# THE DIP PROJECT: ENABLING SYSTEMS & SOLUTIONS FOR PROCESSING DIGITAL CONTENT WITH SEMANTIC WEB SERVICES

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This paper introduces an ongoing research project within semantic web and web services technology – DIP project (Data, Information and Process Integration with Semantic Web Services). Research challenges are introduced, application scenarios are presented potential impact highlighted and expected results are listed. Finally a full description of work packages is outlined.

## 1. Introduction

Current web services are based on – if not limited to – the interaction between humans and computer systems. Their extension to similar transactions between computers requires machine-processable semantics of data and information. The **Semantic Web,** initiated by World Wide Web inventor Tim Berners-Lee [1], has the goal of developing adequate solutions for these problems. Through the use of ontologies and metadata – information about information – the Semantic Web enables the computer to query, retrieve and manage semi-structured information. The Semantic Web is therefore fundamental to enabling systems and solutions for processing information by providing a universally accessible platform. This allows it to be shared and processed by automated tools, by providing machine-understandable semantics that enable automatic processing and exchange.

A range of mark-up frameworks and languages have already been developed, notably the revised Resource Description Framework (RDF) [4] and the Web Ontology Language (OWL) [3] which mark the emergence of the Semantic Web as a broad-based, commercial-grade platform. However, much work remains to be done for upper layers of the Semantic Web, which are considerable research challenges.

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Complementary to the Semantic Web is **Web Services,** a new breed of application. These are self-contained, self-describing, modular applications that perform anything from simple requests to complex business processes, which can be accessed across and via the Web. Web services can significantly increase the potential of the Web's architecture by providing a way of automated program communication, discovery and invocation of services.

The next step to Web Services is a fusion of Semantic Web and Web Service technologies - called **Semantic Web Services.** Semantic Web Service technology will allow structural and semantic definitions of documents, providing completely new possibilities in Knowledge Management, Enterprise Application Integration, and e-Commerce. Based on its ability to provide semantic processing of data, information, and processes will provide Semantic Web Services especially for e-Commerce a new infrastructure, just as the telephone did a century ago for mankind.

## 2. The DIP project

The EU-funded DIP[2] (Data, Information, and Process Integration with Semantic Web Services) project has the mission is to make Semantic Web Services a reality by providing the required infrastructure, i.e. an open source architecture and a set of exploitable tools. The successful creation of such an infrastructure could potentially change the way electronic co-operation and business is conducted in the same way that the original Web revolutionised access to electronic information. Furthermore, a combination of Semantic Web and Web Services technology may well deliver the killer application for the Semantic Web. Semantic Web Services can provide an infrastructure that would not only revolutionise the processing of digital information but also the way we access computational resources in general. They will provide a completely new infrastructure to facilitate more effective and cost-efficient electronic business by reducing drastically the costs of Enterprise Application Integration (EAI). This is considered today to be the major bottleneck for realising the full potential of electronic co-operation and business. Studies estimate that up to 30% of IT budgets and resources are currently spent on EAI activities within one company and to other ones. As EAI is extended to address Process Mediation needs, this percentage even can become larger.

DIP aims to get these integration or mediation activities performed automatically and dynamically and therefore develop Semantic Web Services as a scaleable and cost effective solution to existing integration problems. The elimination of one of the key inhibitors of the modern networked society based

on electronic communications would be another revolutionary contribution, with an almost immeasurable impact. Eighteen partners, consisting of European Universities and leading IT focussed companies are working together for three years to accomplish these results. They are structured in fifteen teams with individual research and development focus.

## 3. Research challenges

There are several research challenges that DIP is addressing as follows:
**Information Management challenge:** DIP will address and employ Semantic Web Service technology to allow structural and semantic definitions of documents providing completely new possibilities: Intelligent search instead of keyword matching, query answering instead of information retrieval, document exchange between departments via ontology translations, definition of views on documents providing personalisation and contextualisation of information.

Ontologies specify the make-up of domain knowledge in a formal logic designed for automated processing by machines. This shifts the onus of understanding digital content from algorithms, functions, procedures and rules in software components to the representation of the content itself. Through the introduction of semantic attributes, they make digital content more readily accessible, understandable and usable to ontology-aware services and systems However, the state-of-the-art can only currently deal with small-sized, homogeneous, and stable ontologies, which leads to three major challenges:

- Large-scale ontologies are difficult to build.
- Ontologies need the consensus of heterogeneous groups, i.e., they are distributed and heterogeneous by definition. An appropriate infrastructure for structuring ontologies in an effective way is required.
- Ontologies reflect consensus that changes over time, i.e., they need to be dynamic. A flexible infrastructure that copes with this dynamic nature is needed.

Next figure 1 shows the natural evolution of enterprise applications (EAI) towards Semantic Web Services that DIP is going to address.

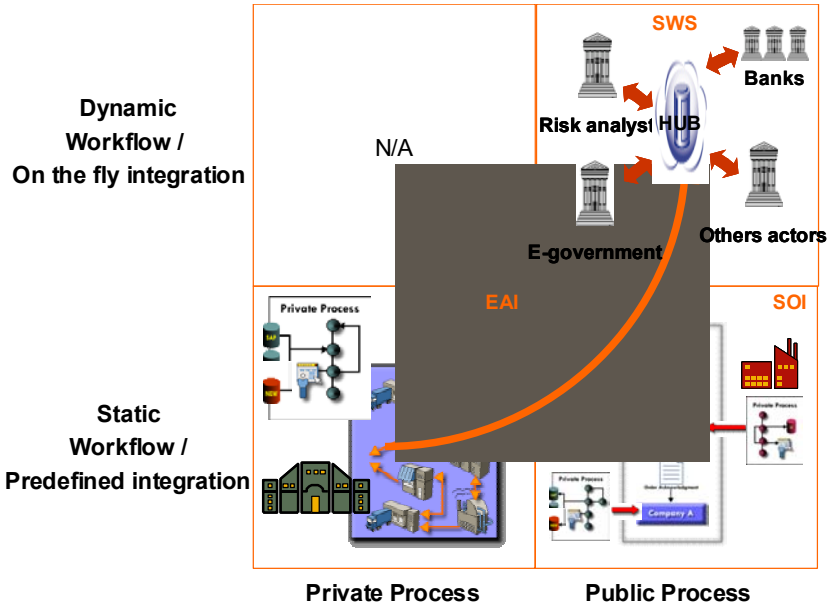


Figure 1 From EAI towards SWS

**Enterprise Application Integration challenge**. DIP will address develop a successful integration strategy that combines the advantages of ad-hoc and global integration strategies. Learning from ad-hoc integration means ensuring we reflect business needs as the driving force for the integration process. Learning from global integration means ensuring we create extendable and reusable integration. In consequence, DIP will adopt the following goals, which are essential ingredients for successful integration:

**Purpose-driven** Business needs should drive the integration process. We need to identify the major integration needs in terms of business processes and available information sources. We structure our integration efforts around these needs and employ integration techniques that avoid the disadvantages of ad-hoc integration, i.e., we care about extensibility and reusability.

**Extendable**. We will use ontologies to avoid ad-hoc integration. We will use ontologies for publishing information regarding data sources and for aligning it with business needs. By using ontologies for the purpose of making information explicit, we will ensure that our integration efforts can be extended in response to new and changed business needs.

**Reusable**: We will use Web Service technology to reflect further integration needs based on standardisation. Ontologies provide extendable

integration solutions. We must ensure that our chosen software architecture enables their actual reuse in new business context.

**Flexibility**: We will use Semantic Web Services for ad-hoc integration on the fly in accordance with changing demands. Current integration efforts reflect fixed integration needs that are always behind the actual needs. The flexibility of Semantic Web Services enables dynamic integration in directions that were not even foreseen when implementing the integration solutions.

Enterprise Application integration is concerned with the mechanisation of data and process integration within an organisation. The next logical step is the integration of data and processes between different organisations.

**eCommerce challenge: The huge potential of "modern" Commerce.** Web-enabled eCommerce needs to be available to large numbers of suppliers and buyers. Its success is closely related to its ability to mediate a large number of business transactions. "Modern" eCommerce needs strong support in three aspects in order to avoid being yet another unsuccessful hype in the IT field:

**Openness** of eCommerce cannot be achieved without standardisation. This lesson can be learnt from the success of the Web. But the standardisation requirements for eCommerce will be much more stringent. This will require standardisation of the actual content and business logics that are exchanged, which goes far beyond the requirement of standardising protocols and document layouts. DIP will develop significant contributions to this area (see also standardisation).

**Flexibility** of eCommerce cannot be achieved without multi-standard approaches. It is likely that no one standard will arise that covers all aspect of eCommerce that will be acceptable in all vertical markets and all cultural contexts, nor would such a standard free us from the need to provide user-specific views relating to it and the content it represents. DIP will develop mediation support dealing with heterogeneous Ontologies and business processes.

**The Dynamics** of eCommerce will require standards that develop almost as 'living entities'. Products, services, and trading modes are subject to high turnover rates. DIP will develop electronic trading devices that reflect the dynamic nature of the processes they are supposed to support.

In business environments DIP will enable automatic co-operation between enterprises. An enterprise requiring a business interaction with another enterprise will be able to automatically discover and select the appropriate optimal Web Services based on selection policies. These will be invoked automatically. It will also be possible to initiate payment processes. Any necessary mediation will be implemented based on data and process ontologies

as well as the automatic translation of their concepts. A good example would be supply chain relationships, where a manufacturing enterprise of short-lived goods frequently needs to seek suppliers as well as buyers dynamically. A Web Service infrastructure will enable automatic searching for suppliers and buyers based on defined constraints, replacing the existing labour-intensive efforts conducted by employees

## 4. Application scenarios

### 4.1. *Application Scenario #1: Intelligent Information Management*

DIP uses the term information management as a synonym for knowledge management to express its focus on the "hard" IT aspects of this activity, and to highlight the potential of the Semantic Web in improving human information access to unstructured and semi-structured information.

The project forms an excellent test bed for some of its own technologies for intelligent information management, where DIP partners already have established track records of using ontology based technologies. New Semantic Web technologies will be deployed to support knowledge sharing as they emerge from on-going project work.

### 4.2. *Application Scenario #2: Enterprise application integration*

Semantic Web Services hold the promise of moving beyond the simple exchange of information, the dominant mechanism for application integration today, to accessing application services that are encapsulated in both old and new applications. This means organizations will be able to not only move information from application to application, but will also be able to create composite applications by combining services found in any number of different local or remote applications.

According to Gartner analysts, there will be strong and in some cases explosive demand for Web Services and integration technology and services as businesses react to the need for more integration and more agility. Making disparate systems share information cost-effectively is a perennial problem for companies and represents billions of dollars in technology spending, with an estimated 30% of worldwide IT budgets dedicated to EAI type projects.

### 4.3. *Application Scenario #3: Dynamic & Smart eCommerce*

Semantic Web Services in B2B applications will enable virtual and smart organizations in commercial and non-commercial environments. Here we focus

on the integration of data, processes, and applications between different organizations introducing advanced requirements for openness, heterogeneity, and change. A major challenge is the integration of heterogeneous business processes and interaction protocols. Formalizing them in ontologies will significantly help to enable ad-hoc formation of business coalitions.

## 5. Real world case studies

DIP also addresses one of the critical success factors in the market take-up of Semantic Web Services by using Semantic Web Services as an infrastructure to create practical solutions to real-world business challenges. Case studies are an integral part of the project and involve many different aspects including, business problem definition, technology development, evaluation, and demonstrations. The motivation for including these specific case studies in the project is based on the potential contribution they provide with respect to the three high potential application scenarios presented above.

**e-Banking: Bankinter.** *While many financial institutions offer simple straightforward information portals, only a few are offering advanced services such as financial aggregators, where distributed, heterogeneous information is aggregated into a one-stop-shop. While those applications are quite advanced, the challenge lies in the cost of construction and maintenance. Potential applications to be considered in this case study include mortgage contracting, risk analysis, mobile phone banking transactions and user-friendly interfaces for customers.*

**e-Government: Essex County Council .** Essex County Council in the UK will test project results within a local government Web Services supply chain. Ontologies, service description and discovery and other related tools emerging from the project will be integrated in the delivery of real services to citizens and organisations. The benefits of additional semantically-enhanced Web Service functionalities (e.g. for aggregated services involving multiple agencies) will also be investigated. The results of the case study will be used in best practice and dissemination and awareness activities for public administrations throughout Europe.

**Virtual Internet Service Provider (VISP)**: TiscaliTechnology enables service providers and their partners to reach new customers and expand into new markets, while simultaneously reducing the cost of operations. Semantic Web Services can expose functions and information within service provider's systems

and allow third party companies to creatively configure new bundles of products and services under their own name. VISP infrastructures for the B2B market could offer facilities to compose new virtual services and to support the building of new virtual enterprise portals.

## 6. Expected results and potential impact

In addition to the real-world case study applications, DIP aims to deliver the following results:

*Open source* Semantic Web Services Architecture. One of the key public deliverables of DIP is the open source Semantic Web Service Architecture. The goal of the open source approach is to enable take-up in a wide range of research and commercial organisations

*Exploitable tools*. The tools used in implementing and realising parts of the overall architecture will become exploitable on a large scale for the DIP partners. This approach ensures real impact - there will be a big demand for tools in combination with the open source architecture.

*Standards*. A major standards proposal in the area of Semantic Web Services will be submitted to one of the major standards organizations such as W3C or OASIS. DIP will generate major input to the work of the Semantic Web Services Initiative (SWSI), where project results are expected to significantly influence SWSI work.

We foresee DIP to have substantial impact on the introduction and the development of Semantic Web Services in the following areas: industry; market; and research community.

**Impact on Industry.** DIP will heavily contribute to standardisation in the SWS area. Work of DIP partners will directly influence upcoming standards. By having some of the major players in the IT market on board who will exploit the technology developed in DIP in their products, DIP has sufficient industry backing to make the standards enter the overall IT market and push their adaptation by other leading companies in the field. Making the ERA the crystallisation point for this new technology development will certainly be a competitive advantage for European companies. We envision that SWS will have a similar economic effect as the introduction of the WWW itself had and thus know-how and technologies in European companies have to be at hand when SWS get adopted by broad market segments. Products improve their ability to integrate based on the new as well as enhanced standards impacted by DIP. Products of major IT player will be enhanced through technology exploitation In the e-Commerce sector the integration of enterprises will require

far less effort then today based on DIP's new approach to integration through SW and WS technology.

**Impact on Market.** Besides making European companies the leading technology providers in the SWS field, DIP will also generate opportunities for new companies to enter the market that will be able to provide products and consulting expertise. This will animate the IT provider market and enable EU companies to gain leadership in this area or maintain and strengthen it.

In addition to this impact on the technology provider segment of the economy, DIP could have potentially a much more far reaching impact on the Internet's economy: Standardisation of SWS technology and the provisioning of missing SWS technology will enable all kinds of service providers to offer their services in a flexible and portable way while service users can access such services easily, compare their prices, quality of service, and business models, and make informed choices which services to use. This can be seen as a step towards making the emerging service economy domain on the Internet more flexible and diverse and enable the development of a competitive service market that will offer advantages for all market participants:

- service providers can reach more potential customers more easily
- company users can choose easily among a larger number of competitive service providers
- customers can access services more easily and competition will make combined services cheaper thus the customer benefits

**Impact on Research Community**. Providing novel technologies and keeping innovative development inside the ERA will also motivate experts in all related research areas to participate and bundle their research activities inside the ERA instead of moving to other non-ERA countries. This will be specifically important to gain and maintain scientific leadership in respect to US research efforts.

This offers major potential also for economic success as the developments in the telecommunication sector, e.g. GSM and the leadership of European companies such as Nokia or Ericsson have shown. Nevertheless, close co-operation with the entire scientific community will be required to render research results as soon as possible. From a viewpoint of strengthening the ERA the goal should be to take the lead in defining the research directions rather than to follow.

A potential impact of DIP on the research community could be the establishment of interest groups to conduct joint research in the area of SWS. Many participants of the DIP consortium already participate very actively in or have founded platforms to bring together researchers from the various fields to co-operate in developing SWS technologies and their theoretical foundations. DIP could provide even more focused scientific output to motivate further co-operation.

## 7. Work packages description

**Work Package 1 – Ontology Reasoning and Querying.** In response to perceived deficiencies in RDF(S), OWL has been proposed for managing Semantic Web ontologies. OWL is in fact a syntactical variant of SHIQ-D description logics. Compared to RDF(S), description logics offer a much higher degree of expressivity. Hybrid and modularised reasoning is about profiting from the different strengths of different knowledge representation approaches. In this work package we will build on the existing work in the field of description logics and logic programming and integrate them into a hybrid and modular reasoning framework. We will in particular report on the trade-off between expressivity and scalability and approach this problem taking modularization into account. Dynamics plays an important role within Semantics Web Services. Therefore, we will add reasoning mechanisms to handle dynamics. In this context we will build on existing work in the field of "transaction logic". Based on these inference services, a query engine will be developed that provides schema and instance level query access.

**Work Package 2 – Ontology Management.** The actual state-of-the-art of ontologies deals with small-sized, homogeneous and stable ontologies, but when working with them, these characteristics become major issues to be solved. Among these problems the following may be included: (1) Large–scale ontologies are difficult to build, (2) they need to attain consensus of heterogeneous groups, which means that they are distributed and heterogeneous per definition, and (3) the consensus they reflect changes over time. The objective of this workpackage and more generally of DIP is to propose practical approaches to these problems. The work to be done aims to provide a scalable environment able to cope with heterogeneous and changing ontologies. Concepts and tools will be developed in order to: deal with large-scale ontologies, making the handling of ontologies with several thousands of concepts possible; manage heterogeneous ontologies networks, even if they have conflicting or

complementary definitions; and organise the process of change of ontologies, so dynamic ontologies can be used.

**Work Package 3 – Service Ontologies and Service Description.** Ontologies are a key component for the Semantic Web and Web Services and are therefore used for several purposes in DIP. The main concepts of DIP such as business data, goals, Web Service functionalities, and trading partners may be defined by means of ontologies. A highly functional ontology authoring and management component is necessary in order to describe all the required ontologies. In this way it is possible to manage the mentioned concepts according to these different ontologies. Therefore, the major objective of this work package is to employ the ontology and Semantic Web infrastructure that was described earlier for Semantic Web Services, i.e., for adding semantics to Web Service descriptions. This naturally translates into a number of sub-goals:

A vocabulary and catalogue management component is required for referring to a standard vocabulary. In addition, an authoring environment must be provided for that purpose. We will employ the ontology management environment for the purpose of Semantic Web Services.

Business data ontology for Web Services: This will provide the functionality to manage business data based on the ontology management and the authoring environment. We must be able smoothly to align heterogeneous data structures of combined Web Services.

Process data ontology for Web Services: An additional challenge in open and flexible eCommerce is the integration of heterogeneous business processes and interaction protocols. Formalizing them in ontologies will significantly help to scale up ad-hoc formation of business coalitions.

Goal ontology: Instead of describing goals, Web Service functionalities, and quality of services from scratch, reusable terminologies have to be provided that allow a simple plug-and-play process for establishing this definitions.

**Work Package 4 – Service Mediation.** Mediation of heterogeneous data, information and processes is a key component for DIP in the way that it enables the use of different services on the Web or within companies. A strong focus will be placed on usability of the mediation function in different environments like mediation adapters or mediation services with high scalability. Mediation of data and information requires semantic mapping capabilities by ontologies as well as specialised matching and integration techniques for a specific application context. Mediation of processes in addition requires the interpretation of goals as well as workflow and flexible Web Service invocation. The focus for the mediation function layer will be especially placed on flexibility, scalability, and usability. We will provide a general mediation function layer and prove the

usability of developed or used tools which are capable of verifying developed prototypes and can be used by selected Case Studies as well.

**Work Package 5 – Service usage.** Service usage is a key aspect, whereby users and systems are afforded (semi-)automatic access to semantically-wrapped Web Services. Service usage will use the output from service ontologies, service description and service mediation to create a set of tools and software modules for exploiting semantically-described Web Services. We envision both semi-automatic (offering user support) and automatic approaches (for agent support and systems integration). Tools and/or modules will be developed to support the following capabilities:

Composite Web Service description: support for the creation of composite services from simpler ones, including compatibility checking of composed services. Components will be chosen (by a user or by a software agent) to be used together, and the browser will check for compatibility.

- Service discovery: enhanced service discovery based on semantic search and browsing capabilities
- Service invocation: invocation of (composite) Web Services
- Service monitoring: checking progress of Web Service execution and intelligently advising user/agent of abnormal events and possible recovery actions

**Work Package 6 – Interoperability and Architecture.** Work packages 1-5 provide the basic conceptual and technological building blocks required to set up the infrastructure for Semantic Web Services, i.e., the "vertical" components. This workpackage "puts things together" in terms of architectural and technological integration, i.e., provides a consolidated DIP architecture and interfaces for cooperation among the components and for the DIP infrastructure as a whole. The main objective is to provide clear conceptual infrastructure and smooth interoperability across the project. Part of the work under this component will be dedicated to provide (adapt or develop) basic application programming interfaces (APIs) to support integration and tool development. It will be further ensured that the APIs and the architecture cover the requirements of the case studies. As a second major objective this work package will provide the "horizontal" services that are needed throughout the architecture, i.e., by the other components. These include, for example, communication facilities and security models. The issues of transport, security, and management will be addressed both in terms of components and separate tools as well as APIs and proper infrastructure for the tools.

**Work Package 7 – Technology Watch and Standardization.** This work package will provide a continuous technology watch on emerging standards in Web Services Technology and standards/formats used in E-Business. It will monitor ongoing standardization activities at the W3C, covering, for example, the W3C Web Services Activity, the Semantic Web Working Groups, OASIS, WS-I and industry consortia. Whereas SOAP and WSDL have reached a certain degree of maturity and are widely accepted as basic ingredients of Web Services Technology, there is still no common viewpoint on architecture, choreography or security. Thus, for the general issue of combining individual Web Service operations to complex workflows there are currently at least four competing proposals:

- BPEL4WS 1.0, proposed by BEA, IBM, and Microsoft in July 2002 and superseding WSFL (from IBM) and XLANG (from Microsoft);
- BPML 1.0 developed by BPMI.org, which was published as a first draft in March 2001;
- WSCI 1.0 co-developed by BEA, Intalio, SAP, and Sun in 2002;
- WSCL 1.0 submitted as a W3C Note in March 2002 by HP.

It is thus safe to say that in the forthcoming years several standards for Web Service Workflow and/or Choreography will compete with each other for adoption by standardisation bodies or gaining industry backing. The situation is similar in areas like security, coordination, transactions, etc.

**Work Package 8 – Case Study VISP.** The Virtual Internet Service Provider (VISP) case study will provide early test beds for the DIP technology developed and will demonstrate the potential of Semantic Web Services by developing an architecture for a VISP platform. The goal of the VISP platform is to enable typically non-ISPs to create virtual enhanced services based upon existing services. These existing services will be made available as semantically described Web Services. The work in this workpackage concentrates on the analysis of the business needs and potential VISP customers. The requirements for a VISP platform will also be defined and specified. The VISP platform will be built on existing provisioning tools and platforms. The VISP ontology used to store the domain-specific vocabularies for value-added service classification will be a major part of the VISP platform. The expected result of this workpackage is a first design for the architecture of a VISP platform based on the DIP model of SWS

**Work Package 9 – Case Study eGoverment.** Local government authorities in Europe need to develop ways of delivering more usable and comprehensive electronic services to their citizens in a cost-effective way, if they are to be able to comply with the goals of an e-Europe and the related growth in national e-government imperatives. To achieve these goals, they need to understand and have confidence in the application of technologies which can improve electronic service delivery. There is a need to develop and test applications which enable a supply chain involving a variety of data and service suppliers, to support joint working and system integration for provision of joined-up services for the citizen and local businesses. Together, these point to a need to move current applications to a Web Services environment supported by a rich citizen-focused ontology for e-public services to facilitate description, discovery and matching of services. The initial case study involves development of a citizen's information service (seamlessUK/Essex Online) in a Web Services environment. This will require the development and testing of an e-government ontology to support the description and discovery of Web Services relevant to e-government and public administration.

**Work Package 10 – Case Study eBanking.** In WP 10, we will apply Semantic Web Services technology to solve integration and aggregation problems in the financial sector. Based on an analysis of the potential application of this technology, both from a business and an IT point of view, in this sector, phased planning will be made, including contingency plans. A selection will be made of which financial services to include. The next step will be a requirements analysis phase followed by a design phase. A financial ontology will be one of the important results of the case study. Other main results of the case study will be to show-case applications illustrating the potential business value for the

financial sector of the technology developed in the project. Deliverables will be made publicly available as widely as possible. In case the deliverable as such is restrictive, care will be taken to produce a public document summarizing the main results at a global level.

**Work Package 11– Dissemination.** The purpose of the Dissemination package is to establish a focal point for the European Semantic Web community, targeting both industrial players and the academic researchers. Its principal purpose will be to inform the community of the state-of-the-art developments taking place in the Semantic Web domain, this includes not only the results emerging from the DIP project but also developments happening more widely elsewhere in the world.

**Work Package 12 – Market observation.** This work package provides a continuous "Semantic Web Services market and competitor observation and exploitation alert". This observation and alert will provide real-world background information to the technology partners in the project to enable a continuous alignment of the research project focus with the needs of the market. The selected case studies will support market observations and provide a clear understanding of the business needs of the different use cases.

To achieve these goals, the SWS market observation and exploitation alert will provide a series of studies focusing on the following aspects:

- Identification of potential application areas and upcoming market opportunities for Semantic Web Services within the fields of knowledge management, integration and B2B e-commerce and possibly in adjacent fields
- Assessment of the state and maturity of these markets with respect to SWS and related technologies
- Assessment of the role of SWS building blocks (taxonomies, ontologies, Web Services, etc.) within these markets
- Identification of, as well as observation of, trends and acceptance of competing technological approaches offering similar value propositions
- Assessment of the awareness about SWS within enterprises and the use of building blocks, knowledge about this area and related technologies
- Assessment of the level of preparation for acceptance within enterprises (e.g. readiness of infrastructure, availability of necessary skills for adoption, etc.)

**Work Package 13 – IRP Activities.** As detailed in section 7, plans exist for an Exploitation Board to manage and deliver project results and exploitation both at the partner and consortium level as well as take-up actions with a

particular focus on SMEs. All these plans will be designed and executed in the context of the current market and competitor and technology analysis activities. The partners will carefully consider the appropriate vehicle for protection of intellectual property rights on a case-by-case basis. The inventing partner or partners will bring to the attention of the project Exploitation Board for ratification every such intention to protect (or otherwise) the intellectual property generated during the course of the Project.

**Work Package 14 – Training.** The primary purpose of the Training work package is to prepare the case study participants for the provision of basic knowledge on the approaches and tools that the DIP project will be utilizing to understand the area of semantic organization and usage of Web Services. We intend to reuse where possible the output from the OntoWeb NoE and from the Virtual Institute for Semantic Web Education which will be set up by the OntoWeb-II (KnowledgeWeb) NoE.

One of the main results of the work package will be a set of face-to-face workshops which will both provide a conceptual overview of Semantic Web Services and give participants extensive hands-on sessions with DIP partner tools.

**Work Package 15 – Management**. The Management work package is concerned with ensuring:

- that the project remains on course,
- that it is effectively and correctly managed financially
- that its progress and status are efficiently and effectively monitored
- that the required reporting is prepared and delivered in a timely manner
- that all quality aspects of the project are fully and correctly addressed
- support for the infrastructure supporting the web-based facilities to be used for dissemination and central intra-project communication and cooperation

This will entail day-to-day central management and coordination activity; coordination and maintenance of the facilities established for intra-project communication; development and maintenance of the website and its content management applications; preparation and maintenance of project and quality plans; and coordination of the development and delivery of project reporting, both internally to the project and externally to the Commission.

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