PROJECT FINAL REPORT

Grant Agreement number:	222011
Project acronym:	ONTOWIKI
Project title:	Semantic Collaboration for Enterprise Knowledge Management, E-Learning and E-Tourism
Funding Scheme:	Project targeted to special groups such as SMEs and other smaller actors
Period covered:	**from** 1.11.2008 **to** 31.10.2010

Name of the scientific representative of the project's co-ordinator, Title and Organisation:

Dr. Sören Auer, Universität Leipzig

Tel: +49 341 97-32367

Fax: +49 341 97-32329

E-mail: auer@uni-leipzig.de

Project website address: http://ontowiki.eu

4.1 Final publishable summary report

Executive Summary

The aim of the OntoWiki project was to substantially advance and adapt the semantic collaboration software OntoWiki for the three different target domains Enterprise Knowledge Management, E-Learning and E-Tourism.
OntoWiki was originally developed by the research group AKSW at Universität Leipzig. OntoWiki is open-source software and a Web application, which can be installed at any Web space and accessed by an ordinary Web browser. OntoWiki facilitates the visual presentation of a knowledge base as an information map, with different views on instance data. It enables intuitive authoring of semantic content, with an inline editing mode for editing semantic content, similar to WYSIWIG for text documents. In the spirit of the Wiki idea, OntoWiki's central aim is to establish an *architecture of participation*, where interested people can contribute information as easy as possible and which allows users to add value to the system as they use it. However, different than classic Wikis OntoWiki's fundamental artefacts are not texts, but semantic representations based on the RDF statement paradigm. In addition to that, OntoWiki fosters social collaboration aspects by keeping track of changes, allowing commenting and discussing every single part of a knowledge base, enabling to rate and measuring the popularity of content and honouring the activity of users. OntoWiki enhances the browsing and retrieval by offering semantic enhanced search strategies. All these techniques are applied with the ultimate goal of decreasing the entrance barrier for projects and domain experts to collaborate using semantic technologies. The main challenges addressed by the project were:

- Extending the Virtuoso triple store into a versatile knowledge store component supporting the distribution and federation,
- Implementing of a strategy for social semantic collaboration based on knowledge structuring, enrichment and provenance,
- Integration of OntoWiki with the SME partners software products for Enterprise Knowledge Management,
- Advancement of OntoWiki as a platform for the creation and management of semantic E-Learning as well as E-Tourism content.

In addition to extending and integrating software products of the SME partners with OntoWiki, the consortium was releasing a number of additional software components as open-source to the wider-public. This includes various Virtuoso and OntoWiki releases as well as releases of the Erfurt Semantic Web API, the LESS - Leipzig Semantic Syndication, the SPARQL Adaptive Query Cache, the linked data authoring library RDFauthor, the notification service Semantic Pingback as well as the EvoPat- Evolution Patterns engine. The source code as well as installation archives are available at major open-source repositories such as Sourceforge.net and Google Code.

In the course of the project the consortium has published more than 30 scientific publications in renowned journals and at major international conferences. The OntoWiki consortium members released a large number of informal publications (such as blog posts etc.) through their Web dissemination channels as well as presentations and videos on platforms such as Slideshare and Videolectures. To facilitate the dissemination of the results the OntoWiki consortium co-organized a number of events such as Leipziger Semantic Web Tag 2009 and 2010, International Conference on Semantic Systems (I-Semantics) 2009 and 2010, Triplification Challenge 2009 and 2010, Workshop on Scripting for the Semantic Web 2009 and 2010, Vienna Semantic Web Meetups, LinkedDataCamps and others. An important aspect of disseminating expertise and knowledge gained within the project is through the curricula of students studying at the academic institutions participating in the project.

Summary description of project context and objectives

The aim of this project was to advance and exploit the semantic collaboration software OntoWiki in three different target markets. The selection of the target markets and respective application domains as well as the involved SMEs representing these application domains in the project were the result of experiences with OntoWiki's existing user community. The participating SMEs are active users, multipliers and system integrators for OntoWiki and are eager to start a commercial exploitation in their respective application domains and markets.

- **Openlink** is developing and selling database, data integration and collaboration solutions to its customers in the European and North American markets and extends its offerings (by bundling its database Virtuoso with OntoWiki) towards semantic collaboration and knowledge store.
- **BI** extended its product for enterprise collaboration and knowledge management Trilith with the semantic collaboration functionality of OntoWiki. As in the case of OpenLink, BI's application domain and target market is semantic enhanced Enterprise Knowledge Management.
- **B2** is market leader for education, training and E-Learning in Slovenia and (a) exploits the possibilities of semantic annotation and structuring for E-Learning content and (b) broadens its existing training offerings with curricula about semantic technologies.
- **PUNKT** is a specialist for developing custom Web applications and content management solutions based on their CMS product CONX. PUNKT is an active OntoWiki integrator, has a large number of customers in the content, knowledge management & tourism sector and integrated their CMS product with OntoWiki.
- **Vakantieland** provides a very successful and comprehensive tourism information portal for the Netherlands and transformed this portal into a semantic collaboration platform around tourism content based on the OntoWiki software and aims to transfer its business model to other counties.

All these participating SMEs have the need to either integrate semantic functionality (such as taxonomy authoring or semantic based search) into their products and most of them are already active OntoWiki users but need additional functionality, extensions and adoptions in order to successfully start-up the OntoWiki exploitation within their markets. The participating RTD performers (InfAI and CUAS) are world-leaders regarding semantic collaborative applications, E-Learning, Knowledge Management and market adoptions and have the exactly required expertise to research and develop these extensions and adoptions for the SME participants (in fact InfAI hosts the OntoWiki development team).

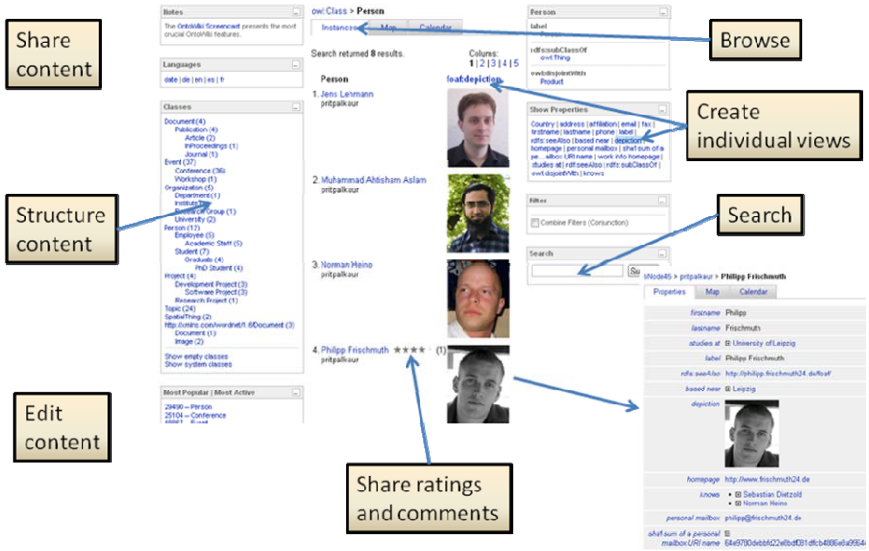

Figure 1: The OntoWiki approach: effortless, semantic collaboration.

The semantic collaboration platform OntoWiki

OntoWiki is a comprehensive semantic collaboration platform, which was developed by the research group AKSW at InfAI. On-

toWiki is open-source software and a Web application, which can be installed at any Web space and accessed by an ordinary Web browser. OntoWiki facilitates the visual presentation of a knowledge base as an information map, with different views on instance data. It enables intuitive authoring of semantic content, with an inline editing mode for editing semantic content, similar to WYSIWIG for text documents.
In the spirit of the Wiki idea, OntoWiki's central aim is to establish an *architecture of participation*, where interested people can contribute information as easy as possible and which allows users to add value to the system as they use it. However, different than classic Wikis OntoWiki's fundamental artefacts are not texts, but semantic representations based on the RDF statement paradigm. In addition to that, OntoWiki fosters social collaboration aspects by keeping track of changes, allowing commenting and discussing every single part of a knowledge base, enabling to rate and measuring the popularity of content and honouring the activity of users. OntoWiki enhances the browsing and retrieval by offering semantic enhanced search strategies. All these techniques are applied with the ultimate goal of decreasing the entrance barrier for projects and domain experts to collaborate using semantic technologies.

Project objectives

The objectives of this OntoWiki project are based on the hypothesis that comprehensive Knowledge Engineering techniques are rarely used within large Enterprises and almost never in SMEs – more lightweight adaptive Knowledge Engineering methods are needed to be useful in the SME setting. Building blocks to realise such a light-weight adaptive Knowledge Engineering for SMEs are methods of social semantic collaboration, scalable knowledge stores and techniques for intelligent search and revealing of emergent semantics. The aim of the OntoWiki project is to integrate these building blocks within a product grade software solution and to rigorously adopt the solution for the use within three application scenarios.

Towards Adaptive Knowledge Engineering

Within OntoWiki we will (inspired by adaptive methodologies in other domains) rethink the way how knowledge bases are created and develop methods for knowledge engineering, which are light-weight, adaptive and promote self-organization.

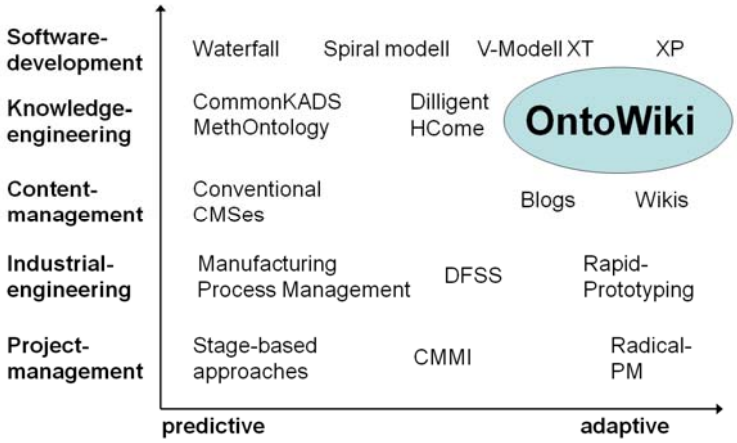

Figure 2: Methodologies: adaptive vs. predictive.

Examples from Software Development, Communication and Knowledge Management show that support for agile collaboration scenarios has an *enormous potential for reduction of resources, reduction of development times and increase of quality*. For example in Software Engineering the shift towards higher adaptivity of processes has started long ago with methodologies like eXtreme Programming, Scrum and Adaptive Software Development. These individual approaches were later unified by the "Manifesto for Agile Software Development".[1] Subsequently, agile methods in software engineering led to the creation of complex software applications such as the GNU/Linux operating system, the Mozilla Firefox Web browser, or the office software OpenOffice. But the success of adaptive methodologies is by far not limited to Software Engineering: Just recently, adaptive com-

[1] http://agilemanifesto.org

munication methods of social software (such as Weblogs, Skype or LinkedIn) enabled entirely new communication patterns. The domain of collaborative publishing and Content Management was revolutionized by Weblog and Wiki technologies, which resulted in far reaching news networks without central control and made the creation of the most comprehensive encyclopaedia, which is edited solely by volunteers, possible - Wikipedia. The development in OntoWiki facilitate more sophisticated social collaboration scenarios, enabling various groups of SMEs not only to participate in creating content (as in Wikis), but also to perform other tasks such as semantic based search and querying.

Enabling Large Scale Social Semantic Collaboration

In order to exploit the infrastructural achievements and technological building blocks of the Semantic Web for semantic collaboration, we employ participative strategies (based on the adaptive knowledge engineering methodology) for the organizing of content and knowledge. According to the needs of the target user communities this aims at the integration of prospective end-users into the process of knowledge representation, as well as other forms of interlinking, curating and rating content.
This OntoWiki novelty shall be achieved by adopting and exploiting strategies commonly subsumed under the concept Web 2.0, such as:

- *Folksonomies:* Content annotation by means of tags (i.e. self-describing attributes attached to content objects) enable the fuzzy but intuitive organization of comprehensive content bases. Tag clouds visualize tags to support navigation and filtering.
- *Architecture of Participation*: The usage of an application already creates an added value. For example, the added value can be generated by interactively evaluating usage statistics to determine popular content objects or by collecting ratings from users to classify content with respect to quality.
- *Instant-Gratification*: Active users are rewarded with enhanced functionality and their reputation in the user community is visibly increased. This promotes contributions and helps to establish a collaboration culture.
- *Mashups and Feeds*: The content collected in the system is syndicated for other services (e.g. as RSS feeds, JSON exports or public REST APIs). This allows seamless integration of different data end transforms the Web into a Service Oriented Architecture.

We will employ such participative collaboration strategies to hide the complexity of semantic knowledge representation from end users and to make (possible minor) user contributions as easy as possible. OntoWiki will also go beyond these developments by providing novel approaches for capturing expert knowledge about a variety of knowledge and content artefacts (e.g. product requirements, music, video tutorial, songs, support FAQs etc.).

Robust Knowledge Systems

Traditional databases technology focuses on data storage and access according to fixed data schemes (i.e. relational data model). In the course of the standardisation of Knowledge Representation techniques within the Semantic Web initiative, standards such as RDF, RDF-Schema and OWL (all basing on the triple or statement data model) emerged and are increasingly used. Hence, there is an increasing need for reliable and robust storage backends dealing with data, information and knowledge adhering to the triple data model. As a consequence Database Management Systems (DBMS) were enhanced with knowledge store capabilities (e.g. Oracle, OpenLink's Virtuoso) and specialized solutions were developed (e.g. Sesame, OWLIM) aiming at dramatically increased schema flexibility and capable to handle large knowledge bases adhering to the Semantic Web knowledge representation standards. However, the mentioned knowledge stores so far only focus on storing and querying RDF based knowledge bases. They do not provide support for higher level vocabularies (such as OWL or

SWRL), the distribution and federation of knowledge stores is not yet tackled and approaches for knowledge evolution, provenance and scalable reasoning were still in their infancy.
In OntoWiki, we contributed to making knowledge store technologies more robust and versatile by investigating and implementing methods for integrated vocabulary support, scalable reasoning, distributed querying and knowledge store federation. These developments aim at producing robust open-source implementations. They will be performed with the awareness that the Semantic Web storage and query infrastructure needs to adapt itself to a broad range of scenarios, from decentralized interconnecting islands of specialized data servers to large search engine style data centers.

Intelligent search and revealing of emergent semantics

More semantically comprehensive knowledge bases enable superior search techniques. However, the complexity of semantic representations should be hidden from laic users as much as possible. For the user friendly exploration of large content and knowledge bases we extend methods for facet-based browsing by making them scale to DLs in the size of Wikipedia. To make them even easier to use by inexperienced users we develop highly scalable search methods combining key word search with faced-based browsing. The DBpedia community effort (co-led by InfAI and OpenLink) extracts structured information from Wikipedia and makes this information available on the Web. It currently already contains a tremendous amount of valuable knowledge extracted from Wikipedia - currently ca. 1 Billion RDF statements containing cleanly structured knowledge about almost every possible information domain. The DBpedia extraction methods are enhanced and refined within the OntoWiki project. The resulting multi-domain vocabulary will be used in the OntoWiki use cases.

Lift OntoWiki from beta status to commercial product grade

OntoWiki is working software, designed and implemented on the basis of state of the art technology. However due to OntoWiki's origin as a research project certain aspects of the software are improved in order built the basis for commercial grade products. These include:

- Documentation for end-users, administrators, developers
- UI design, localisation
- Bootstrapping of an extension and domain adoption eco-system
- Integration with widely deployed standard software (e.g. CMS, ERP, CRM, project management)

Hence, developments in these areas facilitate the shift the OntoWiki software from its current beta status to a commercial grade product. Driven by the OntoWiki use cases Enterprise Knowledge Management, E-Learning and E-Tourism we create, extend and adopt knowledge structures to efficiently capture domain knowledge in these areas. Domain specific extensions, views, widgets, templates and plug-ins are developed for OntoWiki in order for the software to be instantly applicable for end-users.

Description of the main S&T results/foregrounds

The main results of the FP7-SME-OntoWiki project are an extended Virtuoso knowledge store, which is well integrated with the OntoWiki user interface and semantic web application development framework. OntoWiki itself was substantially extended and in the course of the project both in terms of stability and robustness as well as with regard to additional features (particularly with regard to social semantic collaboration: structuring, enrichment & provenance). Besides these core research and development results, the OntoWiki platform was adopted for and evaluated within the three use cases Enterprise Knowledge Management, E-Learning and E-Tourism. In the following we describe these results in more detail.

Extended Virtuoso Universal Server

Virtuoso Universal Server is a new generation middleware and database engine hybrid that combines the functionality of a traditional RDBMS, ORDBMS, RDF, XML, Free Text, Web Application Server, and File Server functionality in a single server product offering. Rather than have dedicated servers for each of the aforementioned functionality realms, Virtuoso delivers a single (multi-threaded) server process that implements multiple protocols. The most prominent installation of the Virtuoso Universal Server is maintained by OpenLink and hosts the DBpedia data set and the whole Linked Open Data Cloud in a cluster. This installation contains several billion triples and showcases the scalability and versatility of the Universal Server as it is queried by thousands of clients daily from all across the Semantic Web. According to the measurements employed by the Berlin SPARQL Benchmark (BSBM) Virtuoso is a competitive RDF store, which implements the SPARQL and SPARUL protocol and contains several useful additions. Alongside the commercial version, an Open Source Version is regularly released at http://sf.net/projects/virtuoso. This Open Source version is of special interest here, as it can be downloaded, installed and distributed the same way as OntoWiki with respect to the licence. Therefore we will refer to the Open Source version as "Virtuoso Open Source" (VOS) or just "Virtuoso" in the following.

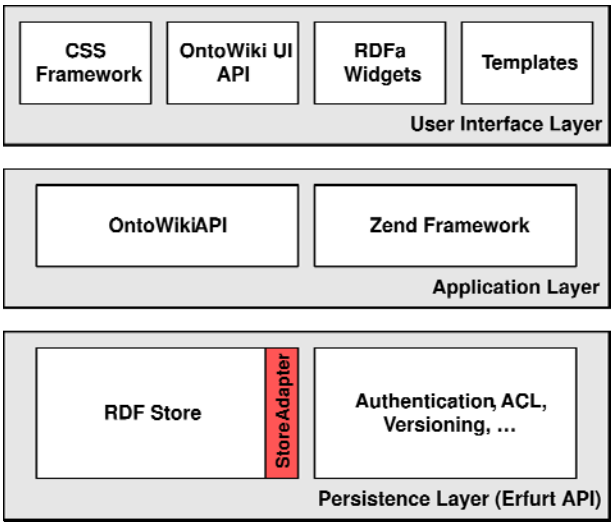

Figure 3: The layered architecture of OntoWiki. The Store Adapter in the lower part is highlighted.

OntoWiki Integration. During the course of the project the application architecture of OntoWiki was generalised to accommodate several stores (see Figure 3). An adapter was created to enable users of OntoWiki to use Virtuoso as an underlying store. The adapter uses the ODBC interface provided by Virtuoso, which was rigorously tested and improved as a result of the versatile requirements

imposed by OntoWiki. OpenLink is contributing to two widely employed and publicly available Open Source projects, the iODBC driver as well as the PHP-ODBC API. Both these were tested and extended. In addition several additional functions implemented by Virtuoso such as the String search were integrated into OntoWiki and made available via the User Interface.

Developed Virtuoso Features

Facets web service and faceted browsing. The Virtuoso Facets web service is a general purpose RDF query facility for facet based browsing. It takes an XML description of the desired view, and generates the reply as an XML tree containing the requested data. The user agent or a local web page can use XSLT for rendering this for the end user. An API was developed to programmatically access the faceted browsing features and made public.

Partial Result Sets – 'Anytime' queries. Unlike relational database semantics, the Semantic Web operates on the Open World Assumption. This is consistent with the returning of partial result sets for queries. Especially with SPARQL, queries can achieve a new order of complexity. The feature enables the publishing of open data sets while still allowing to limit resource consumption. A time limit for queries can be given and partial result sets are returned, if this limit is reached. This feature is important for the autocomplete function of the Query Builder.

Inference Capabilities. Virtuoso SPARQL can use an inference context for inferring triples that are not physically stored. Such an inference context can be built from one or more graphs containing RDF Schema triples. The supported RDF Schema or OWL constraints are imported from these graphs and are grouped together into rule bases. A rule base is a persistent entity that can be referenced by a SPARQL query or end point. Queries running with a given rule base work as if the triples asserted by this rule base were included in the graph or graphs accessed by the query. As of version 6.0, Virtuoso recognizes `rdfs:subClassOf` and `rdfs:subPropertyOf`. `owl:sameAs` is considered for arbitrary subjects and objects, if specially enabled by a pragma in the query; `owl:sameAs`, `owl:equivalentClass` and `owl:equivalentProperty` are also considered when determining subclass or subproperty relations. If two classes are equivalent, they share all instances, subclasses and superclasses directly or indirectly stated in the data for either class. Other RDF Schema or OWL information is not yet taken into account. These features were extended by identity by inverse-functional properties and transitive subqueries in both SQL and SPARQL and thoroughly tested during the course of the project. A feature branch of OntoWiki supports the reasoning capabilities of Virtuoso and allows employment in the OntoWiki UI.

PHP SAPI module for Virtuoso. OpenLink Virtuoso has the capability to act as a host for PHP applications. Where you're currently used to seeing a LAMP (Linux, Apache, MySQL, PHP) stack, Virtuoso can do the job of both Apache as web-server and MySQL as database. The PHP server extension allows Virtuoso to execute PHP pages stored in the file system or in Virtuoso's WebDAV repository. The PHP SAPI module is a prerequisite for the VAD.

VAD - Virtuoso Application Distribution. VAD provides a package distribution framework for installation, management, dependency checking and un-installation of Virtuoso applications. A VAD package contains all required Virtuoso components, which would constitute an application or hosted solution, within a single distributable file. By releasing OntoWiki as a VAD, the installation procedure on an instance of Virtuoso is greatly simplified and thus encourages adoption.

DBpedia Live Extraction

DBpedia is a community effort to extract structured information from Wikipedia and to make this information available on the Web. DBpedia allows to ask sophisticated queries against Wikipedia, and to link other data sets on the Web to Wikipedia data. The DBpedia knowledge base currently describes more than 3.4 million things, out of which 1.5 million are classified in a consistent Ontology. Altogether it consists of over 1 billion pieces of information (RDF triples) out of which 257 million

were extracted from the English edition of Wikipedia and 766 million were extracted from other language editions. The DBpedia knowledge base has several advantages over existing knowledge bases: it covers many domains; it represents real community agreement; it automatically evolves as Wikipedia changes, and it is truly multilingual. Altogether, the use cases of the DBpedia knowledge base are widespread and range from enterprise knowledge management, over Web search to revolutionizing Wikipedia search.

Contributions of this project. So far the DBpedia project has succeeded in creating one of the largest knowledge bases on the Data Web, which is used in many applications and research prototypes. However, the heavy-weight extraction process has been a drawback. It required manual effort to produce a new release and the extracted information is not up-to-date. We extended DBpedia with a live extraction framework, which is capable of processing tens of thousands of changes per day in order to consume the constant stream of Wikipedia updates. This allows direct modifications of the knowledge base and closer interaction of users with DBpedia. Additionally, a system was developed to allow the DBpedia and Wikipedia community itself to take part in the DBpedia ontology engineering process and an interactive round-trip engineering between Wikipedia and DBpedia is made possible.

DBpedia Live Extraction. As DBpedia is based on the Wikipedia dumps, the release cycle of DBpedia depends on downloadable database dumps from Wikipedia. The consortium received access from the WikiMedia foundation to a live update stream, which allows creating DBpedia releases more frequently and independent of the Wikipedia dumps (see Figure 4). The approximately 100.000 daily article updates by editors on Wikipedia can be retrieved via this update stream and are transformed by the DBpedia extraction framework and then loaded into a Semantic Web triple store hosted by OpenLink (Virtuoso). This means that there exists a synchronized version of DBpedia which can be queried via the public service at http://dbpedia-live.openlinksw.com/sparql. There also exists a statistics page at http://stats.dbpedia.org, which shows the last articles edited in Wikipedia and how many triples were extracted. Effectively, this allows editing DBpedia directly by making changes to Wikipedia. Direct edit links are included in the RDF to allow for round-trip editing.

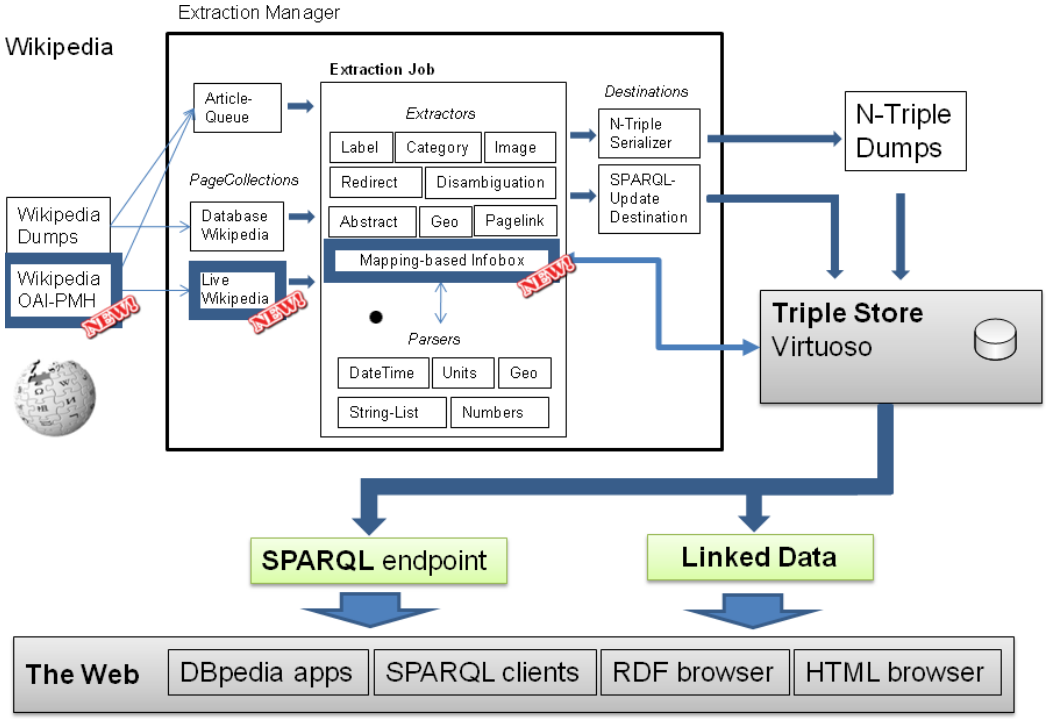

Figure 4: Changes made to the DBpedia Extraction Framework (available as Open Source).

Integration of the Community. The former DBpedia Ontology was engineered and maintained by a small engineering team. Based on achieved work in this project, a Mappings Wiki was created to map properties from the infobox templates on Wikipedia to the 1000 OWL properties in the DBpedia Ontology. Also OWL classes can be assigned to infobox templates. Formerly, the mapping (which is now editable on the Mappings Wiki) was kept in a local and closed database. The information in the database was re-engineered and transformed into MediaWiki templates. The DBpedia community as well as the Wikipedia community can now directly contribute and model data contained in DBpedia. The Mappings Wiki at http://mappings.dbpedia.org has increased the number of active Ontology Engineers from an initial small team of 5 people to a total of 74. Also mappings for 6 languages (de, pt, hu, sl, hr, el) were created by volunteers and contributed to the DBpedia project.

Social semantic collaboration: structuring, enrichment & provenance

Adaptive Ontology Engineering. In order to lift the adaptive collaboration and communication patterns of Social Software and the Web 2.0 towards a truly semantic collaboration we developed an adaptive knowledge engineering methodology called AdaptiveOE. It is inspired by adaptive software development methodologies from software engineering and emphasizes support for small end-user contributions to knowledge bases. While the adaptive methodology proves useful in general, special tool support is needed for agile formalization of knowledge. The AdaptiveOE methodology has been adopted by the design of the OntoWiki extensions described below.

Collaborative Tagging, Annotation & Facet-based Browsing. We extended OntoWiki with multiple extensions to allow collaborative tagging, annotation and facet-based browsing.
Tagging in OntoWiki knowledge bases is the first step in an evolutionary process to create rich semantic annotations. Since there is no generally accepted RDF schema for representing tags in RDF, the OntoWiki tagging extension supports different tagging schemata including tags as resources. In addition to that, OntoWiki tags can be extended with additional metadata to support a smooth transition from tags to attributes or relations in a knowledge base. The annotation component in OntoWiki now supports the following annotation and editing use cases:

- Users should be able to annotate resources with tags, comments, notes and specific domain attributes.
- Users should be able to annotate local resources as well as non-local resources (e.g. resources which are imported via linked data or other external resources as images and videos on the web)
- In the case of annotating non-local resources, pingback information should be transferred over the network to communicate the annotations (see Semantic Pingback below).
- Incoming pingback messages should also be handled, i. e. a reverse link to the annotating external resource should be saved.

Semantic Pingback. In order to communicate annotations between OntoWiki resources and external resources, we developed the Semantic Pingback mechanism. Semantic Pingback tackles the *quality*, *timeliness* and *coherence* as well as *direct end user benefits* of the emerging Linked Data Web. Semantic Pingback extends the well-known Pingback method, which is a technological cornerstone of the blogosphere. It is based on the advertising of an RPC service for propagating typed RDF links between Data Web resources. It is downwards compatible with conventional Pingback implementations, thus allowing to connect and interlink resources on the Social Web with resources on the Data Web. We extended OntoWiki to allow sending as well as receiving Semantic Pingback requests.

Facet-based browsing enhancements. Finally, we extended OntoWiki to allow facet-based browsing based on tags and other annotations. We developed an opt-in attribute cloud module allowing users to decide which attributes (including tag relations) should be displayed as cloud facets. In comparison to other facet-based systems, the opt-in way has a low impact on the GUI at all and integrates well into the other modules. In addition to this, we added a filter module which acts as a generalization of facet selection and allows additional filter types. Both modules allow for selecting of inverse facets (incoming relations). Figure 5 demonstrates the usage of three different attribute clouds (two of them for inverse facets) to select all persons (and their projects) who are members of AKSW and work in room 5-10.

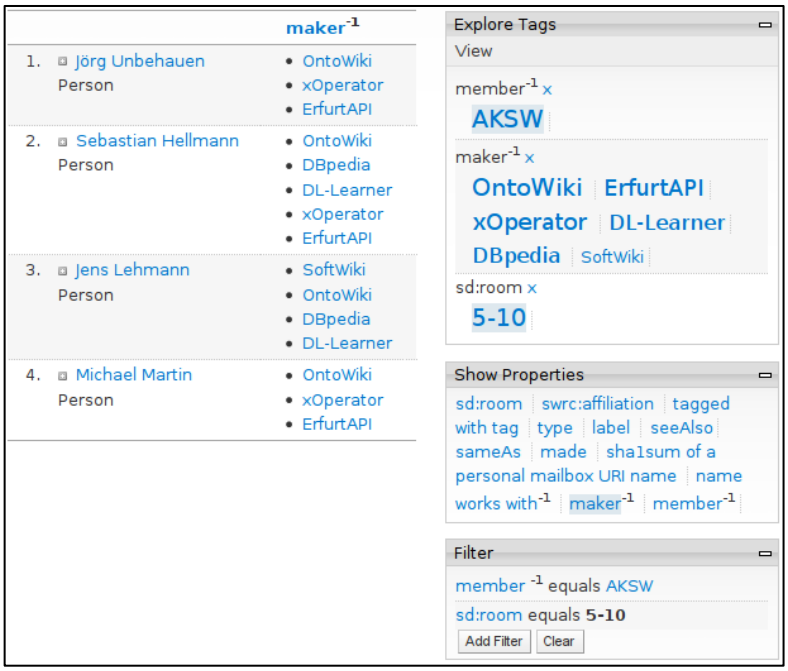

Figure 5: OntoWiki screenshot. Three facets (two of them inverse) are selected and highlighted in light blue.

Integrated Provenance Support
We extended the data export features of OntoWiki and Erfurt to allow adding extra metadata to export along with the instance data. The OntoWiki component that is responsible for the export of resource data includes provenance data on an opt-in basis. Provenance data about the change history for a certain resource is gathered from the versioning component and mapped on an appropriate provenance vocabulary. We make use of the *Provenance Vocabulary* proposed by Olaf Hartig. Additional provenance information can be stored on a model basis as shown in Figure 5. This work was released as version 0.9.5 of OntoWiki.

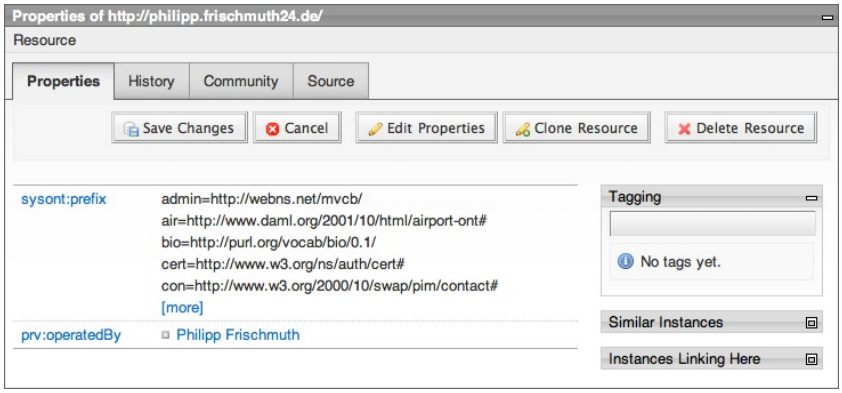

Figure 6: OntoWiki screenshot showing provenance information.

Integration of OntoWiki with ODS, Trilith and CONX

An important result of the project was also the integration of OntoWiki with the content and knowledge management products of the SME partners of the project, in particular ODS, Trilith and conX, which is outlined briefly in the sequel.

ODS integration. OpenLink Data Spaces (ODS) are a collection of Virtuoso plug-ins that allow for management of personal data under a single user interface (i. e. weblog, calendar, discussion forum, and wiki among others). Since all data in ODS is exposed as RDF, OntoWiki can be used to browse ODS data spaces (see Figure 7). This is possible, regardless of whether or not OntoWiki runs in a

Virtuoso-hosted PHP environment. Because of the standards-align nature of ODS data modeling, the complete OntoWiki toolset is available. This includes facet-based search, fulltext search, set-based browsing, complex querying and storage of user-defined queries (among others). One drawback of the current implementation is that making changes to ODS data in OntoWiki is not possible. The ODS data in Virtuoso are unidirectionally mapped to an RDF graph which is then exposed. However, changes to the graph are not recognized by ODS applications. In order to not provoke confusion among users, editing ODS graphs has been disabled in OntoWiki. Also, user accounts are automatically synchronized between OntoWiki and ODS.

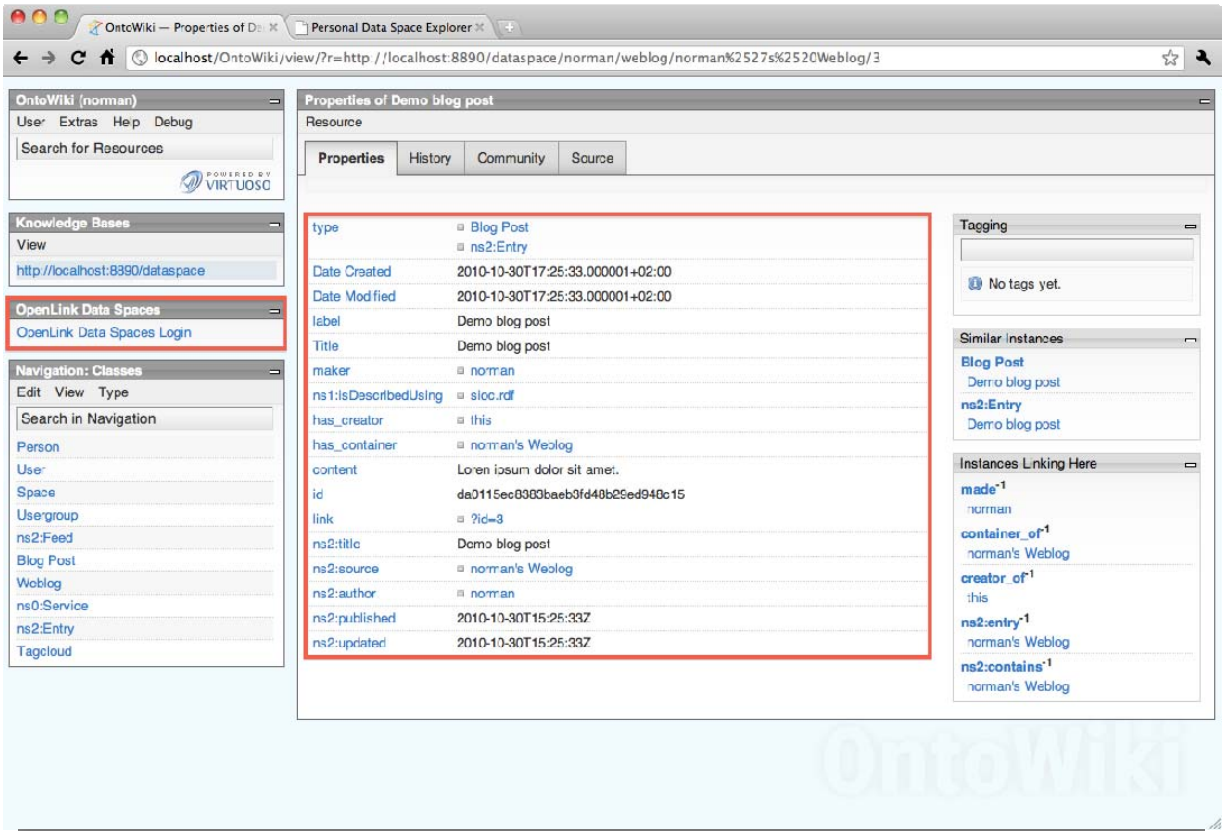

Figure 7: ODS integration in OntoWiki: auto-login and the properties of an ODS blog post as displayed in OntoWiki.

The web portal software solution Trilith is a product of the OntoWiki consortium member BI Business Intelligence GmbH. Goal of this integration process was the availability of OntoWiki as part of Trilith. OntoWiki should be usable for the linking and annotation of existing Trilith concepts. OntoWiki-Trilith integration was achieved on the interface and data layers:

- **Interface Integration.** The Trilith architecture allowed us to plug-in the OntoWiki authentication module to create an integrated single sign-on. Doing so, Trilith users can instantly use OntoWiki by using the “Extras” menu entry on the top of their back-end screen. Figure 8 shows an example screen of Trilith with an integrated OntoWiki.
- **Data Integration.** To integrate Trilith data with OntoWiki, we (one-way) synchronise parts of the main Trilith database with a customized Triplify configuration to a Virtuoso-based OntoWiki installation which is part of the Trilith installation. This synchronised OntoWiki Knowledge Base is kept read-only since changes on this knowledge base will be lost after the next Triplify run. At this point, OntoWiki can be used to browse and query the Trilith data. To create an additional benefit for Trilith users, a second Knowledge Bases was created,

which `owl:imports` the main Trilith data and is writable for all Trilith users. Doing so, users can annotate, discuss and link Trilith concepts and save these annotations separately from the main data. In addition to this, all OntoWiki interfaces as the Linked Data interface or the SPARQL endpoint can be used with the data.

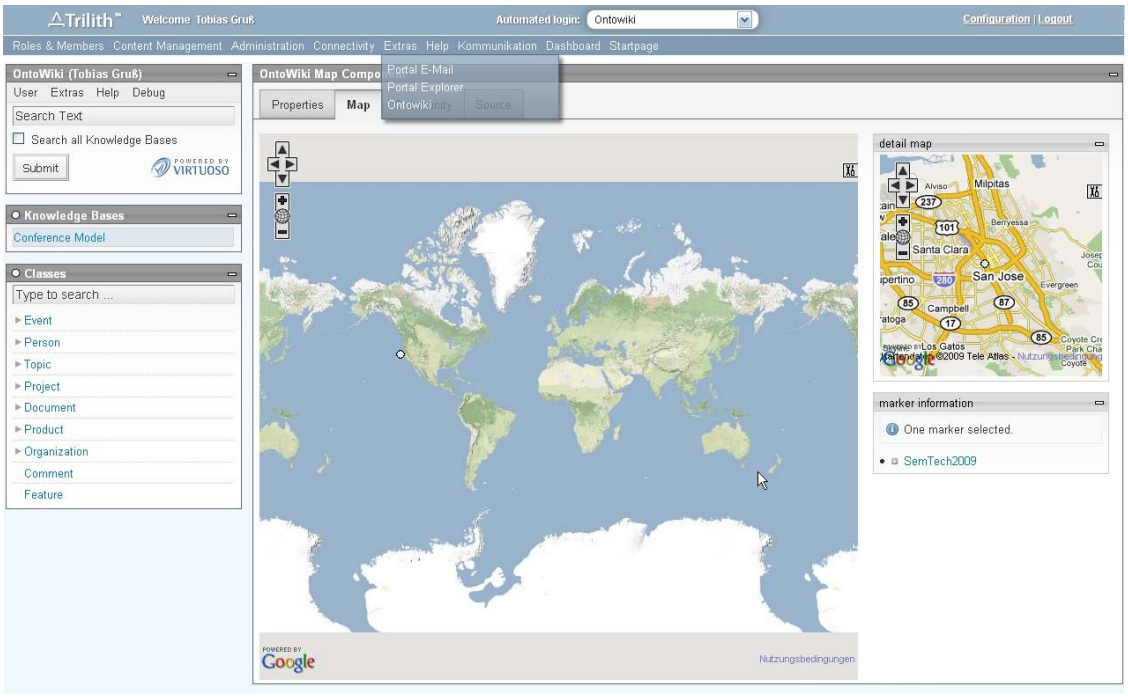

Figure 8: Trilith-OntoWiki user interface integration.

conX Integration. conX is a Web Content Management System developed by the project partner PUNKT. In order to flexibilize this CMS, we integrated OntoWiki with conX as follows:

1. The creation and management of new asset types is facilitated as an ontology in OntoWiki.
2. This ontology is made available for the SQL parts of the conX back end.
3. A triplify schema has been generated for making conX's SQL content available in OntoWiki.

The integration scenario is depicted in Figure 9 and displays the alignment of the newly developed modules. A central component is the *asset rdf backend*. This module serves as a library and is referenced by all other components. It provides the basic mapping from PHP code to RDF data. For editing the ontology we created some OntoWiki plugins. These plugins make direct use of the data manipulation methods of the *asset rdf backend*, as they are responsible for converting the user input into RDF and inserting it into the database. Furthermore, the asset edit relies on the Virtuoso database back end for better support of data manipulation. This restriction was considered feasible in this deployment scenario, as schema manipulation is always carried out by the maintainer of the web application. The SQL generation can be triggered on the front end. This component also relies on the *asset rdf backend* for reading the ontology and further brings in SQL table templates into which the semantically modelled assets are inserted. Newly created conX applications, marked blue in Figure 9, are now able to gather the semantic annotations from the conX *rdf backend*, while resource intensive database access for presenting the data to user is still managed by the SQL backend. The usage of the conX *rdf backend* is optional. The generated Triplify mapping allows a conX application to expose their data without any modification. Further applications can make directly use of the semantic information provided by the *rdf backend*, by embedding this information into html pages as RDF or RDFa.

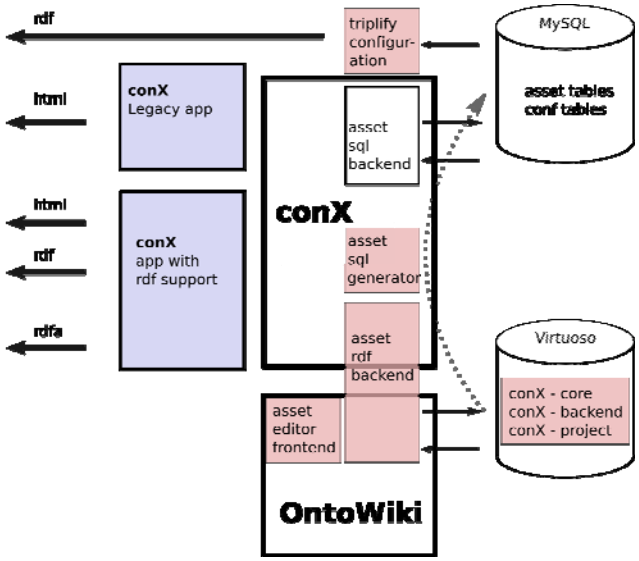

Figure 9: conX Integration - modules created in during the project are marked red.

Managing semantic E-Learning Content

Another domain application was the development of an OntoWiki distribution for authoring and publishing semantically enriched E-Learning content. This distribution supports an E-learning vocabulary which comprises a number of relevant vocabulary emelemnts and standards from the E-Learning domain (most notably SCORM) and is easily adaptable for the use with various other vocabularies. Furthermore, mechanisms for content evaluation and for right management were developed in the course of this domain application.

The main showcase of this domain adoption is the lab2go portal. It represents a repository that offers a common framework to collect and describe laboratory data from different laboratory providers located all over the world. This turns out to be necessary to continually foster the development of laboratories and exchange of knowledge among interested parties. The system hosts information about running research projects, researchers, organisations and existing state of the art technologies in order to strengthen the collaboration in the field.
When comparing the user interface of lab2go (cf. Figure 10) there can be seen some differences to the original OntoWiki version. Lab2go is build up on OntoWiki which was enhanced with some additional extensions and customized components. A general overview of the provided functionalities for anonymous users is:

- Register a new user, login with local account or your OpenID
- Full text search and selection of instances by class
- Facet based browsing and filtering of properties with certain values
- Read feedback of other users
- Export resources

Registered users (grouped into ordinary registered, editor and admin users) have access to more functionality, depending on which user group they belong. This includes authoring, commenting and rating of content (such as lab representations, experiments, learning units etc.). The system also supports the import and semantic representation of SCORM (Sharable Content Object Reference Model) content, which is widely used in E-Learning.

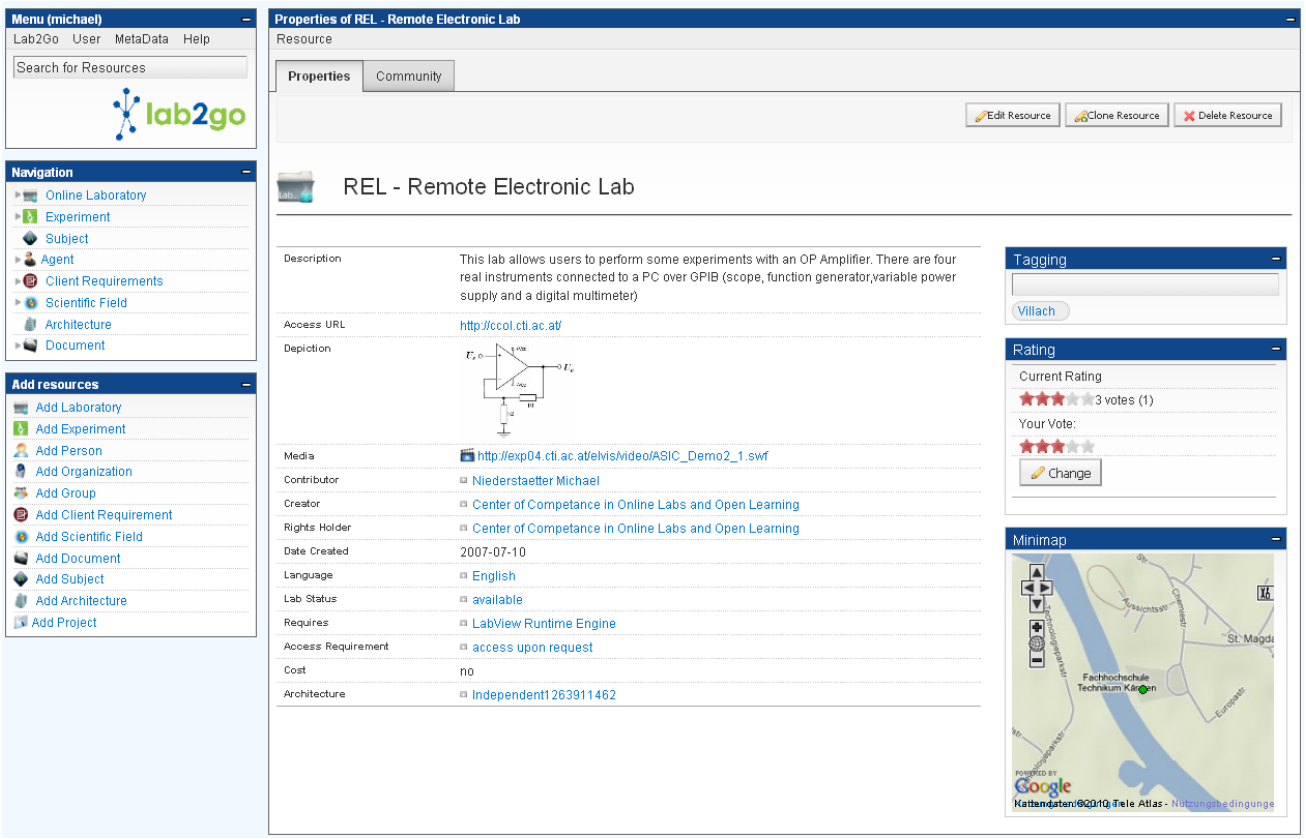

Figure 10: The Lab2go E-Learning portal based on OntoWiki.

Managing semantic E-Tourism Content

One of the showcases of OntoWiki is the data management of the tourism portal Vakantieland. The Vakantieland portal publishes comprehensive information about 20,000 touristic points-of-interest (POI) in the Netherlands including textual descriptions, location information and opening hours. Note that the domain of tourism is wide spread and includes a multitude of information realms such as Geospatial information, Temporal information, Buildings, Booking processes, Water access, Traveling information and much more. All this information is stored in a knowledge base containing almost 2 million triples and is structured using approximately 1,250 properties as well as 400 classes. The portal has two different views, which can be seen in Figure 7. On the one hand - as seen by the knowledge curator - OntoWiki is used to maintain the schema and the data of the tourism domain. On the other hand, we developed a frontend application to represent the tourism information in a user-friendly way. This frontend application supports multiple functionalities to filter and browse the information. It was designed according to the model/view/controller principle and uses the Erfurt API as middleware, which is also used in OntoWiki. The retrieved information for the admin view and the frontend application comes directly from the same SPARQL store (Virtuoso).

To represent and structure information according to requirements of the application, vocabularies were required to encode the existing diversified legacy information. Therefore we evaluated different existing vocabularies such as DublinCore, WGS84, Good Relations, FOAF, vCard, etc. across several domains. Applicable vocabularies were selected and used to structure and annotate domain specific information, which was transformed from the legacy relational database to RDF. The schema of the data was improved in several iterations; Figure 8 gives an overview of the resulting schema. Several OntoWiki extensions were created to ease the creation and maintenance of the different information spaces required in the tourism domain.

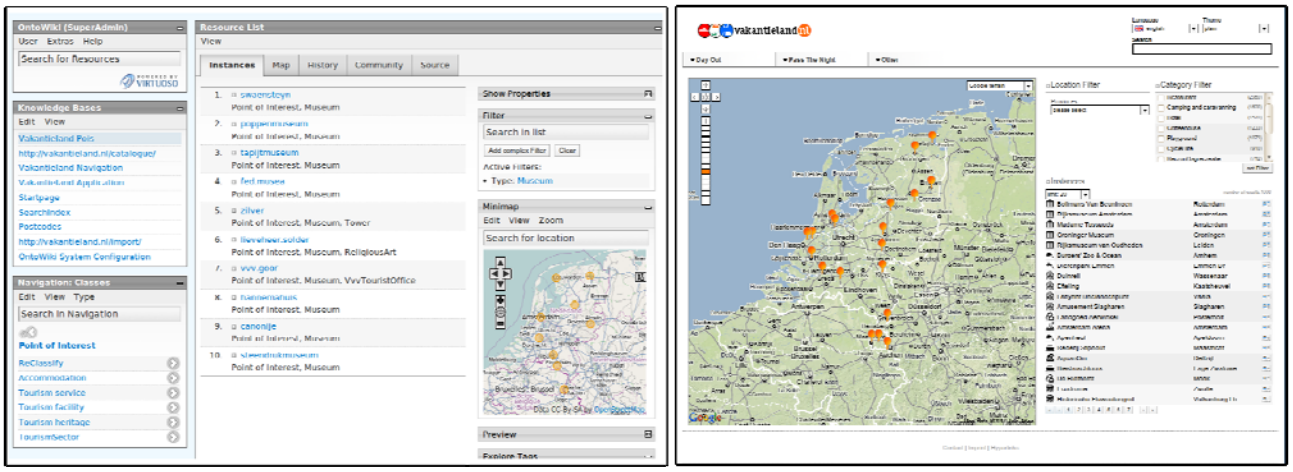

Figure 11: The left side shows the schema and data maintenance view used by the Knowledge curator. The right side displays the frontend for users of the tourism portal.

Multiple-Language Support in OntoWiki

To increase the comprehensibility for users and to efficiently support multilingualism for Semantic Web Applications based on RDF knowledge bases, RDF resources should be labelled and commented in multiple languages. In order to support multilingualism of RDF knowledge bases, content authors have to translate these literal values into other languages and store them in the knowledge base. To assist the work-flow of translating and storing RDF literal values in a (semi-)automated way, we developed a set of OntoWiki extensions for language resource translation and management:

1. The *RDFauthor* extension translates single RDF literal values.
2. The *Individual Resource Translation Module* translates all string literal values attached to a certain resource (cf. Figure 9)
3. The *Massive Translation Component* translates literal values of a complete knowledge base.
4. The *Multi-lingual Resource Versioning and Revision* notifies the content authors to revise new translations and synchronize them.

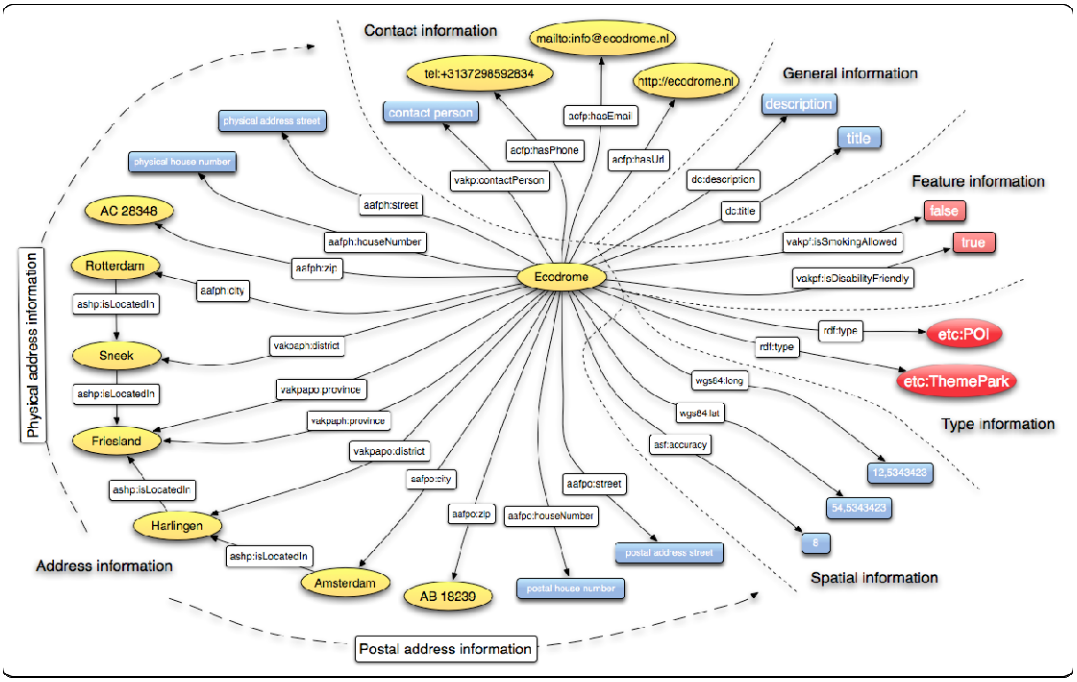

Figure 12: Excerpt of the vocabularies selected for representing E-Learning content.

To enable the semi-automated translation of literal values, we employ the Google Translation Service with its API. This service supports the translation between more than 50 languages such as English, Russian, German, Greek, Vietnamese, Hindi etc. Due to the fact that RDF literal values, which have to be translated, do not always explicitly contain a language tag, it might be required to detect this language code automatically. The Google Translate API supports this functionality. Since not all of possible languages have to be supported by a certain knowledge base, content authors are able to configure a set of the desired languages.

In order to present the tourism content of Vakantieland in multiple languages, we encoded translations of class labels, property labels and, if possible, property values in RDF. The sketched OntoWiki modules were used to support the process of translating resources and to decrease the overall translation time.

Figure 13: Individual Resource Translation Module

Several components of the frontend application use these translations such as the faceted category filter located in the frontend (right side) in Figure 13. At this time, the tourism RDF content of Vakantieland contains information encoded in various different European languages such as Dutch, English, French, German, Italian and Spanish.

Multimedia support in OntoWiki

We implemented a PHP-framework based on Erfurt, which is able to handle large amounts of multimedia data in an automatic process. With the help of this framework, it is possible to import and interlink arbitrary multimedia documents or even complete directory structures into a knowledge base and manage them accordingly with OntoWiki. Currently support for 13 different file types is implemented. Figure 14 gives an overview of the most common formats. The framework was used to create RDF resources for about 850 PDF documents (i.e. info brochures of Point of Interests, so called *POIs*) and interlink them accordingly. In particular, we extended the generic multimedia linking vocabulary in order to specify the rdfs:domain to Point of Interests (POIs) and evaluated the OntoWiki Linking Module. For one hundred randomly chosen documents the suggestions of this module have been compared to manually assigned links, created by a domain expert. This evaluation has shown that for 80% of the documents, the correct suggestion – the POI with the highest probability – was found. Reversing the procedure, i.e. suggesting documents for POIs, it was even possible to find the correct one in 90% of the examined cases. The links created this way are used to display related documents and additional information such as the document's title (translated in various languages) on a POIs details page.

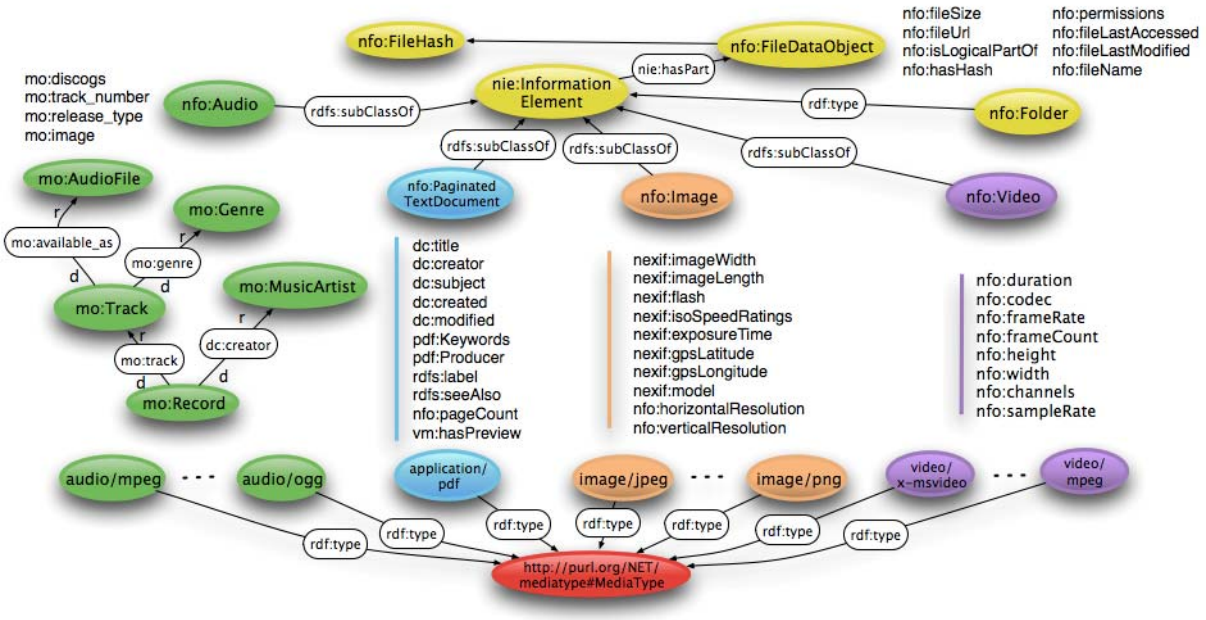

Figure 14: Supported file types and the created Multimedia vocabulary.

Supporting location based information in OntoWiki

In the facet-based browsing approach in Vakantieland, users are offered to filter the objects of a certain area shown on a map by categories or attributes. In order to scale up this browsing approach, we developed and configured a set of software components for OntoWiki and the Vakantieland frontend application.

In addition to filter resources by classes and properties in both applications, it was required to filter encoded resources using interlinks to spatial areas. In our model of the tourism domain the existing spatial areas like the country Netherlands, provinces like Drenthe and cities like Amsterdam are structured hierarchically using the spatial hierarchy vocabulary depicted in Figure 15. On the basis of this spatial hierarchy the user is able to filter resources by using the OntoWiki component depicted in Figure 16.

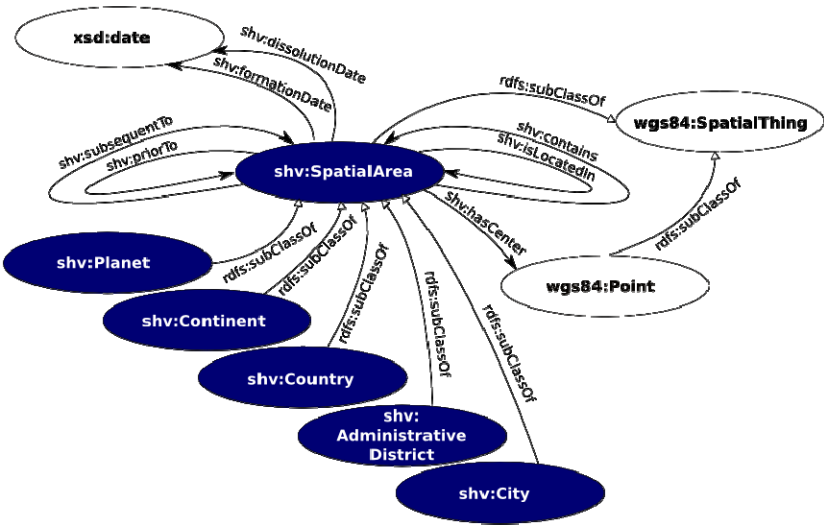

Figure 15: Spatial vocabulary developed for Vakantieland

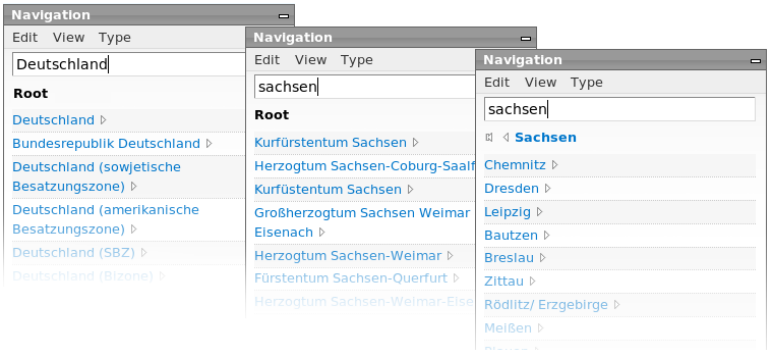

Figure 16: Knowledge Curator view of the spatial hierarchy browser

In the Vakantieland frontend application the user can use a similar component as depicted in Figure 17 to filter resources. In addition to location-based information such as spatial areas, users also have to deal with address and coordinate information in such a knowledge domain. To filter resources by coordinates, the user is able to use an interactively working map component of OntoWiki and the Vakantieland frontend application. In order to create and maintain coordinate information more efficiently we developed a further component for OntoWiki to receive and update coordinate information semi-automated by using different geocoding services such as Nominatim (OSM), Yahoo and Google.

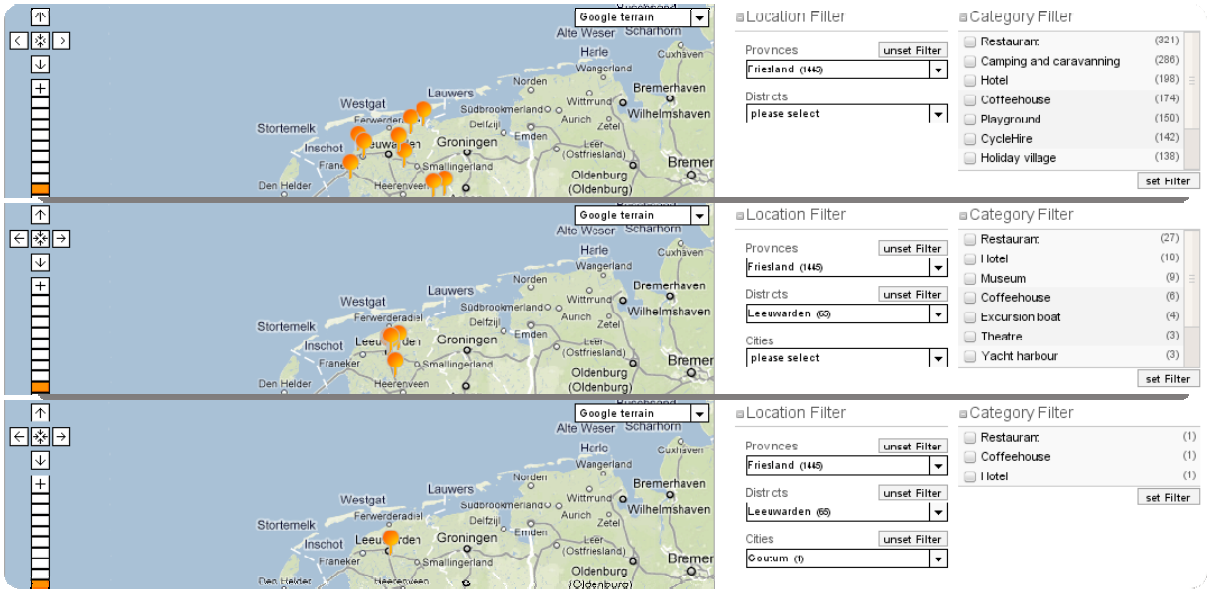

Figure 17: Fronted view showing how resources filter are filtered on a map.

Potential impact

Socio-economic impact

The OntoWiki consortium anticipates significant effects regarding economic growth, employment, and new distribution channels. The project will enable the SME participants to increase their markets and extend/internationalise their business activities as we detail in the following paragraphs:

New products and services. The work performed within the project has the potential to bring forth a number of new products and services. OpenLink Data Spaces, for example, is a community collaboration suite based on the Virtuoso Universal Server including functionality for document sharing, blogging, forum discussions, and wikis authoring. The integration of OntoWiki and ODS in WP4 enables the positioning of the combined Virtuoso/ODS/OntoWiki bundle as a comprehensive application for adaptive Knowledge Management for SME. Project partner BI will offer consulting, support and custom development and adoption services for semantics-based solutions in its markets, especially for energy providers in central Europe. For project partner B2, the coupling and integration of the OntoWiki tool with LCMSes enables B2 to expand its offering towards blended E-Learning / Enterprise Knowledge Management solutions. PUNKT offers consulting, support and custom development and adoption services for OntoWiki based solutions in its markets, especially regarding CMS and Web application integration. Vakantieland envisions to start-up a franchise product in order to use its technical E-Tourism portal platform for other (European) countries.

Improved products and services. In addition to the new products based on the OntoWiki tool, the project will result in a number of significant product and service improvements for the involved SMEs. The OpenLink Virtuoso extensions developed during the project, for example, provide a uniquely competitive knowledge system building block. The application scenarios range from the mobile and desktop to the data center, as all gradations from intelligent on-demand retrieval and query dispatching to data warehousing are covered. The tight coupling of local storage, query optimization, rules and parallel/federated processing circumvents the performance, maintenance and deployment problems traditionally associated with Semantic Web systems made from loosely coupled generic databases, SPARQL front ends and reasoning systems. BI's Trilith content and knowledge management solution was extended towards semantic collaboration by means of collaborative creation of terminologies, taxonomies, knowledge bases. B2's products and services will benefit twofold: firstly the OntoWiki/LCMs integration enables the creation, publishing and consumption of more end-user centred and role-adopted E-Learning content. Secondly, the expertise gained during the project facilitates the launch of training curricula specifically focusing on semantic technologies. PUNKT's content management solution CONX is enhanced with novel semantic interfaces and integrated with OntoWiki as a comprehensive Semantic Content Management Solution (SCMS). The Vakantieland portal benefits significantly from the developments in the project, especially with respect to end-user integration and geographically enhanced E-Tourism Content Management.

Expanding existing markets. The target market for OpenLink's Virtuoso is currently Data Access, Enterprise Data- and Information Integration in the European and North American markets. Starting with the release of the main Virtuoso components as open-source software in 2006, OpenLink aims at broadening its user and customer base towards SMEs and the database market. Part of Virtuoso is also a knowledge store component, which will be significantly extended in the course of the project with support from the R&D partners. Anticipating the developing of a knowledge store market within the next years OpenLink aims to achieve a fast market penetration with Virtuoso. The current target market/industry for BI's Trilith solution is expanded in two ways: Technologically, Trilith's portal and knowledge management solution for unstructured contents was extended with support for structured content types (such as taxonomies or data bases) and semantic collaboration. Trilith is cur-

rently used by gas providers; however the supported workflows, business processes and knowledge management functionality make it easily applicable for energy suppliers in general. The support for adopting terminologies and taxonomies enable Trilith to target this enlarged market. PUNKT already now as a number of customers outside its home market Austria, this tendency was amplified by the project in order to maximize the exploitation of the planned CONX enhancements. Vakantieland aims at scaling its business model to other EU countries by establishing a franchise network of E-Tourism portals based on the semantically enriched Vakantieland technology.

Improving competitiveness. The competitiveness of the involved SMEs is increased mainly in the following ways:

- **Time-to-market.** The R&D out-sourcing aspect of OntoWiki allowed the involved SMEs to focus on their original core competences and utilize their limited resources in order to bring products and services to market more timely.
- **End-user integration.** The semantic collaboration techniques developed within OntoWiki enable the involved SMEs to interact more efficiently and timely with customers and end-users of their products. This involves requirements elicitation, feature requests or support knowledge. Improved end-user integration will also have positive effects on efficiency, time-to-market and accelerated product development cycles.
- **Adaptivity, Flexibility.** The adaptive methodology promoted by OntoWiki increases the flexibility of the SME partners to react to new market trends, to respond on changed customer needs or modified policies and legal conditions.
- **Knowledge and expertise gain.** The project included a number of targeted training activities aiming at disseminating recent research findings, best-practices and methodologies as well as technologies and approaches into the SME world.

Impact on competitiveness of European SMEs in general. The application of light-weight, adaptive semantic collaboration as well as task and role specific provision of knowledge and documentation is of crucial importance within enterprises in the information society. Already, during the lifetime of the OntoWiki project discussions with customers and industrial partners of the consortium members (such as BASF, Siemens, Deutsche Telekom and many SMEs) showed an immense interest in the project results. OntoWiki's focus on established standards and the knowledge defragmentation aspect contributes to improve the competitiveness of enterprises in Europe by fostering the creation of new networked applications and services capable of interoperation across a wide variety of business domains and organisations of all sizes. By its very nature, the use of open-source software reinforces competitiveness in any market where it is used by allowing businesses to compete on equal terms. The lock-in effect of proprietary software, where only one vendor is able to affect changes in the software does not exist with open-source software, which allows the client to choose the vendor with the best offer for affecting changes, or can decide to hire the competence to affect such changes themselves. With the take-up of OntoWiki among SMEs comes also the possibility for SMEs to collaborate with a higher level of efficiency by their use of a common standard for communicating, thereby aiding the SMEs in establishing virtual networks of organisations, both among SMEs and between SMEs and larger enterprises. The increased efficiency of these networks increase the competitiveness of the SMEs and consortia of SMEs in all markets.

Wider societal implications of the project so far

Improve our learning and education systems. OntoWiki specifically strengthens educational semantic collaboration applications. The workshops and outreach activities for example in the course of the Lab2go showcase in for educators and in universities improve educational systems, since learners will get access to an variety of content and knowledge together with methods for effective search and interlinking. This increased accessibility of digital content and knowledge also supports lifelong learning as it is required in the knowledge society.

Involving SMEs and feeding innovation. OntoWiki's contribution to supporting SMEs is twofold: On the one hand, highly skilled SMEs are an integral part of the consortium itself, the leadership in their respective area of competence is strengthened and additional perspectives for their business development already originate from the project. On the other hand, the project outcomes (especially the open-source software component) enable European SMEs and the Communities of Practice or Virtual Organizations to collaborate more efficiently on a semantic level.

The socio-economic dimension. Changes in the way users produce, distribute, access and re-use information, knowledge and entertainment (as envisioned by OntoWiki) potentially gives rise to *increased user autonomy, increased participation and increased diversity*. These may result in *lower entry barriers, distribution costs and user costs and greater diversity of works* as digital shelf space is almost limitless. Accessible semantic collaboration facilities shall provide citizens, consumers and students with information and knowledge. Educational semantically enriched content tends to be collaborative and encourage sharing and joint production of information, ideas, opinions and knowledge. The cultural impacts of this social phenomenon are also far-reaching. "Long tail" economics allows a substantial increase in availability and a *more diverse array of cultural content* to find niche audiences. Accessible semantic collaboration platforms can also be seen as an open platform *enriching political and societal debates, diversity of opinion, free flow of information and freedom of expression.*

Catalogus Professorum - Application of OntoWiki in the Humanities

In addition to the core use cases we applied OntoWiki's adaptive, semantics-based knowledge engineering approach to the humanities with the development of the catalogus professorum. The catalogus professorum is a prosopographical knowledge base. In prosopographical research, historians analyze common characteristics of historical groups by studying statistically relevant quantities of individual biographies. Untraceable periods of biographies can be determined on the basis of such accomplished analyses in combination with statistically examinations as well as patterns of relationships between individuals and their activities. In our case, researchers from the historical seminar at Universität Leipzig aimed at creating a prosopographical knowledge base about the life and work of professors in the 600 years history of Universität Leipzig ranging from the year 1409 till 2009 - the Catalogus Professorum Lipsiensis (CPL).

In order to enable historians to collect, structure and publish this prosopographical knowledge an ontological knowledge model was developed based on OntoWiki and incrementally refined over the period the three years of the project. The community of historians working on CPL was enabled to add information to the knowledge base using an adapted version of the semantic data wiki OntoWiki. For the general public, a simplified user interface is dynamically generated based on the content of the knowledge base and available at available at: http://www.uni-leipzig.de/unigeschichte/professorenkatalog/. For access and exploration of the knowledge base by other historians a number of access interfaces was developed and deployed, such as a graphical SPARQL query builder, a relationship finder and plain RDF and Linked Data interfaces. As a result, a group of 10 historians supported by a much larger group of volunteers and external contributors

collected information about 1,300 professors, 10,000 associated periods of life, 400 institutions and many more related entities.

The benefits of the developed knowledge engineering platform for historians are twofold: Firstly, the collaboration between the participating historians has significantly improved: The ontological structuring helped to quickly establish a common understanding of the domain. Collaborators within the project, peers in the historic community as well as the general public were enabled to directly observe the progress, thus facilitating peer-review, feedback and giving direct benefits to the contributors. Secondly, the ontological representation of the knowledge facilitated original historical investigations, such as historical social network analysis, professor appointment analysis (e.g. with regard to the influence of cousin-hood or political influence) or the relation between religion and university. The use of the developed model and knowledge engineering techniques is easily transferable to other prosopographical research projects and with adaptations to the ontology model to other historical research in general. In the long term, the use of collaborative knowledge engineering in historian research communities can facilitate the transition from largely individual-driven research (where one historian investigates a certain research question solitarily) to more community-oriented research (where many participants contribute pieces of information in order to enlighten a larger research question). Also, this will improve the reusability of the results of historic research, since knowledge represented in structured ways can be used for previously not anticipated research questions.

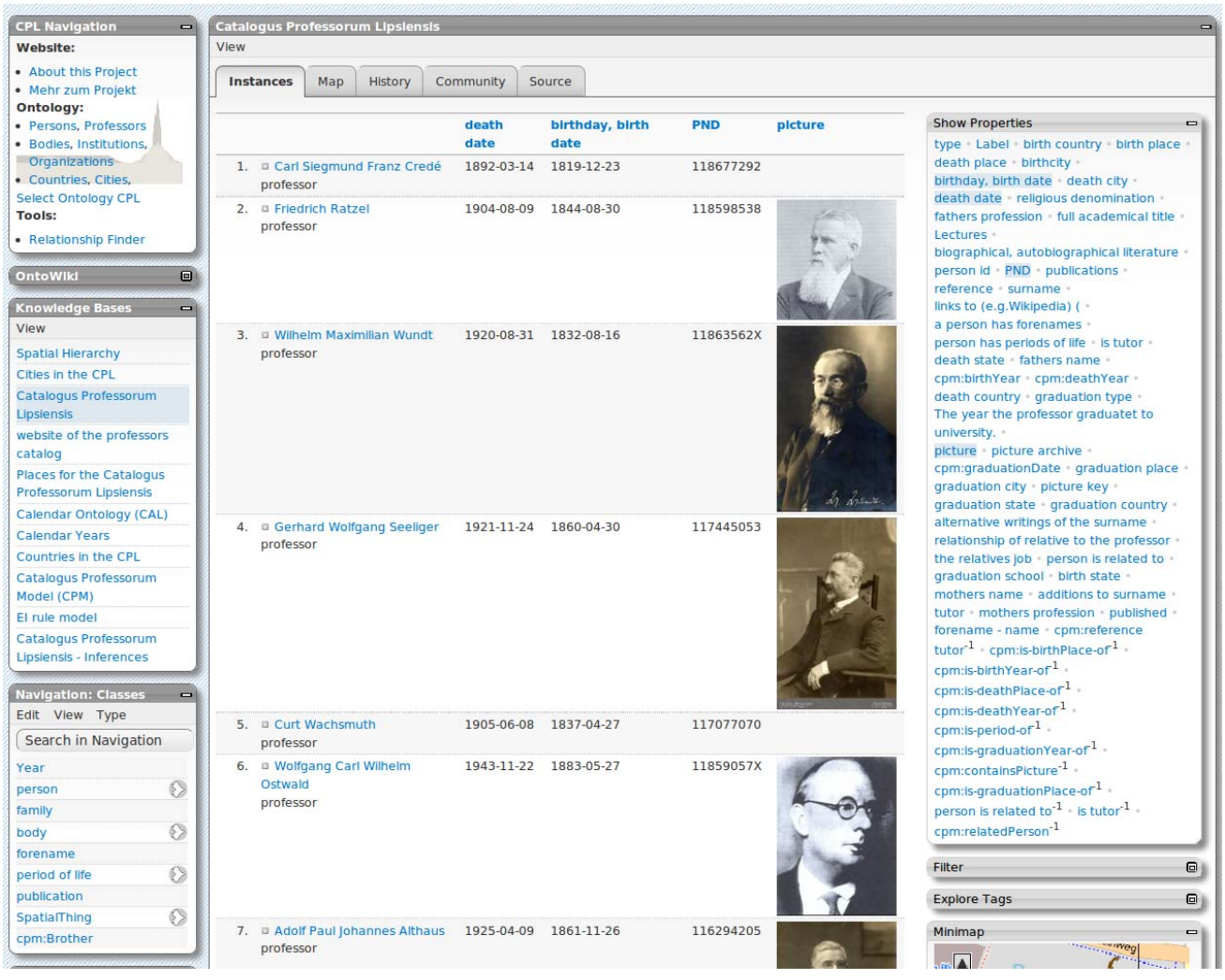

Figure 18: OntoWiki backend for management of the Catalogus Professorum knowledge base.

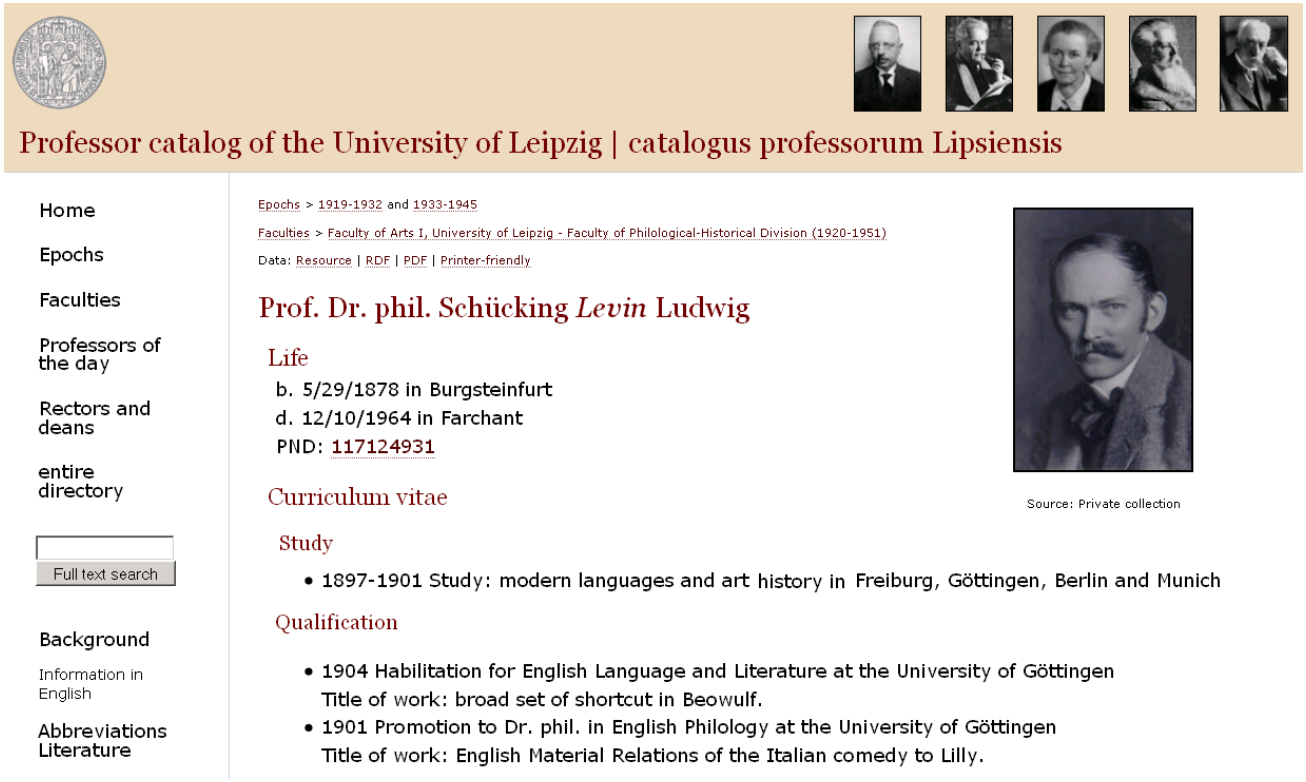

Figure 19: Public Catalogus Professorum website available at: http://www.uni-leipzig.de/unigeschichte/professorenkatalog/.

For historians the followed knowledge base approach resulted in completely new research opportunities, compared to the book/lexicon based methodologies prevalent in prosopographical research. The use of knowledge bases and agile, web-based collaboration has the potential to trigger a paradigm shift in historic research: from individual centered research aiming to solve a specific research task towards collaborative research, which's results can be re-purposed in order to answer unanticipated research questions.
The Catalogus Professorum OntoWiki showcase was very well received by both the research community and the general public. A paper about CPL for example won the best paper award of the In-Use track at 9th *International Semantic Web Conference (ISWC 2010)*. Also, local media (Leipziger Volkszeitung, Radio Mephisto etc.) was reporting several times about CPL in particular and the OntoWiki project in general. The public Catalogus Professorum website as shown in Figure 19 also attracts thousands of visitors be it interested citizens, historians, or researchers every month.

Main dissemination activities and exploitation of results

Scientific publications. In the course of the project the consortium has created a substantial number of scientific publications. These include 5 publications accepted for publication at renowned journals (e. g. Semantic Web Journal, Journal of Web Semantics, International Journal on Semantic Web and Information Systems, Machine Learning Journal) and 31 publications at major international conferences (e.g. World Wide Web Conference, International Semantic Web Conference, Extended Semantic Web Conference).

Informal publications. The OntoWiki consortium members released a large number of informal publications (such as blog posts etc.) through their Web dissemination channels. Furthermore, the OntoWiki consortium released teaching material, which was for example used during the Kick-Off Meeting (17 presentations and their slides can be e.g. found on

http://aksw.org/Events/2009/OntoWikiKickOff) as well as presentations and videos on platforms such as Slideshare and Videolectures.

Events. The OntoWiki consortium co-organized a number of events and participated at a great variety of events with presentations and invited talks. These event organization and participation activities were used as an important dissemination channel for the project results. Organized events include Leipziger Semantic Web Tag 2009 and 2010. International Conference on Semantic Systems (I-Semantics) 2009 and 2010, Triplification Challenge 2009 and 2010, Workshop on Scripting for the Semantic Web 2009 and 2010, Vienna Semantic Web Meetups, LinkedDataCamps and others.

Teaching. An important aspect of disseminating expertise and knowledge gained within the project is through the curricula of students studying at the academic institutions participating in the project. Although these activities were not directly part of the project, they were an important pillar to disseminate best-practices and knowledge as well as to prepare students for work with the innovative technologies researched and developed in the course of the project. More than 10 bachelor and master thesis related to the project were completed in the course of the project. Several internships of students from the participating academic institutions took place at the SME partners of the project. Also, the topics of the project influenced 4 lectures, seminars and practical works, which were held at the participating universities.

Software releases. In addition to the software releases as formal project deliverables the consortium was releasing a number of additional software components and/or intermediate releases as open-source to the wider-public. This includes various Virtuoso and OntoWiki releases as well as releases of the Erfurt Semantic Web API, the LESS - Leipzig Semantic Syndication, the SPARQL Adaptive Query Cache, RDFauthor, Semantic Pingback as well as the EvoPat- Evolution Patterns engine. The software releases were announced at mailinglists and blogs, the source code as well as installation archives are available at major open-source repositories such as Sourceforge.net and Google Code.

Continuation of the research collaboration in the FP7-ICT integrated project LOD2. Three of the OntoWiki project partners (namely Uni Leipzig, Punk and Openlink) will continue the intensive research collaboration within the EU-FP7 funded integrated project “LOD2 Creation Knowledge out of Interlinked Data” (257943). The project is led by Universität Leipzig. Although different in focus, the LOD2 project will build on the results of OntoWiki contribute to the continuation and the sustainable dissemination and exploitation of OntoWiki results. For example, OntoWiki as well as Virtuoso will become part of the LOD2 stack, an aligned toolset of components facilitating the Linked Data Life Cycle.

OntoWiki Consortium

Universität Leipzig Dr. Sören Auer Agile Knowledge Engineering & Semantic Web Universität Leipzig, Institut für Informatik (IfI) Johannisgasse 26 04109 Leipzig Germany Tel.: +49 (341) 97-32367 Fax.: +49 (341) 97-32329 Email: auer@informatik.uni-leipzig.de Web: http://aksw.org	**OpenLink Software (UK) Ltd.** Hugh Williams Airport House, Purley Way, Croydon, Surrey, CR0 0XZ United Kingdom Tel.: +44 (0)20 8681 7701 Fax: +44 (0)20 8681 7702 Email: hwilliams@openlinksw.com Web: http://openlinksw.com
BI Business Intelligence GmbH Jürgen Schubert August-Bebel-Str. 44 04275 Leipzig Germany Tel.: +49 341 30383-30 Fax: +49 341 30383-52 Email: kontakt@bi-web.de Web: http://bi-web.de	**punkt. netServices OEG** Martin Kaltenböck, CMC Lerchenfelder Gürtel 43, IP.TWO 1160 Wien Austria Tel.: ++43.1.897 41 22 – 25 Fax.: ++43.1.897 41 22 – 22 Email: kaltenboeck@punkt.at Web: http://www.punkt.at
Vakantieland.nl Ceriel Jacobs Koornmarkt 42 2611EH Delft The Netherlands Tel.: +31157112149 Fax: +31157112150 Email: c@vakantieland.nl Web: http://vakantieland.nl	**Carinthia University of Applied Sciences** Prof. Dr. Michael E. Auer Europastraße 4 A-9524 Villach/St. Magdalen Austria Tel.: +43(5)90500-2115 Fax: +43(5)90500-2110 Email: M.Auer@fh-kaernten.at Web: http://fh-kaernten.at
Institut für Angewandte Informatik e. V. an der Universität Leipzig Roland Fassauer Grimmaische Str. 12 04109 Leipzig Germany Tel.: +49 341 3928738 0 Fax: +49 341 3928738 9 Email: info@infai.org Web: http://infai.org	**B2 d.o.o.** David Rozman Tržaška cesta 42 1000 Ljubljana SI – Slovenia Tel: +386 1 2444 202 Fax: +386 1 2444 213 Email: david.rozman@b2.eu Web: http://b2.eu

4.2 Use and dissemination of foreground

Section A

TEMPLATE A1: LIST OF SCIENTIFIC (PEER REVIEWED) PUBLICATIONS, STARTING WITH THE MOST IMPORTANT ONES										
NO.	Title	Main author	Title of the periodical or the series	Number, date or frequency	Publisher	Place of publication	Year of publication	Relevant pages	Permanent identifiers (if available)	Is/Will open access provided to this publication?
1	DBpedia: A nucleus for a web of open data.	Auer	ISWC LNCS4825	Yearly, 6th	Springer		2008	722-735	10.1007/978-3-540-76298-0_52	yes
2	Triplify: light-weight linked data publication from relational databases.	Auer	WWW	Yearly, 17th	ACM		2009	621-630	10.1145/1526709.1526793	yes
3	LESS - Template-Based Syndication and Presentation of Linked Data.	Auer	ESWC LNCS6089	Yearly, 7th	Springer		2010	211-224	10.1007/978-3-642-13489-0_15	yes
4	Making the web a data washing machine - creating knowledge out of interlinked data	Auer	SWJ	Vol: 1(1-2)	IOS Press		2010	97-104	10.3233/SW-2010-0019	yes
5	LinkedGeoData - adding a spatial dimension to the web of data.	Auer	ISWC LNCS5823	Yearly, 8th	Springer		2009	731-746	10.1007/978-3-642-04930-9_46	yes
6	I18n of semantic web applications.	Auer	ISWC LNCS6497	Yearly, 9th	Springer		2010	1-16	10.1007/978-3-642-17749-1_1	yes
7	Learning of OWL class descriptions on very large knowledge bases.	Hellmann	IJSWIS	Vol: 5(2)	IGI Global		2009	25-48	10.4018/jswis.2009040102	no, draft version is openly available
8	DBpedia Live Extraction	Hellmann	ODBASE LNCS5871	Yearly, 8th	Springer		2009	1209-1223	10.1007/978-3-642-05151-7_33	yes
9	DBpedia - a crystallization	Leh-	JWS	Vol: 7(3)	Elsevier		2009	154-165	10.1016/j.websem.2009.07.002	yes

	point for the web of data.	mann								
10	ORE - a tool for repairing and enriching knowledge bases.	Lehmann	ISWC LNCS6497	Yearly, 9th	Springer		2010	177-193	10.1007/978-3-642-17749-1_12	yes
11	Concept learning in description logics using refinement operators.	Lehmann	MLJ	78(1-2)	Springer		2010	203-250	10.1007/s10994-009-5146-2	
12	Improving the Performance of Semantic Web Applications with SPARQL Query Result Caching.	Martin	ESWC LNCS6089	Yearly, 7th	Springer		2010	304-318	10.1007/978-3-642-13489-0_21	yes
13	Knowledge engineering for historians on the example of the catalogus professorum lipsiensis.	Riechert	ISWC LNCS6497	Yearly, 9th	Springer		2010	225-240	10.1007/978-3-642-17749-1_15	yes
14	Making the Semantic Data Web easily writeable with RDFauthor.	Tramp	ESWC LNCS6089	Yearly, 7th	Springer		2010	436-440	10.1007/978-3-642-13489-0_39	yes
15	EvoPat – Pattern-Based Evolution and Refactoring of RDF Knowledge Bases	Rieß	ISWC LNCS6496	Yearly, 9th	Springer		2010	647-662	10.1007/978-3-642-17746-0_41	yes
16	RDFauthor: Employing RDFa for collaborative Knowledge Engineering.	Tramp	EKAW LNCS6317	Yearly	Springer		2010	90-104	10.1007/978-3-642-16438-5_7	yes
17	OntoWiki – a Semantic Data Wiki Enabling the Collaborative Creation and Linked Data Publication of RDF Knowledge Bases.	Tramp	EKAW	Yearly	Springer		2010	to appear		yes
18	Weaving a Social Data Web with Semantic Pingback	Tramp	EKAW LNCS6317	Yearly	Springer		2010	135-149	10.1007/978-3-642-16438-5_10	yes
	This List gives the 18 most important peer-reviewed scientific publications of the project. More publications can be found in Deliverable 7.1 and on http://ontowiki.eu/Publications									

TEMPLATE A2: LIST OF DISSEMINATION ACTIVITIES

NO.	Type of activities[2]	Main leader	Title	Date	Place	Type of audience[3]	Size of audience	Countries addressed
1	Blog	ULEI	AKSW Blog: http://blog.aksw.org	continuous		Web users		
2	Blog	PUNKT	Monthly Semantic Web Company Newsletter: http://www.semantic-web.at/newsletter/67.	continuous		Web users		
3	Blog	PUNKT	Semantic Web News: http://www.semantic-web.at	continuous		Web users		
4	Blog	OPEN LINK	Kingsley Idehen's Blog: http://www.openlinksw.com/blog/~kidehen/	continuous		Web users		
5	Blog	OPEN LINK	Orri Erling's Blog: http://www.openlinksw.com/weblog/oerling/	continuous		Web users		
6	Blog	B2	B2 news: http://b2.eu/objave.aspx	continuous		Web users		
7	Blog	BI	BI press releases: http://www.bi-web.de/business_intelligence/ news.html	continuous		Web users		
8	Web site	ULEI, CUAS	Teaching Material http://aksw.org/Events/2009/OntoWikiKickOff	Dec, 2008		Web users		
9	Conference	ULEI	1st Leipziger Semantic Web Tag 2009	29th April 2009	Leipzig, Germany	Visitors	100	Germany
10	Conference	ULEI	2nd Leipziger Semantic Web Tag 2010	5-6th May 2010	Leipzig, Germany	Visitors	200	Germany
11	Conference	Punkt	6th International Conference on Semantic Systems (I-Semantics)	2-4 Sep 2009	Graz, Austria	Visitors	400	
12	Conference	Punkt	7th International Conference on Semantic Systems (I-Semantics)	7-9 Sep 2010	Graz, Austria	Visitors	400	
13	Competition	ULEI	Triplification Challenge 2009 (Co-located with I-Semantics 2009)	See above				
14	Competition	ULEI	Triplification Challenge 2010 (Co-located with I-Semantics 2010)	See above				
15	Workshop	ULEI	5th Workshop on Scripting for the Semantic Web (Co-located with ESWC 2009)	May 30, 2009	Heraklion, Greece	Participants	30	

[2] A drop down list allows choosing the dissemination activity: publications, conferences, workshops, web, press releases, flyers, articles published in the popular press, videos, media briefings, presentations, exhibitions, thesis, interviews, films, TV clips, posters, Other.

[3] A drop down list allows choosing the type of public: Scientific Community (higher education, Research), Industry, Civil Society, Policy makers, Medias ('multiple choices' is possible.

16	Workshop	ULEI	6th Workshop on Scripting for the Semantic Web (Co-located with ESWC 2010)	May 30, 2010	Heraklion, Greece	Participants	30	
17	Workshop	PUNKT	First Vienna Semantic Web Meetup	16th Juli 2009	Vienna	SME's		Austria
18	Workshop	PUNKT	Second Vienna Semantic Web	30th Nov 2009	Vienna	SME's		Austria
19	Workshop	PUNKT	data.gov.at - Meetup	8th April 2010	Vienna	SME's		Austria
20	Workshop	PUNKT	Open Government	8th April 2010	Graz, Austria	Visitors		Austria
21	Workshop	PUNKT	Vienna Semantic Web Winter Meetup	1st Dec 2010	Vienna	SME's		Austria
22	Conference	PUNKT	LinkedDataCampVienna	30th Nov - 1st Dec 2009	Vienna	Visitors		
23	Conference	PUNKT	ZukunftsWeb	1st July, 2010	Vienna	Visitors		
24	Thesis	ULEI	Feng Qiu: Semantic Plugin Repository (Diploma Thesis).	2009				
25	Thesis	ULEI	Raphael Döring: Development and implementation of strategies for the syndication of content based on semantic technologies (Diploma Thesis).	2009				
26	Thesis	ULEI	Jonas Brekle: A SPARQL query component for API-based manipulation of SPARQL queries (Bachelor Thesis).	2009				
27	Thesis	BI	Elena Kop: A Semantic Web ontology for gas market (Diploma Thesis, in cooperation with BI Business Intelligence GmbH)	2009				
28	Thesis	ULEI	Rolland Brunec: A modular and backend-independent SPARQL/SPARUL parser for PHP (Master Thesis).	2009				
29	Thesis	BI	Christoph Riess: Evolution patterns in Semantic Web knowledge bases (Diploma Thesis, in cooperation with BI Business Intelligence GmbH).	2010				
30	Thesis	ULEI	Konrad Abicht: Weighted statements in RDF graphs (Bachelor Thesis).	2010				
31	Thesis	ULEI	Natanael Arndt: Development of a Mobile Social Semantic Web Clients (Bachelor Thesis).	2010				
32	Thesis	ULEI	Collette Hagert: Comparison of rule-based inference mechanisms in the semantic web Assessment for the use in OntoWiki (Diploma Thesis).	2010				
33	**Web site**		**OntoWiki http://ontowiki.eu The Web sites publishes all Deliverables and Software releases**	**continuous**				

Section B
Part B1

TEMPLATE B1: LIST OF APPLICATIONS FOR PATENTS, TRADEMARKS, REGISTERED DESIGNS, ETC.					
Type of IP Rights	Confidential Click on YES/NO	Foreseen embargo date dd/mm/yyyy	Application reference(s) (e.g. EP123456)	Subject or title of application	Applicant (s) (as on the application)

Part B2

Type of Exploitable Foreground	Description of exploitable foreground	Confidential	Foreseen embargo date	Exploitable product(s) or measure(s)	Sector(s) of application	Timetable, commercial or any other use	Patents or other IPR exploitation (licences)	Owner & Other Beneficiary(s) involved
Commercial exploitation of R&D results	Virtuoso Software release	NO		Software	J62.0 - Computer programming, consultancy and related activities	2011	Licensing (dual: open-source and commercial)	Beneficiary 3 (owner) Beneficiaries 4-7 exploitation through GPL open-source license
Exploitation of results through (social) innovation	OntoWiki SW release	NO		Software	J62.0 - Computer programming, consultancy and related activities	2010	Licensing (dual: open-source and commercial)	Beneficiaries 3-7 exploitation through unrestricted license
Exploitation of results through (social) innovation	DBpedia knowledge base release	NO		Knowledge base	J63.1.1 - Data processing, hosting and related activities	2010	Open-source licensing	Beneficiaries 3-7 exploitation through GFDL license
Commercial exploitation of R&D results	Integrated SW release of OntoWiki and Openlink's ODS	NO		Software	J62.0 - Computer programming, consultancy and related activities	2011	Licensing (dual: open-source and commercial)	Beneficiary 3 (owner)
Commercial exploitation of R&D results	Integrated SW release of OntoWiki and BI's Trilith	YES		Software	J62.0 - Computer programming, consultancy and related activities	2011	Commercial Licensing	Beneficiary 4 (owner)
Commercial exploitation of R&D results	Integrated SW release of OntoWiki and PUNKT's CONX	YES		Software	J62.0 - Computer programming, consultancy and related activities	2011	Commercial Licensing	Beneficiary 6 (owner)
Exploitation of results through (social) innovation	Integration with an existing Learning Content Management System	NO		Software	J62.0 - Computer programming, consultancy and related activities	2010	Commercial Licensing	Beneficiary 5 (owner)
Commercial exploitation of R&D results	vakantieland.nl deployment and transfer for other countries	YES		Software	1. J63.1.2 - Web portals 2. N79 - Travel agency, tour op-	2011	Commercial Licensing	Beneficiary 7 (owner)

Type of Exploitable Foreground	Description of exploitable foreground	Confidential	Foreseen embargo date	Exploitable product(s) or measure(s)	Sector(s) of application	Timetable, commercial or any other use	Patents or other IPR exploitation (licences)	Owner & Other Beneficiary(s) involved
					erator and other reservation service and related activities			
Exploitation of results through (social) innovation	Training course material	NO		Training material	P85.4.2 - Tertiary education	2010	Open-source licensing	Beneficiaries 3-7 exploitation through unrestricted license

R1 Virtuoso SW release

Description: The release contains support for efficient distributed inference and querying, inter-community bridges, federation and replication and a knowledge store & data integration API.
It represents a building block for the scalable implementation and deployment of the other software components to be developed in the project.
IPR and Exploitation: OpenLink will obtain the complete IPR regarding the enhanced Viirtuoso release. Virtuoso is and will be released under the terms of Gnu Public License, which enables all project partners to integrate their products with Virtuoso.
OpenLink sells commercial licenses of Virtuoso including support, bug fixes and updates.

R2 OntoWiki SW release

Description: Includes support for adaptive collaboration including evolution strategies & incentive models for light-weight collaboration, collaborative tagging, annotation & facet-based browsing and integrated provenance support.
IPR and Exploitation: All project partners obtain an unlimited, unrestricted OntoWiki license, which allows them to integrate OntoWiki into their products and sell licenses of the integrated products.

R3 DBpedia knowledge base release

Description: Establish an analyse-improve-release cycle for the DBpedia multi-domain ontology.
Allows to refer/align semantic representations within OntoWiki and the partner products to DBpedia.
IPR and Exploitation: DBpedia will is released under the terms of the GFDL, since it is a derivate of Wikipedia, which is released under the same license. Partners are exploiting DBpedia, by enabling functionality within their products for interlinking/aligning knowledge representations with Wikipedia. For that a license is not required.

R4 Integrated SW release of OntoWiki and Openlink's ODS

Includes support for vocabularies for representing enterprise knowledge and contains functionality to facilitate Semantic Enterprise Information Integration.

IPR and Exploitation: OpenLink obtained the complete IPR regarding the enhanced Viirtuoso ODS release.
OpenLink sells commercial licenses of Virtuoso ODS including support and updates.

R5 Integrated SW release of OntoWiki and BI's Trilith
Description: Includes support for vocabularies for representing enterprise knowledge and contains functionality to facilitate Semantic Enterprise Information Integration.
IPR and Exploitation: BI obtained the complete IPR regarding the enhanced Trilith release.
BI sells commercial licenses of Trilith including support and updates and provides consulting, training and custom development.

R6 Integrated SW release of OntoWiki and PUNKT's CONX
Description: Includes support for vocabularies for representing enterprise knowledge and contain functionality to facilitate Semantic Enterprise Information Integration.
IPR and Exploitation: PUNKT obtained the complete IPR regarding the enhanced CONX release.
PUNKT sells commercial licenses of CONX including support and updates and provides consulting, training and custom development.

R7 Integration with an existing Learning Content Management System
Description: Includes support for vocabularies for representing E-Learning content and functionality for authoring and publishing of semantically enriched E-Learning content.
IPR and Exploitation: B2 obtained the complete IPR regarding the enhanced LCMS release.
B2 will primarily use the platform for its own e-learning operations, but considers to sells commercial licenses and provide consulting, training and custom development to other e-learning providers.

R8 Deployment of OntoWiki on vakantieland.nl and transfer/deployment for other countries and regions
Description: Includes support for vocabularies for representing E-Tourism content as well as functionality for visual authoring & representation of geo-content.
IPR and Exploitation: Vakantieland obtained the complete IPR regarding the enhanced Vakantieland release.
Vakantieland plans to sell commercial licenses of the Vakantieland portal and/or to lease the portal software to partners on a franchise basis. Vakantieland will also provide support, consulting, training.

R9 Training course material
Description: This 2 day course material is provided to all partners for conducting Semantic Web trainings for customers or potential customers.
The course covers topics like URIs, RDF, RDF-Schema, OWL, SPARQL, knowledge stores, UIs.
It consists of slides, lecture notes, an assessment test and trainer instructions.
IPR and Exploitation: All partners receive an unlimited, unrestricted license to use the course material for their own purposes.
BI, B2 and PUNKT offer commercial trainings regarding semantic technologies.

4.3 Report on societal implications

A General Information *(completed automatically when **Grant Agreement number** is entered.*

Grant Agreement Number:	222011
Title of Project:	Semantic Collaboration for Enterprise Knowledge Management,
Name and Title of Coordinator:	Dr. Sören Auer

B Ethics

1. Did your project undergo an Ethics Review (and/or Screening)? • If Yes: have you described the progress of compliance with the relevant Ethics Review/Screening Requirements in the frame of the periodic/final project reports? Special Reminder: the progress of compliance with the Ethics Review/Screening Requirements should be described in the Period/Final Project Reports under the Section 3.2.2 *'Work Progress and Achievements'*	***No***
2. Please indicate whether your project involved any of the following issues (tick box) :	
RESEARCH ON HUMANS	
• Did the project involve children?	
• Did the project involve patients?	
• Did the project involve persons not able to give consent?	
• Did the project involve adult healthy volunteers?	
• Did the project involve Human genetic material?	
• Did the project involve Human biological samples?	
• Did the project involve Human data collection?	
RESEARCH ON HUMAN EMBRYO/FOETUS	
• Did the project involve Human Embryos?	
• Did the project involve Human Foetal Tissue / Cells?	
• Did the project involve Human Embryonic Stem Cells (hESCs)?	
• Did the project on human Embryonic Stem Cells involve cells in culture?	
• Did the project on human Embryonic Stem Cells involve the derivation of cells from Embryos?	
PRIVACY	
• Did the project involve processing of genetic information or personal data (eg. health, sexual lifestyle, ethnicity, political opinion, religious or philosophical conviction)?	
• Did the project involve tracking the location or observation of people?	
RESEARCH ON ANIMALS	
• Did the project involve research on animals?	
• Were those animals transgenic small laboratory animals?	
• Were those animals transgenic farm animals?	
• Were those animals cloned farm animals?	
• Were those animals non-human primates?	
RESEARCH INVOLVING DEVELOPING COUNTRIES	
• Did the project involve the use of local resources (genetic, animal, plant etc)?	
• Was the project of benefit to local community (capacity building, access to healthcare, education etc)?	
DUAL USE	
• Research having direct military use	No

• Research having the potential for terrorist abuse	

C Workforce Statistics

3. Workforce statistics for the project: Please indicate in the table below the number of people who worked on the project (on a headcount basis).

Type of Position	Number of Women	Number of Men
Scientific Coordinator	0	1
Work package leaders	1	4
Experienced researchers (i.e. PhD holders)	1	2
PhD Students	1	7
Other	1	5

4. How many additional researchers (in companies and universities) were recruited specifically for this project?	**10**
Of which, indicate the number of men:	8

D Gender Aspects

5. Did you carry out specific Gender Equality Actions under the project?

○ Yes
⊙ No

6. Which of the following actions did you carry out and how effective were they?

		Not at all effective				Very effective
❑	Design and implement an equal opportunity policy	○	○	○	○	○
❑	Set targets to achieve a gender balance in the workforce	○	○	○	○	○
❑	Organise conferences and workshops on gender	○	○	○	○	○
☒	Actions to improve work-life balance	○	○	○	○	⊙
○	Other:					

7. Was there a gender dimension associated with the research content – i.e. wherever people were the focus of the research as, for example, consumers, users, patients or in trials, was the issue of gender considered and addressed?

○ Yes- please specify

⊙ No

E Synergies with Science Education

8. Did your project involve working with students and/or school pupils (e.g. open days, participation in science festivals and events, prizes/competitions or joint projects)?

⊙ Yes- please specify: Students were involved trough bachelor/master thesis
We organized the Triplification challenge competition for students

○ No

9. Did the project generate any science education material (e.g. kits, websites, explanatory booklets, DVDs)?

⊙ Yes- please specify: We created a 3h semantic technologies tutorial as well as a semantics-based website for citizen-scientists interested in history: http://www.uni-leipzig.de/unigeschichte/professorenkatalog/

○ No

F Interdisciplinarity

10. Which disciplines (see list below) are involved in your project?

⊙ Main discipline[4]: 1.1

○ Associated discipline[4]:

○ Associated discipline[4]:

G Engaging with Civil society and policy makers

11a Did your project engage with societal actors beyond the research community? *(if 'No', go to Question 14)*

⊙ Yes
○ No

11b If yes, did you engage with citizens (citizens' panels / juries) or organised civil society (NGOs, patients' groups etc.)?

○ No

○ Yes- in determining what research should be performed

○ Yes - in implementing the research

⊙ Yes, in communicating /disseminating / using the results of the project

[4] Insert number from list below (Frascati Manual).

11c In doing so, did your project involve actors whose role is mainly to organise the dialogue with citizens and organised civil society (e.g. professional mediator; communication company, science museums)?	○ ⊙	Yes No

12. Did you engage with government / public bodies or policy makers (including international organisations)

- ⊙ No
- ○ Yes- in framing the research agenda
- ○ Yes - in implementing the research agenda
- ○ Yes, in communicating /disseminating / using the results of the project

13a Will the project generate outputs (expertise or scientific advice) which could be used by policy makers?

- ○ Yes – as a **primary** objective (please indicate areas below- multiple answers possible)
- ○ Yes – as a **secondary** objective (please indicate areas below - multiple answer possible)
- ⊙ No

13b If Yes, in which fields?

Agriculture		Energy		Human rights	
Audiovisual and Media		Enlargement		Information Society	
Budget		Enterprise		Institutional affairs	
Competition		Environment		Internal Market	
Consumers		External Relations		Justice, freedom and security	
Culture		External Trade		Public Health	
Customs		Fisheries and Maritime Affairs		Regional Policy	
Development Economic and Monetary Affairs		Food Safety		Research and Innovation	
		Foreign and Security Policy		Space	
Education, Training, Youth		Fraud		Taxation	
Employment and Social Affairs		Humanitarian aid		Transport	

13c If Yes, at which level?

- ○ Local / regional levels
- ○ National level
- ○ European level
- ○ International level

H Use and dissemination

14. How many Articles were published/accepted for publication in peer-reviewed journals?	**Journals: 5 Conference Proc.: 35**
To how many of these is open access[5] provided?	
How many of these are published in open access journals?	**3**
How many of these are published in open repositories?	**30**
To how many of these is open access not provided?	
Please check all applicable reasons for not providing open access:	
☒ publisher's licensing agreement would not permit publishing in a repository ❑ no suitable repository available ❑ no suitable open access journal available ❑ no funds available to publish in an open access journal ❑ lack of time and resources ❑ lack of information on open access ❑ other[6]: …….	

15. How many new patent applications ('priority filings') have been made? *("Technologically unique": multiple applications for the same invention in different jurisdictions should be counted as just one application of grant).*		**0**
16. Indicate how many of the following Intellectual Property Rights were applied for (give number in each box).	Trademark	**0**
	Registered design	**0**
	Other	**0**
17. How many spin-off companies were created / are planned as a direct result of the project?		**1**
Indicate the approximate number of additional jobs in these companies:		**5**

18. Please indicate whether your project has a potential impact on employment, in comparison with the situation before your project:

☒	Increase in employment, or	☒	In small & medium-sized enterprises
❑	Safeguard employment, or	❑	In large companies
❑	Decrease in employment,	❑	None of the above / not relevant to the project
❑	Difficult to estimate / not possible to quantify		

19. For your project partnership please estimate the employment effect resulting directly from your participation in Full Time Equivalent (*FTE = one person working fulltime for a year*) jobs:	*Indicate figure:* *30*

[5] Open Access is defined as free of charge access for anyone via Internet.
[6] For instance: classification for security project.

Difficult to estimate / not possible to quantify	❑

I Media and Communication to the general public

20. As part of the project, were any of the beneficiaries professionals in communication or media relations?

○ Yes ⊙ No

21. As part of the project, have any beneficiaries received professional media / communication training / advice to improve communication with the general public?

○ Yes ⊙ No

22 Which of the following have been used to communicate information about your project to the general public, or have resulted from your project?

☒	Press Release	☒	Coverage in specialist press
❑	Media briefing	☒	Coverage in general (non-specialist) press
❑	TV coverage / report	❑	Coverage in national press
☒	Radio coverage / report	❑	Coverage in international press
☒	Brochures /posters / flyers	☒	Website for the general public / internet
❑	DVD /Film /Multimedia	☒	Event targeting general public (festival, conference, exhibition, science café)

23 In which languages are the information products for the general public produced?

☒	Language of the coordinator	☒	English
❑	Other language(s)		