T-D3

Report on existing REWERSE specific courses on the Semantic Web suitable for the industry.

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Abstract

This deliverable is the first on the way towards a set of courses on Semantic Web suitable for industry. It has three main contributions: First, it shows some use cases for Semantic Web technologies. Second, it describes the requirements on industrial education which can differ significantly from education in universities. Third, it surveys the existing educational material on Semantic Web issues from deliverable E-D1 and selects some potentially suitable courses for industrial partners for further preparations. These are intended as a basis for the decision about the preliminary list of industrial courses to prepare in T-D5.

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Keyword List

Semantic Web education, Semantic Web industrial courses

Report on existing REWERSE specific courses on the Semantic Web suitable for the industry.

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Contents

Figures

Abbreviations

SW: Semantic Web

1. Introduction

The past decade showed us the boom of Internet technologies and applications. Now enterprises have Internet connection, Intranet, use e-mail, have their own website, and use the Internet to carry out their business. But tools used nowadays do not understand the meaning of the information that they manage.

The Internet provides users with a huge amount of searchable information, as well as interactive services and applications that, based on our input, allow us to book a holiday or order the latest bestselling novel for instance. But few websites are able to propose the ideal weekend break, having taken into account data regarding our previous holiday destinations, preferred types of accommodation and even our work schedule during that period.

Such services would necessitate a level of reasoning that simply is not available today, and what little reasoning that does exist on today's Internet relies on technologies that are extremely complex, and accordingly expensive.

However, REWERSE (Reasoning on the Web with Rules and Semantics) is hoping to place Europe at the forefront of research aimed at turning this vision into a reality.

The objective of REWERSE is to establish Europe as a leader in reasoning languages for the Web by networking and structuring a scientific community that needs it, and by providing tangible technological bases that do not exist today for an industrial software development of advanced Web systems and applications.

REWERSE gives a lot of opportunities to enhance companies' business thank you to its web applications with reasoning. For instance, the Semantic Web is potentially applicable for e-commerce or for e-procurement. The end users will also benefit from REWERSE: 'Telling someone where to find the 'nearest pharmacy' will depend on exactly where they are, whether they are driving, and therefore, the availability of parking.

Understanding why Semantic Web is interesting for the industry will give us some clues about how industrial courses should be developed.

The Industrial companies should be aware of all advantages that the Semantic Web provides. The Technology Transfer and Awareness (TTA) activities in REWERSE are targeted at the European industry on reasoning languages for Web systems and applications.

The Technology Transfer and Awareness (TTA) activities are focused to dissemination to the industry not involved in REWERSE and dissemination to the research communities.

The objective is to create a durable structure supporting technology transfer and dissemination of knowledge created by REWERSE also after the end of REWERSE funding. To achieve this REWERSE strives at establishing a European network of industrial competence centres offering industry targeted training and education on Semantic Web topics. For this purpose it is very important to present REWERSE's results to the industry, and to convince the industry to use this technology and participate in the REWERSE community.

The main goal of this deliverable (Report on existing REWERSE specific courses on the Semantic Web suitable for the industry) is therefore to collect the industry needs and requirements for presenting them in an accurate way the REWERSE results and to make a survey of all existing industrial and educational courses related to the main REWERSE topics.

For this achieving this goal also, REWERSE will launch an industrial-training infrastructure and a set of courses about Semantic Web issues.

This report presents also why Semantic Web technologies are interesting for the industry and in which cases they can be employed. Then, the singularities of the industrial courses are discussed. Thus, we will be able to expose later the necessary recommendations to adapt the educational courses compiled by the Education and Training (ET) Working Group of REWERSE to industry needs. Finally, the suitable courses for the industry are listed. These courses will be modified following the recommendations outlined in this report.

Hence the main objectives of this report are the following ones:

*To survey use cases where industry could be interested in applying Semantic Web technologies

*To derive requirements on material for industrial education.

*To survey the existing educational material

*To provide an initial classification / taxonomy of Semantic Web topics

*To survey the available material to see which topics are available and which ones are missing

For achieving these goals, we have maintained a long series of meetings with different companies for collecting their requirements and recommendations. We would like to thank all the companies that have invested their time answering our questions for helping us to improve our knowledge about the industrial needs.

The relationship between REWERSE and the industry would, therefore, become a symbiosis: REWERSE would help the industry to acquire all the knowledge on Semantic Web technology and the industry is one of the best channels to spread REWERSE's research results.

2. Use cases: Applying Semantic Web techniques

When comparing industrial training to academic training, the first one is much more focused on the specific application of one technology in specific areas: The academic approach is more abstract but the industrial one is more tangible. Thus, it is first necessary to discuss appropriate use cases, which could be of interest for the industry and which can then be used as a basis for the discussion of potential material for industrial education. This section starts with an overview of the advantages the Semantic Web technologies provide and continues with a set of use cases, where the Semantic Web technologies benefits to the industry sector are shown. Those topics that industrial courses should cover can be identified from this section.

2.1. Advantages of Semantic Web techniques

The Semantic Web (SW) offers many advantages over previous web technologies that make web applications more useful and human independent, but also, its use could increase companies' profits since SW techniques improve the efficiency of these applications. The main advantages are:

2.1.1. Improved web search

The first clear advantage of Semantic Web techniques is the potential of improving web search since SW mechanisms allow for a better analysis of the items to be found. Nowadays, the keyword or word spotting searching is based on true-false results. Ontology-based searching uses the relationships and axioms of concepts, thus it can filter some seemingly appropriate but not desired results and add some seemingly different but actually same results. For instance, if you look for unleaded petrol, your search engine can expand the search to 95 or 98 octane unleaded petrol if both of them are derived from the concept 'unleaded petrol' in the associated ontology. Moreover, this SW-enabled search engines would not only be able to search the object in the language of the query, but also in other languages because the system understands what the user wants.

In this way, Semantic Web technologies enable a search engine to better understand what you are looking for and increase the precision of the returned results. This is especially important in companies who have to deal with a large amount of data. SW-enabled search engines are also especially advantageous in intranets of large companies, because the business of the companies is focused on certain domains where it can be possible to define suitable ontologies.

2.1.2. Better integration

The second main advantage of SW techniques is a higher potential to integrate different components. Business partners are enabled to better understand the syntax and semantics of their documents, to exchange them, and to transfer them into the appropriate application for further automatic processing without human intervention. This also includes appropriate mapping or translation mechanisms. However, even humans can take advantage of a better integration, since ontologies can model relationships between the participants of such a process so they can uncover the hidden structure.

On the software developer side, a higher degree of integration could also promote software component reusing in addition to a higher degree of automation.

2.1.3. Lexicon flexibility & standardization.

Theoretically, ontology mappings and translation allows users to flexibly choose the words they like. A generic ontology would facilitate the mapping and translations of ontologies. All ontologies would be mapped to this generic one and this generic one would be mapped to all

of them. There will be a leak of precision but less ontologies translators would be necessary. It could be also used for standardizing the concepts, and improving the communications between different partners.

2.1.4. Composition of complex systems

In Semantic-Web enabled systems, it is possible to compose numerous Web services and Web contents to produce one more complex system. Several SW technologies could be combined to develop a complex system with further functionalities.

2.2. Example use cases

This section sketches some use cases in which Semantic Web technologies could be applied successfully. In general, information management and interchange is an important area since many industrial information processes have been transferred to computers, currently in the form of conventional data storage and interchange. However, the amount of information that organizations manage today requires intelligent systems that should be able to understand this information. Thus, industry would be interested in more intelligent systems that could manage and process its information and data, and locate resources through the net (Internet and intranet). Industry would like to enhance these kinds of procedures that are presented in its day-to-day activities.

2.2.1. E-commerce

E-commerce is done faster, on a global scale, and with fewer human interventions than traditional trade. Electronic interactions are increasing the efficiency of purchasing, and are allowing increased reach across a global market. But e-commerce can clearly be improved by Semantic Web enabled search facilities to be able to search for the right products and services, business partners, customers, and web services. This is again especially important for companies which have to process a very large amount of data. Examples for Semantic Web enhanced e-commerce applications can be found in the areas of online advertising or Web-data extraction. In the latter case, better software connections are a key challenge to the quick evolution of e-commerce applications. Rather than waiting for suppliers to recode applications to Web service standards, companies can choose a cost-effective path to better Web connectivity: Web Extraction technologies enable break-through results in Web application integration on the basis of existing technologies.

Another example, where a meaningful search could take place, is online-shopping systems, looking for those products that the customer would like to buy. The system would understand what a user needs and it would provide him with the product he is looking for. Semantic Web based search engines can operate among different languages because they understand the meaning of the search, so it would easy the world-wide e-commerce thanks to their capacity of overthrowing language barriers.

Language barriers are not the only ones that could be overthrown. If the system could understand what the user means, the interaction between user and system would be easier and nicer. The client of an online shop could express his needs in the way he does when he goes to a brick-and-mortar store. So, the system could behave like a salesperson.

The automation of the whole product life cycle is another application of Semantic Web techniques in e-commerce. Thus, no salesperson would be necessary. The customer will buy the product he wants through the Internet and then the system itself would be in charge of getting that product and sending it to the client's home. This intelligent e-commerce platform would automate not only the shopping procedure, but also enable a customization of the website. In this way the portal would identify the client's likings and his shopping custom. For this purpose, it is necessary to acquire, extract, process, and store all the available information of each user and convert it into knowledge instead of raw data. Thus, the intelligent centre of the system would use this knowledge to customize the portal according to client's profile.

Knowledge processing for web systems and applications is, therefore, one of the most worthy topics for the industry.

2.2.2. Business-to-Business Applications

In the business-to-business (B2B) e-commerce arena, the last couple of years have seen a continuous flourishing of E-marketplaces. E-marketplaces aggregate buyers and sellers in a single virtual location to create dynamic trading exchanges. B2B applications mostly take advantage of a higher degree of integration, which can be achieved with Semantic Web techniques. It would be easier to connect to different applications of different business partners if the information they exchange is annotated with additional meta-data for a better understanding. For this purpose, semantic B2B engines are currently emerging to alleviate document exchange among business partners, especially if a large amount of information has to be exchanged, which can hardly be handled by humans.

The clearest example of this could be an online travel agent. A user could want to travel to a city and the online travel agency should provide him all the necessary services: the flight, hire a car, book a hotel, etc. So the travel agency platform needs to be in contact with other systems in order to carry out these actions. It means also the automatic negotiation and purchase of services through the Internet.

This refers to a dialogue between systems, not human beings. Web Services are the current solution in this case, but they should be improved in order to locate the right service for each case. The way that information is treated in these cases could be better and more efficient. A good and meaningful communication between systems would ease the creation of complex systems.

2.2.3. Business-to-Customer (B2C) marketplace for personalised offerings

The clearest example for this application could be the tourism sector; we also referred the travel agent example before. Online offerings of personalised tourism packages are highly demanded by tourists. They have become an important part of the Internet commercial activity. The reasons of this growth are:

- The browsing of offers can be spread out over time, with no pressure, different from a specialised travel agent.
- It is possible to browse rival sites directly online.
- It offers centralised reservation and payment services, just like an agency.

However, we can indicate also a disadvantage:

- The customer does not gain benefit from the expertise of a professional, who can guide him through the ins and outs of the offers and the opportunities to grab hold of. His visibility of offers and services depends on his skills in using a search engine and browsing Internet sites,

The current sites essentially suggest package offers based on some information combinations (destination, period, price…), which form the framework of the promotional "package". Semantic Web technology could be used to complete the commercial perimeter of current holiday package offers, with some dynamically packaged solutions to meet the customers' expectations (holidays, weekend, all leisure services).

2.2.4. Knowledge management

Knowledge management includes the processes of capturing, extracting, processing, and storing knowledge. Ontology-based applications in this field could be: Ontology-related inference engines, topic maps, content management, information retrieval and information visualization. This can also been applied to multimedia collections, where ontology technology offers a way to enable semantic modelling on objects, such as images and audio, that could be organized more easily and found more efficiently.

2.2.5. Web-based decision support systems

Web-based decision support systems would be very profitable for industry partners. It would help them to automate their procedures in an intelligent and efficient way. These decision systems should cover several kinds of data such as events, temporal and geographical data.

2.2.6. Recruitment

The recruitment of employees is an important practice for any business. During last years the Internet has become a main channel for recruitment. The actual use of IT in recruitment processes has been profitable for enterprises in terms of money. But also IT has helped firms to find a most suitable candidate for a determined vacancy.

Semantic Web technologies could improve the efficiency of recruitment processes, both for firms and job-seekers. It would help to match job-offers and job-seekers since semantics supports richer matching based on expressed relationships between characteristics of jobs and candidates.

To find the best candidate in the fastest way assures to save money. It also spreads the range of possible candidates which potentially could bring a higher amount of well-trained candidates to the firm.

2.2.7. Multimedia Content Analysis and Annotations

The problems of developing and maintaining large multimedia databases will not be solved by developing faster hardware or designing more sophisticated algorithms. A deeper modelling of the information at the semantic level is required. Retrieving semantic information and extracting knowledge from such content are key factors for the well management and usability of multimedia content. Thus multimedia content could be easily found and accessible by using computers instead of manual searching. This could be done thanks to the annotations of knowledge extracted from the multimedia content, so humans and machines can process large bodies of multimedia more easily. Such tools can reduce costs for producers and encourage the use of media services.

3. Requirements on material for industrial education

Industrial education differs significantly from education for students (e.g. MSc or PhD students). This issue has to be taken into account in the development of industrial courses. Thus, this chapter will comprise a list of requirements on material for industrial education. These requirements will be used in the following to select appropriate courses from the available ones listed in E-D1.

3.1. List of requirements

3.1.1. Requirements related to the audience

Material for industrial education should be specifically intended for a certain target group (ideally for a certain company having a certain business case which shall take advantage of Semantic Web technologies). Specifically, industry courses have to deal with the questions:

- Who is going to be trained?
- Which skills shall be communicated?
- For which specific task can the acquired knowledge be used?

This relates to both, form and content of the course. For example, when adapting existing university material, all educational material related to the evaluation of students could be erased, or adapted to evaluate the knowledge acquired by industries.

It is important that the industrial audience can immediately see a useful scenario where they can apply Semantic Web technology.

From the REWERSE perspective, this requirement is very difficult to fulfil: The target audience for the industrial set of courses is not defined yet, so the material cannot be adapted to a specific audience. One possible solution is to focus the material for industrial education around few use cases, for example, as defined in the previous section 2 or which are currently developed in the industrial area of the NoE KnowledgeWeb.

In general, the following professional audience can be differentiated:

- Technology monitors (which don't need education but just information)
- Executives and managers, project managers
- Programmers

We will discuss the requirements for project managers and people with an advanced technical background, because they are likely to be the first to contact REWERSE. They can be chosen as the main target audience for the industrial set of courses. They are likely to fit the features of our courses for the industry. For instance, they will catch SW technologies and advantages in a 1-2h overview course.

3.1.2. Requirements about taking time into account

Industrial education is not only costly in the sense that the teachers have to be paid, but also because the participants cannot do another work for the company during the education period. Therefore, time is a much more important (cost) factor than in university education.

But also it is very difficult that people from several enterprises could be present in a learning event at the same time due to their agendas. For this reason, the courses and learning material should be prepared to make easy that people learn the issues on their own. Here the idea of asynchronous industry-oriented courses emerges.

Therefore, a 2h overview course addressed to project managers could be the first step. It would be enough to introduce the benefits of SW technologies. After that, further information could be offered under demand.

3.1.3. Requirements about forgetting the academic approach

Industrial courses must not be approached in the way usual academic ones do. For instance:

- Do not present too many details on research. There is no "interesting question" for those who want to apply a technology. Do not discuss differences between OWL-DL and OWL-Lite. Do not present the pros and cons of DL vs. F-Logic. Do not speak academic language (also: professionals rather do not go to a library to grab some article in some ACM transactions...) Remember that there is a huge gap of research knowledge between academics and industry.
- Forget about technical details. Do not give long enumerations of syntactical issues or complete lists of statements, elements etc. It isn't interesting. It will be interesting later for programmers. Simplify in order to present the core idea of the technology.
- Forget about fascination with "new technologies". Relate to which problems exactly are better solved. Compare to today's solutions (remember that these are prior investments that cannot easily be replaced just for the sake of using something new that these research people consider a hot thing)

3.1.4. Requirements about providing a business approach

Thus, industrial courses should:

- Provide a business context. Give estimations/ways to estimate the cost/benefits for the technology under consideration. Report on your experiences in previous projects. Consider the whole lifecycle of the system (so what about ontology-maintenance, who at what costs?) What are the costs to send technical stuff to technical courses? Consider the role of the problem in the business cases of the audience: Does a cost cut in 50% in the specific target use case of the technology induce a noticeable cut in the overall enterprise?
- Provide a business perspective. Give good use cases as illustrations. Try to come closer to the areas of the audience. Spend very much time to present and discuss these use cases.

3.1.5. Requirements about providing state-of-the-art information

A state of the art of each technology could be added too, in order to compare different solutions for industry needs. In this way, a directory with enterprises that have developed systems based on SW technologies or that are dedicated to implement these technologies could be added. Information about stability of the technologies, tools, availability, and cost should be provided, too. We should ensure that this community is large enough to provide support and other services to all its members.

Moreover, the course should include a guide to extend SW knowledge and to be up to date about new developments and research. Thus, we should also be focused on industry needs. For instance, whereas the Semantic Web is still a vision, the (sub)topic how to automatically interact and extract data in a structured manner from today's web is a topic highly requested by various businesses, including CRM (e.g. address updates with web data), Business Intelligence (e.g. price comparison), automotive (e.g. automation of portal-based communication processes), and news monitoring, to name a few. In fact, a tutorial about web data extraction will be developed in the REWERSE educational track.

All above mentioned issues could be included in a chapter called 'How To' which should look like a Do-It-Yourself book covering SW technologies. Apart from that, further assistance on

details could be offered. Extended courses could be offered under demand (this further assistance can be paid, of course).

3.1.6. Requirements about focusing on applications and results.

Companies are interested in SW issues because it enhances its use of the Internet, but not in the same way as for researchers or students. Industry would be more concerned in results and applications that would help them to satisfy their needs in their day-to-day business. Courses for industrial education must, therefore, be practically oriented.

So REWERSE should provide the industry with educational material which helps in the implementation of Semantic Web technologies. Industrial education should not try to provide a course which covers each detail from a particular area of knowledge.

3.1.7. Requirements about providing examples

To show the applicability of Semantic Web technologies, it is important to give more examples and give them in a systematic way around a definition or a proposition:

- First an example showing a usual and interesting problem case.
- Then the definition or proposition
- Then come back to the example or another one to illustrate the proposition and what it means.

This clear line of examples is important for an industrial audience in parallel to the technical details; industrial people take examples more seriously.

More examples and implementations facilitate the application of SW technologies for enterprises. It would be interesting to include small components built using SW technologies, so enterprises could easily modify them in order to develop more complex applications, adapted to their needs. Furthermore, these components should be easily connected to build more complex applications. So some application examples could be detailed, too.

3.2. Learning material structure

We have to take into account that enterprises that belong to the IT sector are likely to have professional skills in many of the foundation technologies, for example, XML. Thus, foundation courses should only be an optional component for industrial education. They are already offered by other companies, so we would only have to tell about them.

So courses should have two levels of learning of these technologies. One of them focused on the concepts of each technology, without mentioning Semantic Web issues.

That could be the first tier of a three-tiers learning material model. On top of that tier would be the courses that are focused on the use of each technology to conform Semantic Web components and applications. These courses would be targeted to those users who already know that technology but not how he can use it in the field of Semantic Web. The third tier would be intended for a whole approach on Semantic Web issues and applications.

This three tier model could be seen on the following figure:

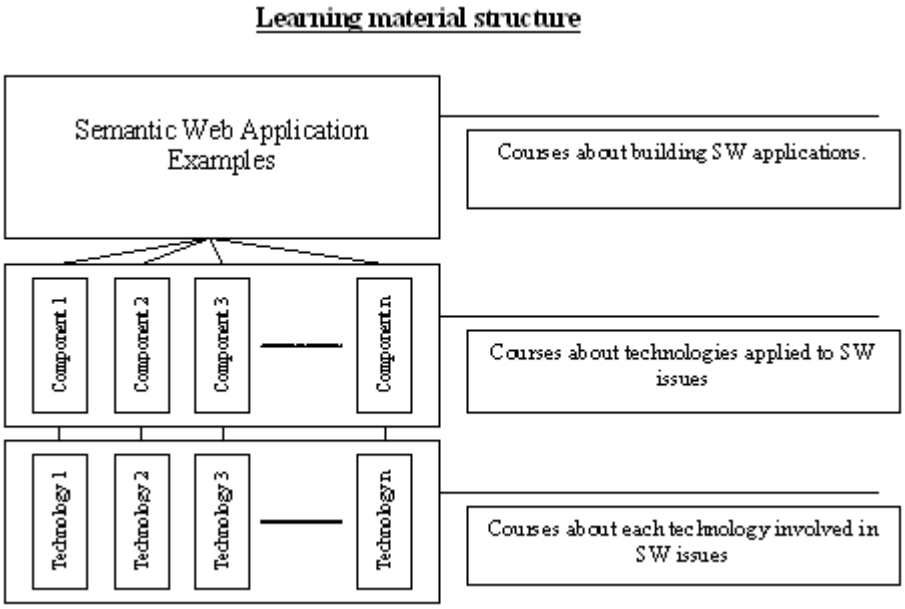

Figure 1. Learning Material Scheme

Interesting topics for industries are related to the implementation of each technology, and how all of them can be put and brought together in order to build a whole Semantic Web application.

4. Analysis of the ET REWERSE courses

The aim of this report is quite similar to the E-D1 report since both of them aim to collect courses about SW issues. However, E-D1 was intended to comprise all SW related material to create a generic set of courses for Semantic Web education. This report aims at the creation of an industrial set of courses, for which the first steps are described in here. The current work plan is:

1. Collecting SW-related existing courses (done in E-D1)
2. Create a SW taxonomy to be able to sort them into different categories (a first attempt will be done in this report)
3. Select those existing courses which seem appropriate for an industrial set of courses. Break existing courses into modules in order to be able to recombine different courses into a set of courses without having duplicate modules.
4. Recombine the modules into different courses suited for industrial education.
5. Create new modules about topics which are important for the industry but not yet covered by existing material.

In general, there are courses about all issues treated in the REWERSE project, but there is much information about some topics, and there is less information about others. In case there are several courses dealing with the same topics, the selection should try to choose the best one suited for industry (or a small group of best courses).

4.1. Preliminary classification of the existing courses

As already implemented in the KnowledgeWeb learning unit repository 'VISWER' (http://ubp.l3s.uni-hannover.de/ubp/), there are three main classes of Semantic Web topics with several subtopics:

1. Foundations
    a. Logics
    b. Web technologies (e.g. markup languages)
2. Semantic Web Core Topics
    a. Knowledge Representation
    b. Ontologies
    c. Semantic Web Technologies
3. Semantic Web Special Topics

4.2. Analysis of existing courses in E-D1

Now, we will discuss about the topics treated in the ET courses. There are many courses about foundation of Semantic Web such as markup languages, (e.g. XML), which are well-known by IT professionals and, thus of less interest. However, other foundation courses such as logics may be interesting, but on a less formal level and more oriented to the applicability of logics to day-to-day problems.

There are many courses about Semantic Web basic issues such as knowledge management, ontologies or the technologies involved in Semantic Web. Perhaps, some of these technologies should be developed in courses about each technology in particular.

Special topics such as Intelligent Agents and Reasoning might also be interesting for the industry because they enable the creation of advanced and intelligent web systems and applications.

4.3. Existing courses potentially suited for the industry

The courses in this list have been selected either because the authors have explicitly marked them as being suited for industrial education (mainly the KnowledgeWeb courses) or because they seem to match the above listed requirements.

- **Course 04. Constraint Programming**.
  - This course presents to constraint programming with a strong focus on logics and semantics. Constraint programming is necessary for REWERSE's research and development; it would be needed for almost all the working groups.
  - Contact person: Francois Fages (Paris).
  - Classification: Foundations (logics)

- **Course 05. Constraint Reasoning and Programming**.
  - Programming with constraints allows to specify problems with incomplete information. It is particularly appealing to take care of special domains with powerful querying facilities, which can be nicely and naturally integrated with rule-based systems. It is very useful for industry and commerce. Constraint logic programming languages are also described here along with commercial applications and case studies.
  - Contact person: Slim Abdennadher (Cairo).
  - Classification: Foundations (logics)

- **Course 18. Introduction to Human Language Technology (HLT) for the Semantic Web**.
  - The Semantic Web, Grid technologies, and Web services will be building blocks of the upcoming next generation Web. Key to the success is the production and maintenance of formal data. The Semantic Web and SW services rely on formal semantics in the shape of ontologies and related instance sets, or knowledge bases. Whereas the simplicity of HTML and the ubiquity of natural languages led to the organic growth of the hypertext web, semantic data is harder to create and maintain. HLT provides the missing link between language and formal data, the glue to fix web services to their user constituency and enable easier enterprise integration. This tutorial covers the use of Human Language Technologies for the Semantic Web and Web Services.
  - Contact person: Hamish Cunnigham (Manchester)
  - Classification: Semantic Web Special Topic

- **Course 20. Tópicos de Representação de Conhecimento para a WEB**.
  - Some basic concepts are discussed here, namely UNICODE, URIs and IRIs, XML Base, XML Namespaces, XSL, and XML Canonicalization. The Resource Description Framework (RDF) and RDF Schema languages are also presented. Description Logics, OWL language and RuleML are also introduced.

Uniform Resource Identifiers are dealt in WG I1.

- Contact person: Carlos Damásio (Lisbon).
- Classification: Foundations (web technologies, logics), Semantic Web Technologies (RDF etc.), Ontologies

- **Course 22. Knowledge Base Programming with Frames and Logic**.
  - This course is focused on FLORA-2. It is a knowledge base development platform, which is based on F-Logic, HiLog, and Transaction Logic.

    WG I3 includes description logics and F-Logics that are implemented in a general purpose logic programming language FLORA-2.
  - Contact person: Michael Kifer (New York).
  - Classification: Foundations (logics)

- **Course 23. Knowledge Management on the Web**.
  - KM is one of the bases of the Semantic Web because it allows data processing through machines and no person is needed. This course also describes the basic SW technology (XML, DTD, schemas, XSLT, namespaces, Xpath, RDF, RDF Schema, Query languages, OWL, ontologies, ontology development basics, Rules on the Semantic Web, RuleML) and some basic applications, that could be interesting for the industry in order to apply the knowledge acquired for e-commerce, knowledge management, etc.
  - Contact person: Grigoris Antoniou (Heraklion).
  - Classification: Foundations (web technologies), Semantic Web Technologies (RDF etc.), Ontologies

- **Course 27. Lectures on Semantic Web**
  - The objective of this course is to explain the basic concepts of the Semantic Web, to discuss the ongoing research in the field and to test practical usefulness of the existing tools and applications.
  - Contact person: Monika Lanzenberger (other)
  - Classification: Semantic Web technologies

- **Course 32. Logics for the Web**.
  - Logic plays an important role in the Semantic Web. This course is about Description Logics, Horn Clauses, and F-Logics for SW. It also describes ontology languages, such as DAML+OIL and OWL, and their relation to DL.
  - Contact person: Patrick Lambrix (Linköping).
  - Classification: Foundations (logics)

- **Course 36. Ontologies in a Nutshell**
  - This short tutorial comprises a short introduction to ontologies in knowledge management and the Semantic Web
  - Contact person: Fabien Gandon (other)
  - Classification: Ontologies

- **Course 39. Semantic Web**
    - This course provides an introduction to the Semantic Web and its foundations such as XML, RDF, Ontology languages, logics and inferences, and adaptive hypermedia systems
    - Contact person: Nicola Henze (Hanover)
    - Classification: Foundations (web technologies, logics), Semantic Web Technologies (RDF etc.), Ontologies

- **Course 40. Semantic Web**.
    - In this course seminar, RDF, OWL and RuleML/SWRL are discussed with their corresponding software tools. RDF and OWL are treated in courses above, besides RuleML. Furthermore, these courses describe three languages and tools focused on SW.
    - Contact person: Gerd Wagner (Eindhoven).
    - Classification: Semantic Web technologies

- **Course 45. Semantic Web Services**.
    - This tutorial covers an introduction to the semantic web and semantic web services, an overview of WSMO, WSML, WSMX, and IRS III and a 1.5 hour hands on session.
    - Contact person: John Domingue (other)
    - Classification: Semantic Web Technologies, Semantic Web Special topics

- **Course 55. The Semantic Web: Ontologies and OWL**.
    - Knowledge representation and "ontologies" are some of the items needed to develop the Semantic Web and meta data. This course presents the knowledge representation paradigms used in a variety of applications.
    - Contact person: Ian Horrocks (Manchester).
    - Classification: Ontologies, knowledge representation

- **Course 58. XML and Databases**.
    - This course is about techniques and methods related to XML and databases developed in the last years. The course gives an introduction to XML basics, formalisms for specifying XML data schemas, query and transformation languages for XML, and indexing methods for XML data. It seems to be quite complete and XML is something very near to REWERSE for instance in WG I1.
    - Contact person: François Bry (Munich).
    - Classification: Foundations (web technologies)

- **Course 6s. Semantic Web Information Day**
    - The Information Day gives an overview of the fundamental concepts and technologies of the Semantic Web. It enables you to incorporate the buzzword ‘Semantic Web’ into your lexicon. Furthermore, it gives you an opportunity to evaluate the meaning of Semantic Web for your existing and future projects.

- Contact person: Robert Tolksdorf (other)
- Classification: Semantic Web technologies

Currently, most of these courses are thought to be carried out in academic environments, so they have to be adapted to the requirements of the industry.

4.4. Identify missing topics

Most of the Semantic Web subjects from the above classification are covered by the existing ET courses. If the few missing issues are important they should be added. Obviously, what is not included in these courses are the REWERSE R&D results. They should be included when available.

Nowadays, the customisation of virtual communities and the management of digital libraries are being new subjects that SW technology could help to develop. Besides, a generic ontology that can be used to map ontologies of different kinds is something demanded by some software development industries.

But rather than talking about missing topics in these courses we should remark that the most important thing is to adapt the available courses to Industry. We exposed before, in chapter 2, what Industry expects from SW technologies, so courses should be targeted to satisfy these needs. The way to do it is shown in chapter 3.

4.5. Conclusions

The selected courses that could be interesting for enterprises comprise at least one course from each technology. The best one should be picked out, eventually, for a final industrial set of courses. However, many courses overlap, for example, they start by introducing basic issues and then continue on different topics. They have to be split into several modules before they are finally useful for the industrial set of courses. For some occasions, it might also be good to have alternative courses in the list, for example, if this list is used as a basis to organize a workshop/training event for the industry.

Finally, the courses are not applicable for industrial education as they are as they have to be adapted in order to fully meet industry requirements. However, this can only be done efficiently by the authors themselves which know deeply the topic of the course. As most REWERSE partners come from the university world, TTA will prepare a list of recommendations how to convert university courses to industrial courses. This is intended to alleviate the work of the authors when adapting their learning material to industrial needs.

5. Recommendations: How to prepare material for industrial education

We have exposed in the chapters above how the material for industrial education should be prepared. Here we summarize them:

- Focus on solving the needs and use cases exposed in chapter 2.
- Be aware of the kind of the target audience in order to decide which technical level to employ.
- Be aware of the time restriction of industries. In industry time is money.
- Do not include details about the research.
- Forget about technical details. It is interesting later for programmers. Simplify to present the core idea of the technology.
- Be brief and concise. Forget the fascination of new technologies.
- Provide a business context and perspective.
- Provide a state-of-the-art of each technology.
- Give further information and assistance on demand.
- Focus on applications and results.
- Give examples.
- Give a tiered structure of the course material, so each industry could pick out the most suitable for it.

6. Conclusions and future work

We have shown the requirements for industrial courses in the chapters above. The conclusion is clear, educational and industrial courses should be oriented in different ways. We could summarize this saying that educational courses are more theoretical and industrial ones more practical.

After this report, the next steps to follow are:

- The design of the industrial education infrastructure TD4.
- The development of a first draft of an industrial set of courses in TD7.

For this purpose, it is necessary to allocate resources to the development of the courses. A lot of support from the courses authors as well as from the REWERSE partners will be needed for the development and adaptation of industrial courses.

The promotion of the industrial courses and the Industrial Awareness events will be also future activities to carry out and quite related with these set of courses. It will be a very good opportunity to spread the REWERSE results and knowledge.

Annex 1: Industrial companies providing feedback

For preparing this deliverable, the valuable comments we have received from the industrial companies we have contacted have been included. For presenting the project and collecting requirements, needs and advices for preparing the REWERSE TD3, we have maintained a long series of interviews and meetings with the most representative European industrial companies. A lot of phone conferences have also been maintained for discussing about how we can present the REWERSE results to the industrial companies in a way easy to understand and useful for them.

Several questionnaires were also prepared and distributed for collecting the ideas and requirements from the contacted companies. These questionnaires have been distributed to several kind of enterprises: to big industrial companies like Siemens, Philips, Motorola, Microsoft, Ericsson, Nokia, ATOS Origin ……..and to smaller companies like Innova, CNET, Aubay, Tecsidel, Polar SHS…… and of course the main telecom operators have been contacted as well the Telefónica Group companies, mainly Telefónica Móviles and Telefónica Soluciones. A total of more that 30 companies have been contacted.

The main questions presented to the companies have been the following ones:

- What is your position inside the company?
- Are you aware of the Semantic Web technologies and the REWERSE project?
- For what areas/activities would you use the Semantic Web technologies?.
- How the Semantic Web technologies and therefore the REWERSE results will help to improve your business?.
- How many time/money/resources your company invest on training/education/updating employees on new technology?
- In which REWERSE results are you more interested?
- What are you expecting from a Semantic Web and a REWERSE course?
- Which recommendations would you give to the REWERSE course authors?
- Would you be interested on attending these courses?

Finally we would like to thank all the companies that have inverted their time answering our questions for helping us to improve our knowledge about the industrial needs.