D 1.4.3 Report on second international technology show

Coordinator: Valentina Tamma (University of Liverpool) and Roberta Cuel (University of Trento)

Abstract.
The aim of the Task 1.4.3 in Workpackage 1.4 within the network of excellence Knowledge Web is to promote ontology technology through the organisation of *technology shows*. In this deliverable we report on two major events organised in full or in part by Kweb during 2005. These are the Second Technology show collocated with the 2nd European Semantic Web Conference (ESWC 2005), and the "Semantic web days" meeting. In the deliverable we review the systems presented during the technology show, while comparing and contrasting these systems with the demands of specific type of technology made by industrial organisations during the "Semantic web days". In this way we contextualise the technology currently available with respect to the way Semantic Web technology is used in industry.

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Changes

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0.3	10-12-2005	Valentina Tamma and Roberta Cuel	Added analysis and conclusions
0.4	01-02-2006	Valentina Tamma	Added modifications following the Quality controller (Steven Willmott, UPC) comments and comments from the other workpackage members

Executive Summary

The aim of the workpackage 1.4 within the network of excellence Knowledge Web (Kweb) is to promote ontology technology and to show the added value resulting from the use of semantic web technology. The work carried out in this workpackage has the objective of creating awareness of how semantic web technologies can become the vehicle enabling organisations to deliver new products and services.

One of the ways in which the objective is achieved is through the organisation of *technology shows.* That is, events aimed at a wider audience, composed by industrial organisations, public institutions and major IT players, where different tools and applications, partly developed within Kweb, are presented in order to provide efficient support to a faster take up of these technologies by industry.

In this report we review two major events organised in full or in part by Kweb, where academic and industrial researchers presented their work. These are the Technology show at the 2nd European Semantic Web Conference (ESWC 2005), and the "Semantic web days" meeting. In particular, our aim is to review the systems presented during the technology show, while comparing and contrasting these systems with the demands of specific type of technology made by industrial organisations during the "Semantic web days". In this way we contextualise the technology currently available with respect to the way Semantic Web technology is used in industry.

This report builds on the discussions and classification of semantic web technology presented in last year's report on the technology show (D1.4.3v1) [D1.4.3 v1]. Following last year's conclusions, in this report we distinguish *semantic web applications* from *semantic web tools,* where by applications we refer to semantic technologies for the end-user while by tools we denote software aimed at developers of semantic web applications. A tool is meant to be an aid to the development process and might not be an application itself, but might be embedded in a system, or be a plug-in. An application is aimed at a general audience, with no specific background knowledge, whereas a tool is aimed at knowledge engineers or ontology developers.

However there is a shift in focus with respect to the objectives. Last year's report had the twofold objective of describing the innovative technologies demonstrated during the first semantic technology road show, and to identify critical issues that need to be dealt with if these technologies would be implemented in a business environment.

This year we have witnessed an impressive flourishing of applications and technology demonstrators, with around twenty demo sessions presented during ESWC. Several of these systems were presented during last year technology show, which proves that Semantic Web technology is evolving steadily and constantly. In this report we build upon the classification work presented in D1.4.3 v1, and we try to classify the systems presented in the events mentioned above according to the dimensions identified last year. However, classification is then used to draw conclusions regarding which technologies seem more promising, and have drawn the attention of industry so far and are already in use. In addition to reporting on the technologies demonstrated in the major European

semantic web conference, we also report on the "Semantic web days" meeting. This initiative, organised by the network of excellence Rewerse[1] in collaboration with Knowledge Web, aimed at providing a forum where companies and research institutions sharing the objective to accelerate the uptake of Semantic Web technologies could meet. We report on the talks presented and on the discussion topics emerged, that mainly focussed on the degree of maturity of the different technologies exhibited in the conference.

[1] REWERSE is an FP6 funded network of excellence on "Reasoning on the Web", and it is one of the intra-network collaboration partners.

Contents

1. Introduction

The aim of the network of excellence Knowledge Web (Kweb), and in particular of workpackage 1.4, is to promote ontology technology and to show the added potential value resulting from the use of semantic web technology. The work carried out in this workpackage has the objective of creating awareness on how semantic web technologies can become the vehicle enabling organisations to deliver new products and services.

One of the ways in which the objective is achieved is through the organisation of *technology shows.* That is, events aimed at a wider audience, composed by industrial organisations, public institutions and major IT players, where different tools and applications, partly developed within Kweb, are presented in order to provide efficient support to a faster take up of these technologies by industry.

In this report we review two major events co-organised by Kweb where academic and industrial researchers presented their work, that is the Technology show at the 2nd European Semantic Web Conference (ESWC 2005), that took place in Crete from May 28 until June 1st, and the "Semantic web days" meeting, held in Munich on October 6th and 7th, 2005. In particular, our aim is to review the systems presented during the technology show, while comparing and contrasting these systems with the demands of specific type of technology made by industrial organisations during the "Semantic web days". The systems presented at ESWC comprised both *semantic web applications* and *semantic web tools,* where by applications we refer to semantic web technologies for the end-user while by tools we denote software aimed at supporting developers of semantic web applications. A tool is thus meant to be an aid to the development process and might not be an application itself, but might be embedded in a system, or be a plug-in. An application is aimed at a general audience, with no specific background knowledge, whereas a tool is aimed at knowledge engineers or ontology developers. In contrast, during the "Semantic web days meeting" the majority of presentations focussed on applications showing the potential of semantic web technologies for a variety of industrial areas.

The distinction between applications and tools, presented as part of the conclusions of last year's report on the technology show (D1.4.3v1) [D1.4.3 v1], allows us to contextualise the technology currently available with respect to the way Semantic Web technology is used in industry. However, last year report provides only the skeleton for the analysis presented here, where we give a brief description of the software systems presented, subdivided in categories s, but we focus more on providing a snapshot of the current status of the technology demonstrated with respect to the needs perceived by industry and highlighted during the Semantic Web days. We also try to identify the developers (academic and industrial research centres) and the type of technology developed.

However there is a shift in focus with respect to the objectives. Last year report had the twofold objective of describing the innovative technologies demonstrated during the first semantic technology road show, and to identify critical issues that need to be dealt with if these technologies would be implemented in a business environment.

This year we have witnessed an impressive flourishing of applications and technology demonstrators, with around twenty demo sessions presented during ESWC. Several of these systems were presented during last year technology show, which proves that Semantic Web technology is evolving steadily and constantly. As mentioned above, in this report we build upon the classification work presented in D1.4.3 v1, and we try to classify the systems presented in the events mentioned above according to the dimensions identified last year.

In addition to reporting on the technologies demonstrated in the major European semantic web conference, we also report on the "Semantic web days" meeting. This initiative, organised by the network of excellence Rewerse[2] in collaboration with Knowledge Web, aimed at providing forum where companies and research institutions sharing the objective to enhance the uptake of Semantic Web technologies could meet. We report on the talks presented and on the discussion topics emerged, that mainly focussed on the degree of maturity of the different technologies exhibited in the conference.

The reminder of this deliverable is organised as follows: Section 2 briefly introduces the framework used to classify the work, Section 3 is devoted to the 2nd European Semantic Web Conference (ESWC 2005), while Section 4 describes "Semantic Web Days". Finally, we present an analysis of the possible trends, recommendations for the future in Section 5, and we conclude in Section 6.

2. Classification framework

In order to provide a comparable and systematic description of the systems presented during the two major Semantic Web events co-organised by Kweb we outline a classification framework that extends and enhances the concluding remarks presented in D1.4.3 v1.

For each of the software systems presented we divide them between applications and tools. Applications can be of various types and aim at solving specific problems, whereas tools are further subdivided according to their main purpose, such as ontology editing, reasoners, ontology alignment and merging, natural language processing for ontology building, natural language techniques for annotating resources, etc. In addition, we provide a brief description of the software functionalities, its main features, and we also try to indicate, when relevant, whether the system (tool or application) is publicly available, and the type of license used. When available, we also include the website and further reference to the system reviewed.

[2] REWERSE is an FP6 funded network of excellence on "Reasoning on the Web", and it is one of the intra-network collaboration partners.

3. ESWC 2005

ESWC 2005 took place in Heraklion, Crete, from May 29th until July 1st. The technology show was organised as part of the demo session, where more than twenty systems were presented, of which thirteen were applications and eight were tools. In the remainder of this section we present these systems based on the papers accompanying the demos.
The topic of interest of this conference included, but were not restricted to:

- Languages, Tools and Methodologies for Semantic Annotation of Web Data
- (Semi-)automatic ontology learning and metadata generation (Including HLT and machine learning approaches)
- Ontology Management (creation, alignment, merging, evolution, evaluation, linking, mediation and reconciliation)
- Semantic Web Services (service description, discovery, invocation, composition)
- Semantic Web-based Knowledge Management
- Data Semantics
- Database Technologies for the Semantic Web
- Semantic Knowledge Portals
- Semantic Brokering
- Semantic Interoperability
- Semantic Web Mining
- Semantic Web Inference Schemes
- Semantic Web Trust, Privacy, Security and Intellectual Property Rights
- Semantic Web for e-Business and e-Learning
- Semantic Searching and Querying
- Reasoning in the Semantic Web
- Visualization and modelling

3.1 Applications

In the reminder of this subsection we try to group together applications that are similar either because they are aimed at users with common interests, or because they have related objectives.

3.1.1 Search related applications

In this category we classify semantic based search systems, providing facilities for indexing and querying semantic web resources, as well as with systems that offer functionalities to aid the search process, such as visualization and browsing.

Application name: AKTAgent
Developers: N. Kings, A. Duke, J. Davies (British Telecom, UK)
Type of development: Industrial application
Aim: AKTAgent is a prototype developed as part of the FP6 SEKT project that aims at providing semantic search agent facilities and query led indexing and extraction.
Brief description: AKTAgent extends and enhances the functionalities provided by the KIM platform (reviewed in the tool section, subsection 3.2.1 on Information extraction), that provides semantic annotation, indexing and retrieval of documents.

In AKTAgent, users create and store queries that are periodically submitted to a search engine. In this way agents search for documents that match the user's long term interests. Unlike similar applications (such GoogleAlert) the use of semantic web technology permits users to specify semantic queries according to an ontology (the one provided by KIM for the annotation of the resources). This allows users to retrieve information more accurately than search engines that express queries based on natural language only. In addition, these user-specified queries and their results can be used to further enhance the indexing and extraction process of the search engine.
Development status: prototype
Web site: Not available
Further reading: Not available

Application name: ALVIS
Developers: W.L. Buntine, K. Valtonen (Helsinki institute for information, Finland) and M.P. Taylor (Index Data Aps, Denmark)
Type of development: Mixed academic and industrial application
Aim: ALVIS aims to provide a free, standalone semantic-based search system in order to enable application-domain experts to readily build topic-specific search sites.
Brief description: ALVIS allows application-domain experts to link together individual sites so that can they can form a search network, by providing means to develop complementary, distributed components, together with bridges to existing topic-specific search sites.
The system relies on a semantic-based search engine that is intended to automatically build and maintain its own semantic structure from input primitive ontologies. Although making use of ontologies, the semantic structure is created semi-automatically using statistical and machine learning methods for the purpose of returning better search results. The distributed system is intended to operate with heterogeneous search servers, using query topics as a routing mechanism, and using distributed methods for ranking and semantic-based processing.
Development status: prototype, to be released as open source
Web site: http://www.alvis.info/alvis/
Further reading:
[1] E. Alphonse, S. Aubin, J. Deriviere, T. Hamon, D. Mladenic, A. Nazarenko, C. N edellec, T. Poibeau, D. Weissenbacher, and Q. Zhou: Report on method and language for the production of augmented document representations. ALVIS Deliverable D5.1, ALVIS, 2004.
[2] W. Buntine. Open source search: A data mining platform. *SIGIR Forum,* 39, 2005. To appear.

Application name: Name not available
Title of the demo paper: On Searching and Displaying RDF[3] Data from the Web
Developers: A. Harth (Digital Enterprise Research Institute, Ireland) and H. Gassert (University of Fribourg, Germany)
Type of development: Mixed academic and industrial application

[3] RDF: Resource Description Framework (http://www.w3.org/RDF/)

Aim: This application provides a user interface for viewing and browsing data expressed in RDF (Resource Description Framework).
Brief description: The prototype aims at integrating, querying, and displaying arbitrary RDF data with little prior knowledge about the vocabulary used. The system addresses the challenges posed by data that is scattered, uncontrolled, and heterogeneous.
The application is composed by a Semantic Web crawler, storage and retrieval facilities, a reasoner to carry out integration tasks, and a user interface to generate HTML for displaying results of queries. Data is initially retrieved through a keyword based search. The results obtained are then integrated before being rendered in the user interface. This application is a variant of SECO, a system developed at DERI with similar functionalities.
Development status: prototype
License Type: SECO is available under the BSD-style licence.
Web site: Web site not available.
SECO web site available at http://seco.semanticweb.org/
Further reading:
[1] A. Harth. SECO: Mediation Services for Semantic Web Data. *IEEE Intelligent Systems*, 19(3):66–71, May/June 2004.
[3] A. Harth. YARS. DERI, 01 2005. http://sw.deri.org/2004/06/yars/yars.html.

Application Name: SERSE Semantic routing system
Developers: I. Blacoe, V. Tamma and M. Wooldridge (University of Liverpool, UK)
Type of development: academic application
Aim: SERSE aims to efficiently search for digital content on the basis of semantic annotations.
Brief description: The system is based on the idea of building distributed indices that allow information to be queried using their semantics. SERSE is implemented as a multi-agent system, in which individual, specialised agents within the system are each responsible for handling one concept within the global index. SERSE provides the infrastructure to build and manage the index of semantic resources, and to generate and reply to semantically specified queries for these resources. SERSE is able to search for resources annotated with ontologies expressed in OWL(Web ontology language[4]) and RDFS, and uses RDQL (RDF Data Query Language[5]) as query language.
Development status: prototype
Web site: http://www.csc.liv.ac.uk/SemanticWeb/Projects/QUEST/
Further reading:
[1] V. Tamma, I. Blacoe, B. Lithgow Smith, and M. Wooldridge. Introducing Autonomic Behaviour in Semantic Web Agents. *In Proceedings of the Fourth International Semantic Web Conference (ISWC 2005), Galway, Ireland, November 2005*
[2] V. Tamma, I. Blacoe, B. Lithgow Smith and M. Wooldridge. SERSE: searching for Semantic Web Content. *In Proceedings of the 16th European Conference on Artificial Intelligence*, ECAI 2004, Valencia, Spain, August 2004

[4] OWL: http://www.w3.org/TR/owl-ref/
[5] RDQL: http://www.w3.org/Submission/2004/SUBM-RDQL-20040109/

Application name: ELENA
Developers: S. Aguirre, A. Mozo, J. Salvachua (Universidad Politecnica de Madrid, Spain), S. Brantner, T. Zillinger (BearingPoint Infonova GmbH, Austria), G. Huber, Z. Miklos, B. Simon, S. Sobernig (Vienna University of Economics and Business Administration, Austria), S. Markus (Information Multipmedia Communication IMC, Germany), D. Olmedilla (L3S Research Center and Hanover University, Germany)
Type of development: Mixed academic and industrial application
Aim: ELENA provides an infrastructure based on Semantic Web technologies that enables the integration of heterogeneous educational sites in a semantic network and provides access for it.
Brief description: This semantic network is used to support the process of defining learning goals, provide personalised search services, but also to support corporate personal development.
This infrastructure builds on three main components: A common query API, called Simple Query Interface (SQI), a common semantic model for querying and presenting results, instantiated in XML and RDF, re-usable components for integrating existing systems with little effort. These components have been developed for RDF repositories, XML documents (databases) and relational databases. The underlying common schema is specifically designed to the needs of an educational network of training measures while reusing standardized concepts from IEEE LOM and Dublin Core at the same time.
Development status: prototype running on a web server, however the components are available as open source.
Web site: http://www.elena-project.org/en/index.asp?p=1-1
Further reading:
[1] S. Gunnarsdottir, B. Kieslinger, T. Küchler, and B. Simon. From e-Learning to Learning Management: Results of an International Survey. *In Proceedings of 4th International Conference on Knowledge Management*. Graz, Austria, 2004.
[2] B. Simon, S. Retalis, and S. Brantner. Building Interoperability among Learning Content Management Systems. *In Proceedings of the 12th World Wide Web Conference.* Budapest, 2003.

3.1.2 Wiki and community of practices

In this section we group those applications that offer support for collaborative working and to community of users sharing the same interests (community of practice) . Wikis are a noticeable example of collaborative environments. A Wiki[6] is a web application that allows users to add content, as on an Internet forum, but also allows anyone to edit the content. Wiki also refers to the collaborative software used to create such a website.

Application Name: SHAWN
Developers: David Aumueller (University of Leipzig, Germany)
Type of development: Academic application
Aim: SHAWN is a web application that aims to provide support to authors for the annotation of semantically structured content on a Wiki.

[6] http://en.wikipedia.org/wiki/WIKI

Brief description: Wikis are becoming more and more popular as they offer an easy way to publish documents on the WWW. However, the drawback deriving by this ease of use is that often specific information is difficult to find, and users are overloaded by several Wiki pages. Wikis are weakly structured repositories, where all pages are linked through traditional hyperlinks. Semantic authoring therefore consists of entering field value pairs among prose text within a single input field, and users are provided with context aware means of navigation. Assuming each Wiki page resembles a (real world) concept, arbitrary relationships between concepts of any kind can be modelled. This relationship data is entered on Wiki pages in a straightforward and usable manner. The resulting metadata instantaneously gets used by the user. Queries are persistently embedded on Wiki pages in order to maintain constantly up-to-date lists of results.
The application can be embedded in external systems for the management of Wikis, and supports RDQL queries posed on RDFS ontologies. This application was awarded the best demo award at ESWC 2005.
Development status: prototype
Web site: http://wiki.navigable.info/
Further reading:
[1] SHAWN: Structure Helps a Wiki Navigate. *BTW-Workshop "WebDB Meets IR"*, Karlsruhe, Germany, March 2005

Application Name: AKTive workgroup builder (AWB)
Developers: C. McKenzie, A. Preece, P. Gray (University of Aberdeen, UK)
Aim: The AKTive Workgroup Builder (AWB) is a SW application that attempts to solve the practical problem of assembling a workgroup from a pool of known individuals.
Brief description: AWB is developed in the framework of the CS AKTive Space, a repository of information about the Computing Science (CS) community in the UK. AWB uses hybrid reasoning techniques that allow to reason on ontological information as well as on rules expressing constraints on the ontologies.
The system uses distributed RDF data, defined against an OWL Lite ontology, to build and solve a user defined Constraint Satisfaction Problem (CSP).
Development status: prototype
Web site: http://www.csd.abdn.ac.uk/research/akt/cif
Further reading:
[1] K. Hui, P. Gray, G. Kemp, and A. Preece. Constraints as Mobile Specifications in e-Commerce Applications. *In Proceedings of the 9th IFIP 1.6 Working Conference on Database Semantics (DS-9): Semantic Issues in e-Commerce Systems*, pages 357–379, 2001.
[2] C. McKenzie, A. Preece, and P. Gray. Extending SWRL to Express Fully-Quantified Constraints. *In G. Antoniou and H. Boley, editors, Rules and Languages for the Semantic Web (RuleML 2004),* pages 139–154. Springer, 2004.

3.1.3 Health support

In this section we review an application of semantic web technology for health care

Application name: Aingeru

Developers: M.I. Bagues, J. Bermudez, A. Goni, A. Illaramendi, A. Tablado (University of the Basque Country, Spain)
Type of development: Academic application
Aim: Aingeru is an application for tele-assistance of elderly people.
Brief description: Aingeru uses wireless sensors used to capture vital data of elderly patients, and models in ontologies the different situations in which medical attention has to be sought, and the different symptoms that can be exhibited by a patient, together with the vital signs that can be monitored by sensors. A reasoner, RACER (see Semantic Web Days section), is used to reason about instances of the ontology, and the reasoning can be executed also on a PDA.
Development status: prototype
Web site: http://aingeru.net/
Further reading:
[1] M. I. Bagues, J. Bermudez, A. Illarramendi, A. Tablado, and A. Goni. Using ontologies in the development of an innovating system for elderly people tele-assistance. *In ODBASE,* volume 2888 of LNCS, pages 889–905. Springer-Verlag, Nov. 2003. Sicily, Italy.
[2] A. Tablado, A. Illarramendi, M. I. Bagues, J. Bermudez, and A. Goni. Agents in a system for monitoring elderly people. *In J. Nealon, A. Moreno, J. Fox, and U. Cort´es, editors, ECAI 2004. Workshop 7: Agents Applied in Health Care*, pages 47–53, August 2004.

3.1.4 Multimedia Annotation

The application presented below aims to the annotation of multimedia digital content, such as audio, images, etc.

Application name: SIMAC (Semantic Interaction with Music Audio Contents)
Developers: O. Celma and P. Herrera (Universitat Pompeu Fabra, Spain)
Type of development: Academic application
Aim: SIMAC is a set of prototypes to describe semiautomatically music digital content. The system address the problems arising in the area of distributing digital music, such as recommending potential customers songs, based on evaluating similarity and music structure.
Brief description:
Usually recommendations are determined through cultural metadata, or using prior purchasing behaviour data. These types of problems motivate the use of semantic descriptors of music content, as metadata that can be automatically created in the contexts of delivering, recommending, or organizing music collections.
These descriptors are represented in OWL.
The system is composed of three main components: the Music Annotator, which is the tool intended for extracting music descriptors. It computes low-level frame-by-frame values taken from the raw audio signal, the Music Organizer and Explorer that demonstrates the visualization and navigation across existing collections of music titles. 2 dimensional maps can be used to map songs according semantic descriptors, and the Music Recommender, the component intended for providing recommendations of music titles that are legally downloadable from the WWW.

Development status: prototype. The music recommender component is available for download at http://www.semanticaudio.org/
Web site: http://www.semanticaudio.org/
Further reading:
[1] O. Celma, M. Ramirez, and P. Herrera. Semantic interaction with music content using foaf. *In Proceedings of 1st Workshop on Friend of a Friend, Social Networking and the Semantic Web*, Galway, Ireland, 2004.

3.1.5 Semantic Portals and Personalised Browsers

In this section we review applications that use semantic web technology in order to provide principled access to heterogeneous information sources and thus support several tasks such as efficient retrieval of documents, and decision making.

Application Name: JeromeDL
Developers: Sebastian Ryszard Kruk (Digital Enterprise Research Institute, Galway, Ireland)
Type of development: Mixed academic and industrial application
Aim: JeromeDL aims to support collaborative filtering, that is the process of automating the request of recommendations when looking for information on the Internet.
Brief description: JeromeDL is an open source digital library that uses Semantic Web technology to provide better access to its resources.
The systems provides a distributed catalogue, maintained by the users, and resource annotation features that aim to overcome problems related to security and privacy that are common in traditional implementations of collaborative filtering systems.
Development status: Prototype available for download at:
http://sourceforge.net/projects/jeromedl
License Type: BSD style license
Web site: http://www.jeromedl.org
Further reading Links to publications available at:
http://www.jeromedl.org/index.php?option=com_content&task=view&id=22&Itemid=47

Application name: the Madiera data portal
Developers: P. Assisi (U.K. Data Archive, Nesstar Ltd., University of Essex, UK)
Type of development: Mixed academic and industrial application
Aim: The Madiera Data Portal provides access to a large quantity of social sciences quantitative datasets using an easy to use Web interface.
Brief description: The Madiera Data Portal harvests statistical datasets and variables published on the Semantic Web (in RDF format, using Nesstar Data Servers) from a number of high quality data publishers (including all the largest European social sciences data archives), organises them using a set of multilingual thesauri and taxonomies and makes them available through both a simple API and a responsive and highly customizable Web Interface. The Madiera Portal operates as a Web search engine by browsing and querying the Nesstar Data Servers in order to harvest the RDF descriptions of the available statistical objects. The Portal accesses the data servers using the Nesstar API, a Java library that automatically converts the RDF descriptions returned by the servers to corresponding Java objects and stores them in an in memory object database. It

is developed as part of the FP6 funded project Madiera. Once objects are collected the contents of their title, keywords and abstract properties are indexed, then the statistical objects are matched with a set of multi and monolingual thesauri and classification systems.
Development status: prototype available at http://purl.oclc.org/NET/madiera_portal
Web site: http://www.madiera.net
Further reading:
[1] Assini, Pasqualino. Objectifying the Web the 'light' way: an RDF-based framework for the description of Web objects. *Poster presented at the Tenth International World Wide Web Conference*, May 1-5 2001, Hong Kong.
[2] Assini, Pasqualino. NESSTAR: A Semantic Web Application for Statistical Data and Metadata. *In Real World Semantic Web Applications*, Vipul Kashyap and Leon Shklar eds. IOS Press, Amsterdam, 2002, ISBN 1 58603 306 9, pagg. 173-183.

Application name: AKTive Futures
Developers: N. Gibbins, H. Alani, S. Harris, H. Glaser and N. Shadbolt (University of Southampton, UK)
Type of development: Academic application.
Aim: The AKTive Futures system is a prototype Semantic Web portal that facilitates strategic decision making within organisations by providing principled access to information from heterogeneous sources.
Brief description: The portal is meant to support analyst work by providing a means to analyse a large information space.
The portal provides a conceptual open hypertext interface that annotates external resources using a domain ontology, and it is complemented by a graphing tool that allows the analysis of trends in temporal data in the context of relevant contemporary events. An ontology of business drivers provides a common framework used to mediate information gathered from different sources. The ontology allows drawing inferences that are used to indicate the relevance of datasets to key drivers. Data is gathered from a variety of freely-available sources, transformed into RDF/XML using the vocabulary defined by the domain ontology, and stored in an RDF triplestore that provides a query interface to the other system components.
Development status: prototype
Web site: http://triplestore.aktors.org/demo/AKTiveFutures/
Further reading:
[1] Shadbolt, N., Gibbins, N., Glaser, H., Harris, S. and schraefel, m.c. CS AKTive Space, or How We Learned to Stop Worrying and Love the Semantic Web. *IEEE Intelligent Systems*, 19, 3 (May/June 2004), 41-47.

Application name: Jack, the personal semantic web browser
Developers: P. Croke, A. Johnston, K. Tighe (Hewlett-Packard European Software Centre, Ireland)
Type of development: Industrial application
Aim: Jack is a semantic web browser that enriches the browser functionality with semantics without altering the content of the retrieved web pages.

Brief description: Jack categorises web pages according to a specific class or category that is represented in an ontology. The system has several ontologies modelling different topics.
These ontologies can be browsed by users, who can also add named entities thus allowing the annotation of pages. The system suggests links in the correct context of an entity and the user can choose whether or not to add them to the ontology. Jack uses examples of a particular type of web page in order to train its learning algorithm.
Development status: prototype
Web site: Not available
Further reading: Not available

3.2 Tools

In this section we review semantic web tools, where by tools we denote software aimed at supporting developers of semantic web applications, as already mentioned in Section 1. A tool is thus meant to be an aid to the development process and it is meant to be used mainly by knowledge engineers or ontology developers. In the reminder of this section we present tool for information extraction, query and transformation languages, tools supporting the editing and execution of semantic web services, and support to reasoning with ontological information.

3.2.1 Information extraction

Here we present various tools for information extractions that can facilitate the development of ontologies. Often these tools are based on Natural Language Processing (NLP) techniques, or on text analysis.

Tool name: Text2Onto
Developers: P. Cimiano, J. Voelker, Y. Sure (University of Karlsruhe, Germany)
Type of development: Academic
Functionality: Ontology learning from text
Brief description: Text2Onto is a framework for ontology learning from textual resources that extends and re-engineers an earlier framework developed by the same group (TextToOnto). Text2Onto offers three main features: it represents the learned knowledge at a metalevel by instantiating the modelling primitives of a Probabilistic Ontology Model (POM), thus remaining independent from a specific target language while allowing the translation of the instantiated primitives into knowledge representation mechanisms such as RDFS, OWL, and F-Logic. Text2Onto is designed having in mind user interaction, and it allows for sophisticated visualisation functionalities, enabling the user to prune or filter the POM. Finally, the system includes strategies for data-driven change discoveries that enable the selective update of the POM according to the corpus changes, rather than having to process the whole corpus from scratch each time.
Text2Onto offers two types of visualisation, a tabular view showing a number of sorted lists for all kinds of modeling primitives and a graph-based representation.

The system uses different types of learning algorithms to instantiate the POM. The algorithms are applied in order after a linguistic pre processing phase and then the changes suggested are applied to the POM.
Devlopment status: prototype, under constant development
License type: The source code of Text2Onto is distributed under the LGPL and can be obtained from http://ontoware.org/projects/text2onto/.
Web site: http://ontoware.org/projects/text2onto/
Further reading: [1] P. Cimiano, A. Pivk, L. Schmidt-Thieme, and S. Staab. Learning taxonomic relations from heterogeneous sources. *In Proceedings of the ECAI 2004 Ontology Learning and Population Workshop*, 2004.
[2] P. Haase, Y. Sure, and D. Vrandecic. Sekt deliverable d3.1.1, 2005. Ontology Management and Evolution - Survey, Methods and Prototypes.

Tool Name: KIM
Developers: A. Kiryakov, B. Popov, D. Manov, D. Ognyanoff, I. Kiutchukov, I. Terziev (Ontotext Lab, Sirma AI EAD, Bulgaria)
Type of development: Industrial
Functionality: Semantic annotation, indexing and retrieval of documents
Brief description: KIM is a platform that provides infrastructure and services for semantic annotation, indexing and retrieval of documents. KIM enables scaleable and customizable ontology-based information extraction (IE) as well as annotation and document management, based on GATE (described below).
In order to facilitate its functionality, KIM is equipped with an upper level ontology and a very large knowledge base, thus providing coverage of entities of general importance.
The upper level ontology, PROTON (http://proton.semanticweb.org) is encoded in OWL Lite and defines the top and upper layers of entities that are useful for semantic annotation in the open news domain The ontology is defined in a modular fashion in order to allow for easy domain specific extension. It contains definitions of about 270 entity classes and 100 attributes and relations. The semantic descriptions of entities and relations between them are kept in a knowledge base (KB), encoded in the PROTON ontology.

Semantically-enhanced information retrieval is provided on the basis of Lucene (freely available from http://lucene.apache.org/java/docs/index.html).
KIM is ongoing development, and the recent development of the platform include:
- the transition of RDF(S) to OWL Lite;
- Scalable OWL Lite repository based on SESAME (available at http://www.openrdf.org/), capable of keeping 30M statements;
- Integration with the latest GATE, Lucene and SESAME, as core modules used respectively for Information Extraction, Information Retrieval and Semantic Repository;

Cluster architecture allowing for parallel semantic annotation.
Development status: ongoing
License type: Available for evaluation purposes
Web site: http://www.ontotext.com/kim/
Further reading:
[1] Kiryakov, A., Popov, B., Terziev, I., Manov, D., Ognyanoff, D. Semantic Annotation, Indexing, and Retrieval. *Elsevier's Journal of Web Semantics, Vol. 1, ISWC2003 special issue (2*), 2004. http://www.websemanticsjournal.org/ps/pub/2005-10
[2] Popov, B., Kiryakov, A., Ognyanoff, D., Manov, D. KIM - Semantic Annotation Platform. *2nd International Semantic Web Conference (ISWC2003)*, 20-23 October 2003, Florida, USA. LNAI Vol. 2870, pp. 484-499, Springer-Verlag Berlin Heidelberg 2003.

Tool Name: Gate
Developers: K. Boncheva, H. Cuningham (University of Sheffield, UK), M. Sabou (Vrije Universiteit Amsterdam, The Netherlands)
Type of development: Academic
Functionality: Text mining
Brief description: GATE (a General Architecture for Text Engineering) is a well-established infrastructure for the customisation and development of Natural Language

Processing (NLP) components. GATE allows users to handle a variety of linguistic formalisms in a common framework by means of a theory-independent annotation format for encoding metadata associated with documents.
An annotation in GATE is described by a type, a pair of nodes pointing to positions inside the document content, and a set of pairs attribute values that encode further linguistic information. An annotation layer is organised as a Directed Acyclic Graph on which the nodes are particular locations in the document content and the arcs are made out of annotations. The markup contained in the text used to create the document content is automatically extracted into a special annotation layer and can be used for processing or for exporting the document back to its original format. The annotations associated with each language resource (e.g., document) are a structure central to GATE, because they encode the language data read and produced by each language processing module. GATE also supports import and export back to the resource's original format (e.g., SGML/XML/ HTML).
In addition to providing annotations, GATE also provides support for importing, visualising, and accessing ontologies, and connect the to NLP tools.

GATE supports the process of ontology learning and population. Concerning ontology learning, GATE provides the functionalities for linguistic preprocessing of data, and it enables ontology population by harvesting instances automatically from text.
GATE is developed as part of the FP6 project SEKT.
Development status: ongoing
License type: GATE and its IE tools are freely available, under the GNU Library License, from http://gate.ac.uk.
Web site: http://gate.ac.uk
Further reading:
Documentation and academic papers available at: http://gate.ac.uk/documentation.html

3.2.2 Query languages

This subsection describes two languages for querying and transforming semantic web content
Tool name: Xcerpt and visXcerpt
Developers: S. Berger, F. Bry, S. Schaffert (University of Munich, Germany)
Type of development: academic
Functionality: (Semantic) web data querying and visual support to querying
Brief description: Xcerpt and visXcerpt are two languages for querying and transformation. Xcerpt and visXcerpt, both based on the same paradigms and principles, have been conceived for querying not only Web meta-data, but also arbitrary Web data. Xcerpt realizes these paradigms and principles textually, visXcerpt visually.
The main features of Xcerpt are pattern based query and construction of graph-structured data, possibly incomplete query patterns reflecting the heterogeneity and the semistructured nature of web data, rules relating query and construction and rule chaining enabling simple inference and query modularization. visXcerpt is merely a hypertext rendering of Xcerpt, a novel approach to realize a visual language. visXcerpt has been conceived as a mere Hypertext rendering of Xcerpt using (a slightly extended variant of)

the styling language CSS. This approach yields a visual language tightly connected to a textual language it is a rendering of.
The visual counterpart of the textual rule uses nested rectangles with name tabs to represent the nested term structure. Colours depending on the nesting depth help recognizing structures while browsing complex patterns. visXcerpt has interactive features helping for a quick understanding of large programs: boxes representing XML elements can be folded and unfolded and semantically related portions of programs (e.g. different occurrences of the same variable), can be highlighted. References (e.g. ID/IDREF references) can be followed back and forth as Hypertext links. visXcerpt programs can be composed using a novel Copy-and- Paste paradigm specifically designed for tree (or term) editing. Patterns are provided as templates to support easy construction of visXcerpt programs without in-depth prior knowledge of visXcerpt's syntax.
Moreover, they are both capable of inference. The inferences (vis)Xcerpt can perform are limited to simple inference like needed in querying database views, in logic programming, and in usual forms of Semantic Web reasoning.
Development status: prototype
License type: A prototypic implementation of Xcerpt is publicly available (licensed under GPL) at http://www.xcerpt.org. An online demonstration of visXcerpt is available in http://visxcerpt.xcerpt.org/.
Web site: http://www.xcerpt.org/about/intro/
Further reading:
[1] S. Berger, F. Bry, S. Schaffert, and C. Wieser. Xcerpt and visXcerpt: From Pattern-Based to Visual Querying of XML and Semistructured Data. *In 29th Intl. Conference on Very Large Data Bases*, 2003.
[2] S. Schaffert and F. Bry. Querying the Web Reconsidered: A Practical Introduction to Xcerpt. In *Extreme Markup Languages*, 2004.

3.2.3 Ontology search

This subsection reviews a tool that allows to find ontologies based on the terms used to define the ontology itself.

Tool name: Ontosearch
Developers: Edward Thomas, Alun Preece, Yi Zhang, Craig McKenzie, Derek Sleeman, Joe Wright (University of Aberdeen, UK)
Type of development: Academic
Functionality: Ontological search engine
Brief description: OntoSearch is an ontological search engine designed to help users find RDF based ontological information on the Semantic Web. It uses the Google API to search the available ontologies in the RDF(S), OWL and DAML (+OIL) representational formalisms. Once the Google results have been returned, each document listed is examined and summary information identifying where the terms matched the returned documents and statistical data about the size of the ontology is presented to the user to allow quick evaluation on the suitability of a large number of potential ontologies and other Semantic Web Documents.

OntoSearch is implemented as a number of specialised servlets. The SearchServlet is responsible for querying the Google database using the Google API object. The query can be expresses either through a web form or as an HTTP GET request. The results are a list of matching ontology files from Google, in a HTML file or an RDF file (depending on a variable set in the user's request).
In particular, if an HTML file is returned, this will contain several embedded frame elements which each reference the DetailsServlet. This accesses each document and examines the ontology returned and displays a list of where the search terms were found in the ontology gives information about the size of the ontology (number of classes, properties and instances) and lists the namespaces used in the ontology.
Development status: prototype, under constant development
License type: OntoSearch is freely available in http://www.ontosearch.org/
Web site: http://www.ontosearch.org/
Further reading:
[1] Zhang Y, Vasconcelos W, and Sleeman D. OntoSearch: An Ontology Search Engine: *(AI-2004) The Twenty-fourth SGAI International Conference on Innovative Techniques and Applications of Artificial Intelligence*, Cambridge.

3.2.4 Support to semantic web services

The tools reviewed in this section offer functionalities that support the development and deployment of semantic web services

Tool name: OWL-S editor
Developers: D. Elenius, G. Denker, D. Martin (SRI International, USA)
Type of development: Industrial
Functionality: Editor for the development of services in OWL-S
Brief description: OWL-S Editor is an intuitive OWL-S service development and to provide a variety of special-purpose capabilities to facilitate SWS design. OWL-S Editor is built on top of the Protégé OWL Ontology Editor, which means that users can take advantage of querying and visualizing the Knowledge Base (KB), and to export the KB to different formats. The OWL-S Editor presents the user with a tab inside Protégé as the main point of interaction. The OWL-S tab is separated into two parts. The left-hand side provides the so-called instance panes that list all instances of a service, divided into service, profile, process, and grounding instances. The right-hand side of the OWL-S tab is an editing pane that changes depending on the selection in the instance panes, to show a specialized editing mode for the chosen type of OWL-S instance.
Other functionalities are the WSDL support, Input/Output/Precondition/Result (IOPRs) management and a special window shows the relationships of all top-level
OWL-S instances graphically.
Moreover, OWL-S editor enables to visualize the control flows of a composite process, using boxes for subprocess invocation (called Performs in OWL-S), diamonds for conditional nodes (e.g., for If-Then- Else constructs), and arrows showing the flow of execution. In addition to control flow, OWL-S Editor allows to manage data flow. For example, it can represent and edit that the input of Process B being the sum of the outputs of Processes A and C.

Development status: ongoing
License type: The OWL-S Editor is available for download in both binary and source formats on http://owlseditor.semwebcentral.org.
Web site: http://owlseditor.semwebcentral.org.
Further reading:
Documentation and publications available from:
http://owlseditor.semwebcentral.org/documentation.shtml

Tool name: Semantic web services browser and composer
Developers: S. Watkins, A. Duke, M. Richardson, D. Anicic (British Telecommunications, UK)
Type of development: Industrial
Functionality: Search, retrieval, and composition of semantic web services
Brief description: The Semantic Web Services Browser and composer is a system for searching, retrieving, invoking and composing semantic web services. Using a SESAME-based registry, users can store OWL-S descriptions of web services and link them to an ontology of services categories, which is displayed in the browser.
The user can search or browse this ontology to find a service that they require. They can then invoke this service directly or use it as a basis to begin composition of a more complex service. The composition module gives the user a graphical view of the web service and allows them to select input or outputs. The system will then automatically search all other web services in the repository to find services that have semantically equivalent input/outputs, which could be linked to create a composite service. This can be repeated until the user has built the required composition. Any non-matching inputs can be entered manually, and the composition invoked. The Browser offers the facility to combine Web Services so that the data output of one service can be fed into the input of another, thus creating a new composite Web Service. Currently, the Browser assumes that the data types of these inputs and outputs are the same. More realistically, a mediation function would be required to convert between differing data types.
Development status: ongoing
Web site: Not available
Further reading: Not available

3.2.5 Support to reasoning

In this section we present reasoning tools that can be used to check consistency of ontologies, or to infer new facts.

Tool name: Kaon2
Developers: B. Motik, R. Studer (University of Karlsruhe, Germany)
Type of development: Academic
Functionality: reasoning with ontologies

Brief description: Kaon2 is a scalable reasoning tool for the semantic web, which enables practical reasoning with reasonably large ontologies. It is based on the type of description logic (SHIQ(D)) that provides the logical foundation of OWL.
Furthermore KAON2 explores a completely new approach, based on the relationship between description logics and disjunctive datalog. More concretely, given a description logic knowledge base KB, our algorithms derive a disjunctive datalog program DD(KB) which entails the same set of ground consequences as KB. In this way, query answering in KB is reduced to query answering in DD(KB).
KAON2 also supports the so-called DL-safe fragment of the Semantic Web Rule Language (SWRL). The DL SHIQ(D) and function-free rules are integrated as usual, by allowing concepts and roles to occur in rules as unary and binary predicates, respectively. It allows concepts and roles to occur in rule heads; but to achieve decidability, it requires that each variable in the rule to occur in a body literal with a predicate outside of the DL knowledge base. DL-safe rules provide means to circumvent certain expressivity drawbacks of OWL-DL without losing decidability of reasoning. KAON2 combine DL-safe rules by simply appending the rules to the program DD(KB).
Development status: prototype
License type: KAON2 is available as a precompiled binary distribution and is free of charge for research and academic purposes, from http://kaon2.semanticweb.org/.
Web site: http://kaon2.semanticweb.org/
Further reading:
[1] B. Motik, A. Maedche, and R. Volz. Optimizing Query Answering in Description Logics using Disjunctive Deductive Databases. In *10th International Workshop on Knowledge Representation meets Databases (KRDB-2003)*, Hamburg, Germany, September 15-16 2003.
[2] B. Motik, U. Sattler, and R. Studer. Query Answering for OWL-DL with Rules. *In S. A. McIlraith, D. Plexousakis, and F. van Harmelen, editors, Proc. Of the 3rd Int. Semantic Web Conf. (ISWC 2004)*, volume 3298 of Lecture Notes in Computer Science, pages 549–563, Hiroshima, Japan, 2004. Springer.

Tool name: dlpconvert
Developers: B. Motik, D. Vrandecic, P. Hitzler, Y. Sure, R. Studer (University of Karlsruhe, Germany)
Type of development: Academic
Functionality: Converts fragments of Description Logic Programs (DLP) encoded in OWL into logic programming syntax.
Brief description: dlpconvert is a tool that allows to convert OWL encoded DLP fragments into logic programming syntax, as used by standard Prolog systems. The DLP fragment is the intersection—in an intuitive sense — of OWL DL and (Horn) logic programming. As such it imposes certain constraints on OWL DL in order to guarantee that all axioms stated are transformable in an efficient way to Horn clauses, i.e. rules in the sense of traditional logic programming.
dlpconvert is based on the algorithms for reducing description logics to Datalog implemented in KAON2. It reads in an OWL ontology, reduces it to disjunctive Datalog, if possible, and finally serialises it into a logic program, which can be used for easier reading and thus understanding by people with an appropriate logic background or as

input for Prolog interpreters. dlpconvert comes as a command line tool, implemented in Java, with numerous switches for different kinds of name transformations and serialisation options. It can be used to convert an OWL DL file directly into a Prolog program file that can be consumed by a Prolog interpreter. In addition to the command line tool, there is a Tomcat-powered online conversion available on the DLP website, which is a thin wrapper around the dlpconvert java package. One may choose to either supply a URL for an ontology, upload a file from the local hard disk or even write (or copy and paste) an ontology directly into the website. The ontology will be converted and the result shown within an HTML page.

Development status: prototype

License type: An online demo of dlpconvert is available in http://logic.aifb.uni-karlsruhe.de/dlpconvert/.

Web site: http://logic.aifb.uni-karlsruhe.de/dlpconvert/.

Further reading:

[1] Hustadt, U., Motik, B., Sattler, U.: Reducing SHIQDescription Logic to Disjunctive Datalog Programs. In *Dubois, D., Welty, C., Williams, M.A., eds.: Proc. Of KR2004*, Menlo Park, California, USA, AAAI Press
(2004) 152–162

[2] Hustadt, U., Motik, B., Sattler, U.: Reasoning for Description Logics around SHIQ in a Resolution Framework. *Technical Report 3-8-04/04*, FZI, Karlsruhe, Germany (2004)
http://www.fzi.de/wim/publikationen.php?id=1172.

4. Semantic Web Days

Semantic Web Days[7] was a joint event co-organised by Knowledge Web and REWERSE with the objective to offer "*a forum for innovative companies and research institutions with the strong desire to accelerate the uptake of Semantic Web technologies. A major goal of the two-day conference was to present the latest Semantic Web technologies which are very promising or already in use*". In particular, this forum aimed at assessing the degree of maturity of the various semantic web technologies currently available i.e. Ontology, Reasoning, Business rules, facing real needs in industry i.e. data, services and business automated integration.

In this deliverable we review the Semantic Web Days meeting in order to provide a an overview of the technology currently available from the perspective of industry. The reminder of this section reviews some of the talks presented at the Semantic Days meeting, and outlines the main argument in favour or challenging the uptake of Semantic Web technology from industry.

The meeting comprised a number of presentations made by invited speakers and a technology exhibition, where company could set up stands and advertise their products. Among the presenters and exhibitors at this event, there were representatives of medium or large companies that are involved in developing semantic web technology, including the World Wide Web consortium, Siemens, Elsevier, SAP, etc.

From the presentations and the panel session, it emerges clearly that Semantic Web is considered worth exploring by many companies, however the level of maturity of some of the technologies is considered a possible obstacle for the uptake of the technology. An example of this is given by technologies for reasoning on the Semantic Web. In his presentation Massimo Marchiori (W3C) outlined how reasoning is necessary for the web, as it provides means for "programming" the web. However, the intrinsic data handling cost for a flexible environment are high, and are growing linearly with the size of the web, therefore becoming potentially huge. Silvie Spreeuwenberg (LibRT) made a case for representing and offering support to business rules on the SW. Her talk outlined the underlying similarity between business and SW rules, however business rules are implementation independent, and they need to be transformed into platform and/or technology specific models. But the main difference between business and SW rules is that while the former are intended to be read by human, SW rules are meant to be machine readable, and she argued for better cooperation between different practitioners in order to help capture semantics of real-world domains.

Also Donald Baisley's talk (Unisys) focussed on business rules and on the standardisation effort undertaken by the OMG in order to create a vocabulary for talking

[7] Semantic Web Days website: http://www.semantic-web-days.net/

about meaning, vocabularies and business rules, and a model and XML format for representing the semantics of vocabularies and business rules.

Another interesting aspect that emerged from the presentations and the discussion concerns the possible industrial applications of Semantic web technology.

Herman, from Siemens AG gave a keynote speech in which he identified the role of Semantic Web technologies in knowledge management at Siemens. His talk highlighted how Semantic Web technology allows the transition from internal management of knowledge based on ontologies to the development of corporate technologies. Siemens is currently working on using Semantic Web technology for portfolio management (ontologies), developing a repository of business services (Semantic Web services), and for the advanced modelling of medical ontologies.

In particular, portfolio management consists in the provision of comprehensive customer packages (e.g. for the Athens Olympic Games) obtained by combining solutions offered by different parts of Siemens. In these types of applications ontologies are used to help with achieving a common understanding of domain terminologies, of organisational structures, and finally common processes.
Siemens' interest in medical ontologies is aimed at providing ontological representations for those conditions that are classified using traditional approaches, but for which no canonical systems has been provided (e.g. ontologies for genes, tumours). These ontologies are then to be used in order to develop individually optimised therapies by using pattern matching for identifying the most suitable therapy.

Other speakers presented how their companies are making use of semantic web technology in order to create added value. Anita de Waard presented the experiences made at Elsevier. Her talk focussed on the way in which scientific publications can be published in more structured ways, where semantic information can be used to organised knowledge around defined terms, or to have modular documents, where linear, narrative text is interlinked with descriptions of relevant objects. In short, semantic web technology allows to separate knowledge from the descriptive text, and to link with existing knowledge, by using metadata to link to other documents.

There were also presentations by companies that are making profit from the development of semantic web technologies, such as Ontotext and Sirma. In both cases the speakers used an application (automotive and engineering industry for Ontotext and Recruitment Intelligence) to demonstrate the usefulness of the technology they develop.

Finally, there were several applications centred on the use of semantic web technologies for supporting specific application areas, and in particular semantic web services in industry and life science. With respect to the semantic web services area it was argued that adding semantics to conventional web services it ensures modularity, independence and robustness thus allowing them to scale.

It was also argued that semantic web services need the representation of procedural

knowledge through rules, in order to provide some form of programming necessary to express constraints, usage, and to enable composition. But rules need to be expressed in an interchangeable format.

Life science applications have made extensive use of semantic web technologies that are needed for dealing with the enormous quantity of data available in life science, where the bottleneck in information integration has a noticeable impact on the success of the applications. Semantic web technology is mainly used for improving the results of search engines, to model the complex interactions emerging from protein analysis, but, most importantly to unify the view on the different domain ontologies.

5. Analysis and conclusions

In this deliverable we have reported on two events organised by workpackage 1.4 in Knowledge Web whose aim is to provide technology recommendations for the uptake of semantic web technology by industrial organisations.
The main event we reported on is the technology show, organised as part of the 3rd European Semantic Web Conference, for which we provided a classification of the main systems demonstrated during the technology show, together with a short description of their functionalities and details regarding the development status and the type of distribution license, when possible.

The technology show provided us with a sample of the range of the types of applications and tools that are currently being developed, where by applications we refer to systems that are aimed to an end-user, whereas by tools we denote those systems that are used in order to use semantic web technology within applications. Firstly, with respect to last year, we have witnessed an impressive growth in the number of systems presented at the technology show, with 22 systems presented in total versus the 9 presented last year, as illustrated in Figure 1. Of these 22 systems, the majority was still composed by applications (13 systems), thus confirming the trend already seen last year.

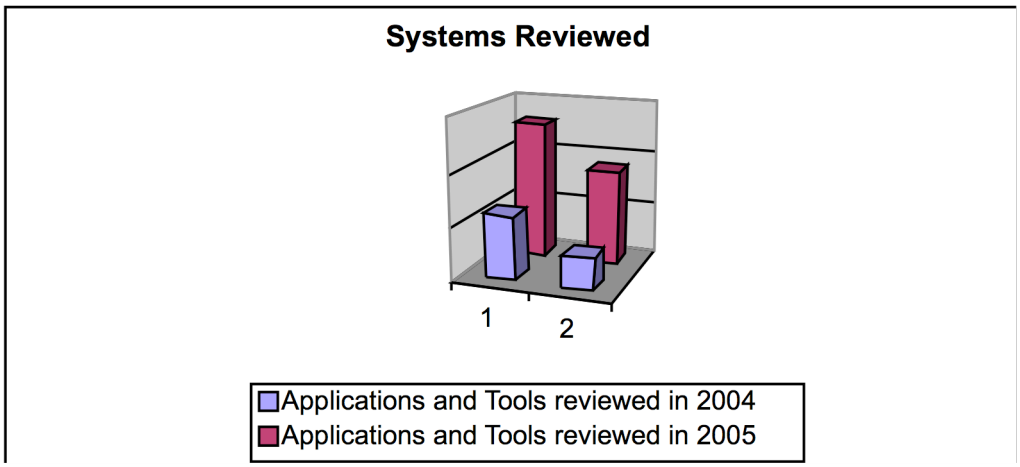

Figure 1. The systems presented in 2004 with respect to the systems presented in 2005

For what concerns applications, we could clearly identify common objectives, which are linked to those areas where there seem to be a clear need for the development of technological solutions. One of these areas is the support to search engines that exploit semantic web representations in order to provide a better service to the user. Another area that received much attention is the development of environments for collaborative work, or in general for enabling sharing of information among communities with similar interests. Closely related to this application area is the development of semantic portals and personalised browsers. Similarly to last year, the extent to which these applications

make use of semantic web technology is very diverse, and ranges from systems using ontologies expressed in OWL (Lite or DL) in order to provide a common terminology for the main terms used to describe a domain, to complex combinations of semantic annotations, ontologies and reasoners, used to infer knew facts, from those already expressed by the annotations. This lead us to believe that it is still unclear what characterising features make a simple piece of software a true semantic web application, and that this will become more evident with the more widespread use of semantic web.

In contrast, the problems addressed by the various tools presented at the technology show are more clearly identifiable. The tools focussed on providing support for ontology learning from digital resources, natural language processing, automatic annotation of web resources, reasoning, and web service representation and composition. Interestingly, there was some continuity with respect to the tools presented last year, since most of the tools presented at this technology show demonstrated either the addition of new functionalities, or an improvement in usability. This aspect confirms that there is a growing interest in taking these tools away from research development environments and to use them to support the development of complex applications. Indeed, most of the tools are made available under some sort of public license.

Another interesting aspect emerging from the technology show concerns the organisations developing these tools. Whilst during last year technology show the systems demonstrated were mainly developed by academic researchers, this year there was a definite increase in the number of companies that participated to the exhibition with either systems developed as part of their research activities, or systems to be commercialised in a near future. But, more importantly, industrial organisations were among the developers of semantic web tools, thus showing that there is a growing market for this type of technology. Interestingly, the vast majority of the systems was developed in the framework of some EU funded project (Figure 2), showing how European funded research provides also impulse for industrial research activities.

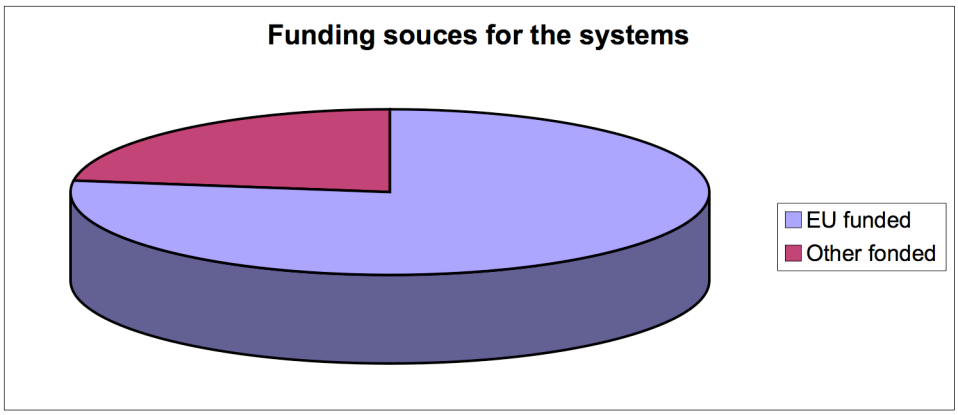

Figure 2. Funding sources for the systems presented

In addition, European funding seems to act as an enabling factor in the development of technology throughout Europe, and to foster collaboration between different organisations illustrated in Figure 3.

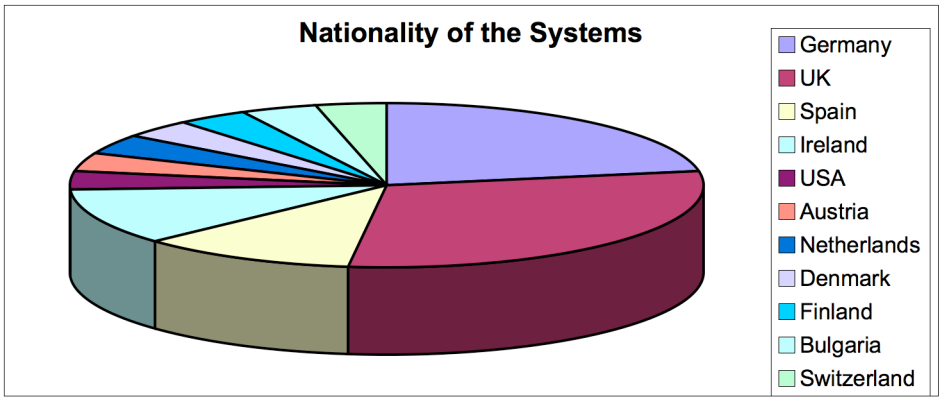

Figure 3. Nationality of the organisations developing the systems

However, the technology shows is only one side of the coin, and in order to get a more objective evaluation of how the technology currently developed is perceived by commercial and industrial organisations, we report here on some of the findings that emerged from the "Semantic web days" meeting.

The interest from mainstream companies emerged clearly from the "Semantic web days" meeting, however their perception of what is currently available is that Semantic web technology can be used to achieve some sort of semantic coherence within applications, indeed the chief application areas for ontologies as well as for other semantic web technologies are information application and knowledge management. However, the perception is also that current solutions mainly exist in the form of pilot studies, but there are very few major industrial projects, and indeed it was argued that somehow the promoters of the Semantic Web are still not offering targeted solutions. In particular, the tools offered are perceived as lacking appeal to end users, especially because they do not target specific types of users.

It is clear that defining what is semantic web technology and what is the added value that comes from its use it is still a problem, and that other approaches are available to companies, and therefore the SW community should learn to differentiate their offer. However, it was recognised the power of the Semantic Web approach as well as the need for catching-up.

To conclude, the analysis of what emerged from the two main exhibitions of semantic web technology lead us to believe that there is still a clear need for technology shows where the real potential for semantic web technology is demonstrated. The technology shows that took place in 2005 demonstrated that there are a growing number of applications that are being deployed through the use of semantic web technology. In addition, semantic web tools are becoming more stable, and an effort is made in order to add new functionalities and to make them more appealing to users. However, one criticism that emerged from the "Semantic Web days meeting" is that the tools need to be made even more appealing for end users, in order to widen the uptake of semantic web technology.

These shows should aim at engaging more industrial and commercial organisations, as only few major applications of semantic web technology are currently deployed by industrial organisations.

In addition to trying to involve more closely industrial players, we will make available the descriptions of the systems reviewed in this deliverable on the Knowledge Web portal, in order to provide a point of reference for the technology described in this deliverable

6. Bibliography

[D1.4.3 v1]: Knud Möller & Ellen Schulten: "Technology Road Show Report", Deliverable 1.4.3 v1, Knowledge Web