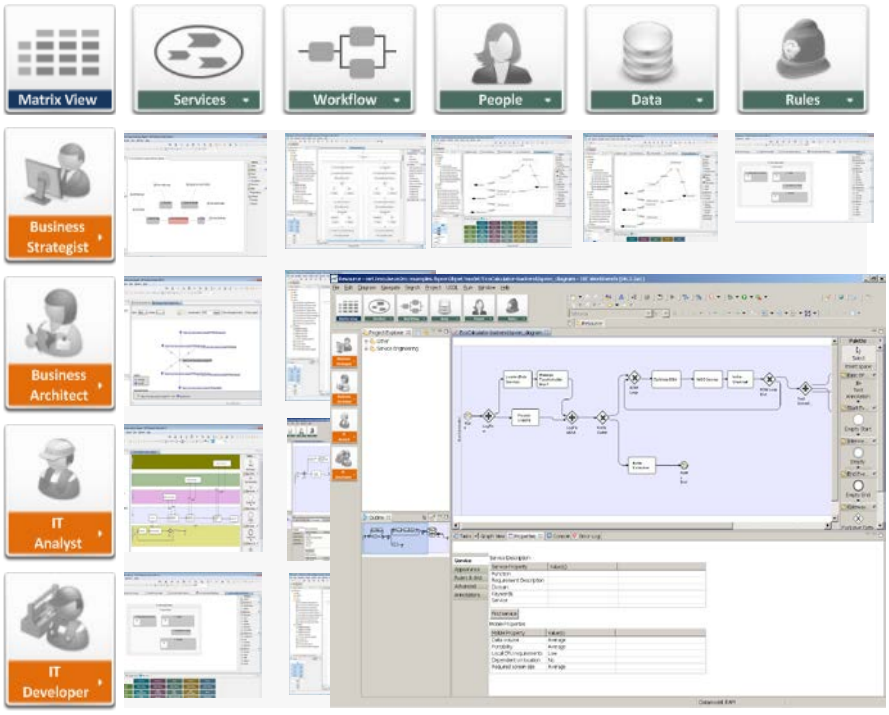

Fig. 2. ISE Workbench [7]

Therefore, there is the need to develop new tools which implement the gUSDL graphical specification language (see section 3) and provide an intuitive environment

for services. The tool, a gUSDL Design application, provides an environment to design services which can later be automatically transferred to a compliant service marketplace (see section 5).

To accomplish this goal, there is the need to understand as much as possible about non-IT professionals, their needs, their work, and the context of their work, so that the gUSDL Design tool can support them effectively in designing business services for SME. Focus groups and workshops need to be carried out to get a group of stakeholders together to discuss issues and requirements. Rather than purely evaluating usability against guidelines, we argue that designing service-based descriptions for SME will benefit from a more holistic and systematic approach. Namely, by relying on task analysis frameworks, and low-fidelity and high fidelity prototyping to capture a view on non-IT professional requirements. Important activities include:

- *Tool requirements.* A first objective needs to identify a set of relevant functionalities, fine-grained data requirements for service specification, environmental and non-IT professional profiles, and usability requirements from non-IT users for the gUSDL Design tool.
- *Hierarchical Task Analysis (HTA).* HTA can be used to break the activities associated with describing a business service down into subtasks. This will enable to focuses on the physical and observable actions performed by non-IT professionals from SME and translate the actions into functionalities.
- *Low-fidelity and high-fidelity prototyping.* Since they are simple and quick to produce and modify, low-fidelity prototypes enable the exploration of alternative designs for the gUSDL Design tool constructed based on the ideas provided by non-IT professionals. High-fidelity prototypes provide a close visual representation of the final gUSDL Design tool.

The gUSDL Design tool also needs to be validated by modeling several sets of services that represent distinct classes of services. Ideally, to preserve consistency across validations, the services used to validate the graphical language described in section 3 can be re-used to validate the gUSDL Design.

5 One-click service marketplace

Once services are designed using a gUSDL Design tool, service specifications need to be uploaded for advertisement in a service marketplace. This service marketplace will bring consumers and providers (e.g. SME) together in a “one-stop” exposure of business services through a centralized channel.

While marketplaces exist for large companies, for example Software-as-a-Service initiatives like Salesforce, simpler prototypes are needed to show that non-professional users are able to interact and feel comfortable with such a platform to publish and consume services on their own. Currently, there is a lack in formalizing non-technical aspects of a service, such as pricing, benefits, quality of service or legal requirements (see USDL specification for a complete list). Therefore, there is the

need to include such information in a structured way in service marketplaces by relying on rich knowledge representation structures, such as ontologies [25], for the annotation of business services. Hence, ontologies are significant structures for representing semantics in a generic and formal way [26]. An approach similar to SAWSDL [27], but applied to USDL, can be a good solution for the IoS. Semantic annotation languages, like SAWSDL, connect service descriptions with ontological entities, thus enabling semantic search engine to efficiently and effectively query them [28].

Messerschmitt [29] provides a good overview of the issues that need to be considered when developing a marketplace. Additional considerations that need to be taken care of include:

- *Marketplace architecture*. Elaborate an architecture for a service marketplace ecosystem accounting for loosely coupled modules such as identity management, billing, bundling, rating, SLA compliance, and integration with social networks for CRM and integration with service delivery platforms.
- *Service archive*. Develop a SAR (Service Archive) for SME services. A SAR is an entity consisting of one or more resources such as USDL files, BPEL files, PDF files, HTML files, Java class files, XML files, etc. which contain all the necessary information to trade a service in a marketplace. Packaging services' resources into SAR archives makes it easy to reuse and reassemble components as new services and distribute them to various service marketplaces.
- *Semantic search mechanism.* Implement semantic search mechanisms that capitalize on the use of semantic Web theories. Business services' properties, such as the one captured by the business, operational and technical perspective of USDL, can be annotated with concepts presents in classification schema and taxonomies (such as UNSPSC). These annotations enable the development of efficient and effective search algorithms. For SME users and non-IT users this enables to obtain better results at a lower cost.

The service marketplace needs to be validated using modern approaches and ad hoc usability testing is not recommended. At this stage, experts and non-IT professional from SME need to be involved to prepare expert-based evaluations. For example, cognitive walkthroughs need to be used to evaluate the intuition of using service marketplaces.

6 Comprehensive service use cases set

So far, there is a lack of a systematic validation of the languages, methodologies and tools proposed for the IoS. For example, USDL only provides a few examples of the use of the language and its ISE engineering workbench. Therefore, there is the need to identify which business models, industries, companies and organizations generate services which have recurring use cases and patterns. Having a set of use cases and patterns at hand, non-IT professionals and SME will be able to learn from examples, and easily and quickly apply existing service solutions to their own business. The construction of a set of use cases requires an exhaustive exploration of the various

dimensions of gUSDL which include, for example, pricing schema, service levels, strategic partners and alliances, law and cyberlaw, and SLA negotiation. The elements are to be used to characterize existing services from the industry. Use cases also provide a consistent, uniform and baseline for the validation of IoS solutions.

Here again, there is the need to rely on contemporary approaches and methods such as scenarios, storyboarding, cognitive walkthroughs, and case studies to compile a multi-perspective view on best practices to design, model, advertise, search and consume SME business services using marketplaces. In particular the following activities are important:

- *Scenario creation.* Using the vocabulary and phrasing of SME users means that the service trading, service consumptions and service provisioning scenarios can be understood by non-IT professionals and other stakeholders, and they are able to participate fully in the development process. In fact, the construction of scenarios by stakeholders is often the first step in establishing business cases for other industrial partners' requirements.
- *Service storyboarding.* A storyboard consists of a series of sketches showing how non-IT users might handle a service using gUSDL, the gUSDL Designer, and the service Marketplace. When used in conjunction with a scenario, the storyboard brings more detail to scenarios and offers stakeholders a chance to role-play with the prototype, interacting with it by stepping through the scenario.
- *Documentation studying.* Studying documentation to identify characteristics, procedures and rules often written down in manuals is also a good source of data about the steps involved in a SME service lifecycle.
- *Expert Meetings.* Expert meetings need to be conducted with an industry partner and research partners from the faculty of economics, psychology, law, and management. The main objective is to identify the fundamental aspects that make up a service and study how they are typically designed by SME in order to be made operational.

Services will benefit from the development of domain-specific use cases and reference models. References models, which are more abstract than domain-specific architectures, capture a larger class of services and can provide an organizational structure and organizational principals to service development. A good source of information for the classification of use cases is the NAICS standard. NAICS has provision for specific services in the utilities (services such as electricity, heating, water, and natural gas distribution), finance and insurance (investment and retail banks, securities industry, stock trading, funds, trusts, and other financial vehicles), and real estate and rental (real state, rental and leasing services).

7 Conclusions

The research topic of the Internet of Services (IoS) and the concept of service have acquired a renewed importance since after several years of public debate, the European Parliament has approved an important service directive. This directive

intends to enhance competition by removing restrictions on cross-border market access for services in Europe. The implications of this measure are significant since the service sector represents more than 70% of the Gross National Product.

Within the IoS, services will be created and operated relying on a systematic approach and using proper methodologies, standards, and tools. This will enable their trading over the Internet using emerging service marketplaces. To provide a suitable infrastructure for SME to trade business services four challenges need to be addressed and are discussed in this paper. The first objective targets to provide an intuitive graphical representation language to describe services. The second objective is to develop an easy-to-use tool to design services. The third objective targets the development of a "one-click" service marketplace to trade services. Finally, the fourth objective is to compile a set of use cases that document and illustrate how SME can describe, design, advertize, and trade services using a one-click marketplace. Reaching these four objectives will enable non-IT professionals from SME to have access to practical solutions and to be an active participant in the IoS. These developments will give the opportunity to SME to create and drive a new "service industry" for provisioning, brokering, (re)selling and operating business services.

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