Economic efficiency, a challenge in semantic service implementation

Dominik Kuropka
University of Potsdam, Germany
dominik.kuropka@hpi.uni-potsdam.de

Abstract: This paper presents economic efficiency as a challenge, raised when it comes to implementation of semantic service solutions for real-world scenarios. This challenge hinders practical usage of semantic services in business, since it causes uncertainness in return of investment. It will be concluded that combined research efforts of academia and industry are needed to face this challenge.

1. Introduction

Today, fundamental technological issues of services and service-oriented architectures (SOA) [1] are well understood and standards for the the specification and invocation of so called Web services like WSDL [2] and SOAP [3] are established [13]. Even though services are designed to drive inter-organisational business, it can be observed that services are still missing acceptance in this role. There are two reasons for this: First, services are often tailored to intra-organisational technical issues instead of being tailored to business demands [4]. Second, current standards in use for the description of services lack formal semantics. This hinders discovery, integration and composition of services by enforcing a manual execution of these tasks, rising the costs in usage of service-oriented architectures. The key potential of services, dynamic discovery and automated binding across enterprise boundaries, is hard to implement with current standards.

Semantic services address the second aspect directly and the first indirectly by providing detailed semantic descriptions of services at the level of business functionality, abstracting from low-level technological issues. Ontologies [5] are the basis for such formal semantic specifications of service functionality and the meaning of messages. Ontologies are used in this context to define basic concepts of a domain. These concepts are referenced in the semantic specifications of a services to define their semantics. Major emerging standardization efforts in the field of semantic services are the Web Service Modelling Language (WSML) [6] and Ontology [7] (WSMO) and the Web Ontology Language (OWL) [8] based Web Service Ontology [9] (OWL-S).

Projects like the European Commission funded Adaptive Services Grid[1] show that semantic services are well supporting dynamic discovery of services. It is even possible to automate the composition of existing services to some extend. This is useful in case a requested functionality can not be provided by one existing service alone, but by a composition of several existing services [10, 11]. Current prototypes developed in the Adaptive Services Grid project make the feasibility and business utility of semantic services tangible. It turned out that the most important utility of semantic services for business is the gain of flexibility and adaptability of business processes. Supported by semantic services it is feasible to implement business processes, which are automatically able to adapt to changes in the service landscape. This is an important issue since the service landscape is always in motion. For example, simple technical breakdowns of services and networks may temporarily disable some functionalities. New services and service providers may enter and compete with the existing one or provide new functionalities with new business potentials. Existing technologies like Web services have to be adapted continuously and manually to the changing service landscape. Semantic services allows to automate most parts of this adaptation efforts, which clearly helps in saving time and costs.

1 Project-homepage: http://www.asg-platform.org

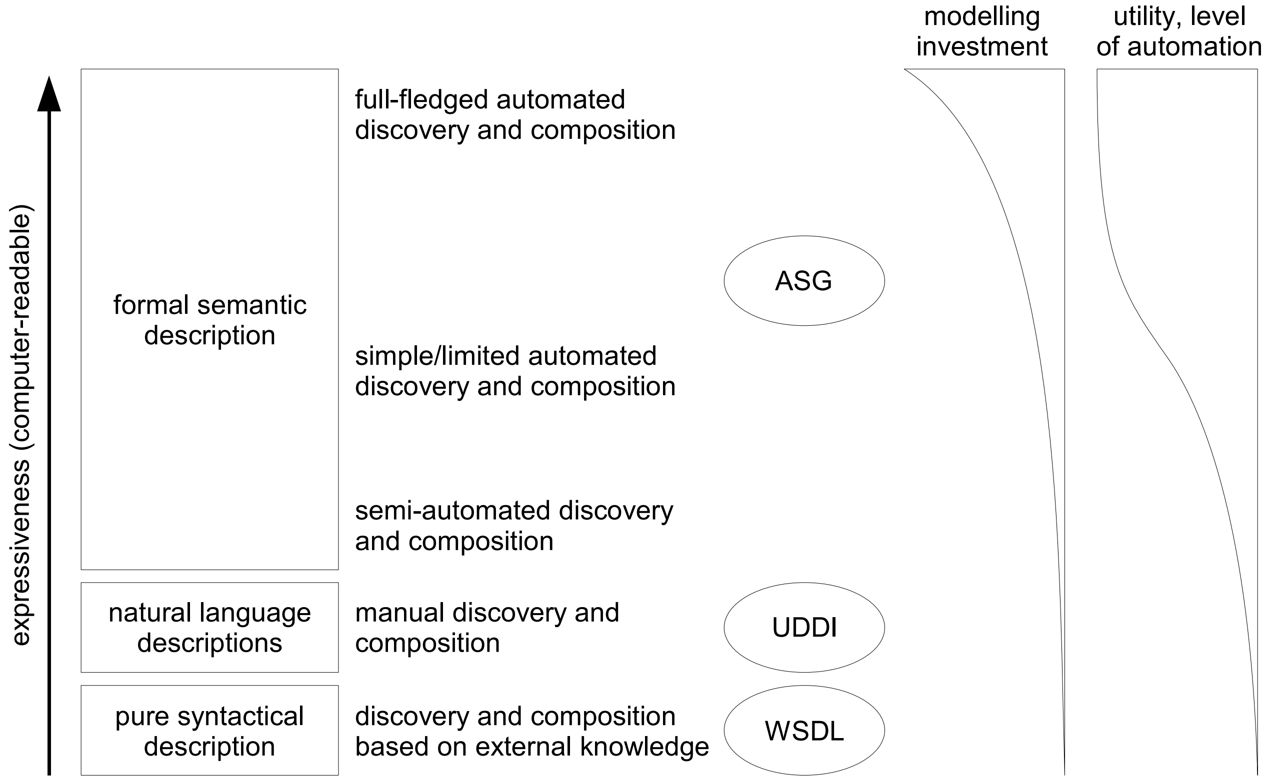

Figure 1: Expressiveness of service specifications versus modelling investment and utility [14].

2. Challenge of economic efficiency

However, there is an important challenge concerning the applicability of semantic services in business which is currently neither adequately addressed by academia nor by running research projects. This is the challenge of economic efficiency in implementation and application of semantic services as a whole. Next to the named benefits like saving time and costs in business process adaptation, the application of semantic services causes investment efforts. Probably one of the biggest efforts is the investment in domain ontology creation and announcement. As already mentioned, ontologies are the base of semantic service specifications and semantic requests. For this reason, the expressiveness of the language used for the ontology, service and request specification as well as the granularity of the ontology directly affects the usability, quality and power of semantic-enabled discovery and composition of services.

Figure 1 presents the relation between expressiveness, capabilities, utility and modelling investment. Pure syntactical descriptions basing on WSDL cause small investments but provides also only very low utility and automation for discovery and composition. UDDI [12] for example adds some natural language descriptions to WSDL service specifications and allow some classification and categorisation of functionality. However, according to automation the benefits are limited, since computers can not handle natural languages very well. This might be a reason why UDDI repositories are still lacking success. Formal semantic descriptions enable semantic services. Semantic service platforms provide formal semantic languages and reasoners which differ in their expressiveness and capability (e.g.: are complex logical expressions or temporal expressions allowed?). Furthermore, the level of granularity of the used ontology provides further limits in expressiveness. Some ontologies provide only high level concepts (like city) other provide more detailed classifications and relations between concepts (like cities belong to a country like England, Germany, Poland, etc.) and finally it is sometimes useful to add instances to an ontology (like London, Berlin, Warsaw).

Current observations made in the Adaptive Services Grid project indicate that the modelling investments rise in a disproportionate way in relation to the expressiveness of modelling. The number of concepts of fine grained ontologies rises very fast when lowering the granularity level. On the other side, the utility and level of automation seem to rise slowly with low levels of expressiveness as well with high levels of expressiveness, in the middle there seems to be a steep rise. With low expressiveness levels many problems are not solvable automatically by computers. Means for representing of important information are missing. With a mediocre level of expressibility most problems seem to be solvable at least in some parts or in a simplified way. Of course the number of solvable problems rises with the level of expressibility. However, the increase of solvable problem gets lesser while the remaining, usually complex problems need more information details for a solution. The challenge in economic efficiency of semantic services is to find an answer to the following question:

"*What is a proper level of expressiveness for modelling of semantic services, which provides a good balance between the investment in ontology/service modelling and obtainable level of utility/automation?*"

3. Conclusion

Each enterprise aiming at gaining benefits from automation of adaptation of business processes has to find an answer for the question above. For this reason, research in this direction is needed, since current research activities and projects are not addressing this important issue with the needed priority. To make industry and consumer benefit from the full potential of semantic services, a tight cooperation between industry and science is needed to ensure real-world feasibility of scientific results. The obstacle in finding the right level of expressiveness is the fact, that the right level can only be found by taking theoretical and practical experiences and real-world business cases into account. This combination of experiences can only be provided by research activities which are integrating academia and industry efforts.

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