

# Knowledge web: leveraging the European effort for realizing the semantic web\*

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## Abstract

The semantic web and semantic web services are major efforts in order to spread and to integrate knowledge technology to the whole Web. The Knowledge Web network of excellence aims at supporting their developments at the best and largest European level and supporting industry in adopting them.

The current World Wide Web (WWW) is, by its function, a syntactic web where the structure of the content has been expressed while the content itself is inaccessible to computers. Although the WWW has resulted in a revolution in information exchange among computer applications, it still cannot provide interoperation among various applications without some pre-existing, human-created agreements outside the web. This applies to multimedia documents as well as classical web documents for two reasons: First because these are easier to produce, compose and exchange each day; but mainly because the conceptual content to be extracted from a multimedia document is not usually expressed in a symbolic language like text is.

Nowadays, when a user wants to search some information on the web, she receives a huge amount of irrelevant information and faces the task of going through all the results in order to identify what information is useful for her. Finding the cheapest version of a music CD, or finding a hotel in a given city with some price restrictions, implies surfing a big amount of web sites or designing parsers and brokers which are very quickly obsolete. multimedia documents are even more difficult to find.

The next generation of the web, the semantic web [Berners-Lee *et al.*, 2001; Fensel and Musen, 2001], aims to alleviate such problems and provide specific solutions targeting concrete problems. Web resources will be more readily accessible by both human and computers with the added semantic information in a machine-understandable and machine-processable fashion. The degree of formality employed in capturing these descriptions can be quite variable, ranging from natural language to logical formalisms, but increased formality and regularity clearly facilitate machine un-

derstanding.

Similarly, web services can significantly increase the potential of the web architecture. However, in their current state of development they fail to fulfil their vision. First, current technology provides limited support in mechanizing service recognition, service configuration and combination (i.e., realizing complex workflows and business logics with web services), service comparison and automated negotiation. All these features are required by e-commerce applications. Second, all the given service descriptions are based on semi-formal descriptions. Therefore, the human programmer needs to be kept in the loop and the scalability as well as economy of web services is limited. Keeping the human in the loop prevents scalability, maturity, and economy in price. Bringing web services to their full potential requires their combination with semantic web technology [McIlraith *et al.*, 2001].

The semantic web has the potential to significantly change our daily life due to the hidden intelligence provided for accessing services and large volumes of information. By adding explicit and machine-processable semantics, the semantic web will bring the web to a new level. Users will specify their needs in an explicit and machine-understandable manner. The hidden intelligence of the semantic web will help to provide only the results that are relevant to the user.

The semantic web will have a much higher impact on e-work and e-commerce than the current version of the web. Explicit semantics will enable the automatic and dynamic location, composition and interoperation of web Services, dramatically reducing the cost of e-work and e-commerce solutions and improving their flexibility.

Nonetheless, there is a long way to go to transform the semantic web from an academic adventure into a technology provided by the software industry. Supporting this transition process of semantic web technology from academia to industry is the main and major goal of Knowledge Web.

## 1 Objectives of Knowledge Web

Knowledge Web is a FP6 Network of Excellence which counts with 18 participants including leading partners in semantic web, multimedia, human language technology, workflow and agents. In a nutshell, the mission of Knowledge Web is to strengthen the European industry and service providers in one of the most important areas of current computer technology: Semantic web enabled e-work and e-commerce. This

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network of excellence aims at achieving relevant results for the development of the semantic web and semantic web services and their transfer to the European industry.

The project concentrates its efforts around the outreach of this technology to industry. Naturally, this includes education and research efforts to ensure the durability of impact and support of industry. Therefore, Knowledge Web devotes its efforts to the three areas.

**Outreach to Industry** The main objective of Knowledge Web's outreach to industry area is to promote greater awareness and faster take-up of semantic web technology within Europe in full synergy with the research activity, in order to reduce time needed to transfer the technology to industry and, therefore, to market.

In the increasingly competitive knowledge-intensive economy, the search for competitive advantage creates a pressing need for evaluating the contribution to value creation of any new technologies and specifically the ones that are potentially disruptive. Outreach to industry has the objective of providing awareness, bridge building, cross-fertilization, software framework and industry-enabling services to boost opportunities for market take-up of the key results of semantic web technology. The key focus is on accelerating the rate of the technology transfer from research.

The activities of the industrial area will lead to the recommendation of an ontology language, tool, and methodology set that jointly covers all the major tasks in working with ontologies and to the development of standards that will help to solve the interoperability problem. Benchmarking, compliance testing, usage scenarios, cook-book style textbooks with best practices, and definition of tool environments based on loosely coupled web services will also result from the outreach to industry activities of Knowledge Web.

Contributing to the creation of an Ontology Outreach Authority and the elaboration of a consortium for sharing the tools developed within Knowledge Web is seen as one of the main durable structures that can be proposed to industry.

**Outreach to Education** If the European workforce is to establish and hold a lead in the use of semantic web technologies, it is absolutely vital that the means for educating the next generation of semantic web application developers and researchers are in place. Moreover, since learning can take place in a variety of contexts, training courses for professionals in industry have to be provided. The objective of Knowledge Web is to work towards the establishment of a Virtual Institute for Semantic Web Education which will act as the principal focus for educational activities on semantic web.

The current achievements in this domain are the well-established Knowledge web summer school. But we already have designed, in cooperation with REWERSE, REASE a repository of pedagogical resources on the semantic web which already features several tens of support material. Later, REASE will provide enhanced delivery of course materials by making use of novel semantic web technologies in combination with more traditional e-learning environments.

Knowledge web is in the process of establishing a common European master programme on the topic of the semantic web. Several high level educational institutions will guarantee that the proposed curriculum persist as long as it is nec-

essary (or necessary at the European level). This will eventually create a well-trained European workforce, also guaranteeing some homogeneity within this workforce, which will be a benefit, both to research and industry.

**Coordination of Research** The leading position of Europe can only be maintained and strengthened by continuing to perform cutting edge research. The objective of Knowledge Web will be to ensure that the research as performed by the leading groups in this area will be sufficiently coordinated to avoid both duplication and fragmentation. Such coordination is particularly important for the semantic web: since it is an inter-disciplinary area, joint collaborations among and across various research communities is necessary. Knowledge Web coordinates the European research effort to make semantic web and semantic web services a reality.

Knowledge Web research activities address the major scientific concerns with respect to the implementation of a semantic web and the design of semantic web services. It aims at transforming ontology technology into a mature technology for the semantic web. The emphasis here is on large ontologies with several tens to hundred thousands of definitions; on heterogeneous ontologies with conflicting definitions; and on ontologies that keep changing depending on the underlying reality and design rationales.

We focus on these three main aspects for realizing the semantic web: scalability, heterogeneity, and dynamics. These topics are not the whole semantic web, but deal with serious challenges to its availability that require research by not just one team but a community of European researchers. Knowledge Web has decided to concentrate its attention on these challenges, and to additionally contribute to the development of appropriate rule and query languages for the semantic web. Our goal is to address these issues so that results can be progressively transferred to the industrial part of the network.

Together with these three areas, our work focuses on applying them to one of the key application domains for semantic web technologies: semantic web services. The dissemination of research results will be done through many different instruments, including publications, norms, the Knowledge Web semantic portal, lectures given to VISWE, and industry seminars and tutorials.

Furthermore, Knowledge Web encourages mobility, which is expected to provide a wider recruitment pool for research institutions. Its integration within the European Research Area is testified by its links with other efforts (e.g., REWERSE NoE, DIP and SEKT IP).

## References

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