
**NeOn: Lifecycle Support for Networked Ontologies**

**Integrated Project (IST-2005-027595)**

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# D9.7.1 Report on economic viability of NeOn case studies and on experiences with demonstrating the case study prototypes

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## Change Log

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## Executive Summary

Going from generic to more specific results, the report shows several radars and studies about the adoption and maturity of semantic technologies. These radars show that the technology is reaching the markets very slowly, and although giving signs of maturity in some concrete parts, it is still not completely mature. NeOn adds value in going beyond the single and static ontologies, understanding and supporting aspects of the ontology lifecycle in distributed environments involving large numbers of networked ontologies. This approach has a strong impact in a strongly collaborative domain, giving further efficiency and effectiveness and allowing to gain strategic advantages.

In the light of the NeOn case studies, this report explores different dimensions of business value, namely effectiveness, efficiency and business edge. Several people from the case studies with different background (consultants, developers, ontology engineers, etc.) have been contacted in order to seek their opinions of the NeOn proposition for the verticals covered in the fisheries and pharmaceutical domain. As people from the use cases see it, the usage of networked ontologies can give more strategic advantages to their respective domains. Being both knowledge intensive domains, they believe that the NeOn proposition could have a significant impact in the market.

On the other hand we sought also the opinions of end users. In general terms, end users have big expectations in the NeOn results, but they are waiting for more stable versions of the software of the case studies and the NeOn Toolkit. Therefore, technical issues apart, there is a big emphasis falling on proper business exploitation and dissemination, and in demoing the case studies results among end users and clients of the organizations in order to show the project results in application verticals.

# Table of Contents

# 1. Introduction

Ontologies are seen as one of the key technologies to support interoperability on the Web and to enable semantic integration of both data and processes. Since the notion of ontology was first proposed by Tom Gruber, ontologies matured; we are now in the phase when ontologies are produced in larger numbers and exhibit greater complexity than before. In recent years we saw substantial effort on ontologies in the medical, genetic engineering, bio-medical, food and fisheries domains, as well as on generic, top-level ontologies. The authors of these ontologies faced many challenges, some were domain-related, and others were social. However, a substantial challenge comes from lack of appropriate tools. This is where NeOn tools and its approach to networked ontologies fit in.

The aim of this report is to assess the economical and business perspective of the technology developed in NeOn from the case study perspective. In this sense, the idea is going from the generic to the specific: starting from several radars and studies about the adoption and maturity of semantic technologies and finishing by the perspective of the end people and end-users involved in the case studies. On the other hand, due to the fact that most of the plugins and tools of NeOn are still under development, the aim of this deliverable is more on evaluating the case studies opinions in a qualitative way, rather than preparing an extensive economic study based on quantitative indicators.

The document is structured as follows. First, we study some technology and business radars and reports to assess the degree of maturity of semantic technologies. After that we give an overview of the main dimension of business value from the case studies perspective. Then, we ask some questions to key people on the case studies organisations in order to check their impressions about the business value with which NeOn contributes to the case studies. After that, we gather the opinions of the users from the different demos the participants of the case studies have done so far. Finally we draw some conclusions and suggest possible future steps.

# 2. The business value of NeOn from the case studies perspective

## 2.1. Business value indicators

In previous deliverables [1] , we discussed that the primary motivations for investing in new technologies that create business value are basically three:

1. **Efficiency gain**: Doing the same job faster, cheaper, or with fewer resources than it was done before. The key measurement is cost savings.
2. **Effectiveness gain**: Doing a better job than before, improving quality, making other resources more productive. The key measurement is return on assets (ROA), a financial indicator of how profitable a company is relative to its total assets.
3. **Business Edge** (other strategic advantages): Changing some aspect of what the business does, resulting in strategic advantages such as growth, new value capture, mitigation of business risk, improved agility in responding to new needs, improved Customer Relationship Management (CRM), Enterprise Resource Planning (ERP) and Business Process Management (BPM), less capital re-investment, reduced vulnerability to fraud/liability/litigation, outsourcing, etc. Key measurements are return on investment (ROI) and return on equities (ROE).

Another relevant financial estimate that besides measuring efficiency is also good for comparison of technologies/systems, is Total Cost of Ownership (TCO), designed to help enterprise management assess direct and indirect costs related to the purchase of any capital investment, such as - but not limited to - computer software or hardware. TCO is the purchase price of an asset plus additional costs of operation, or said in another way, it is the sum of all the costs related to the technology/solution to be implemented, the software, maintenance costs, support services, training fees, license fees, update fees (if any), etc.

If the benefits represented by these three priority categories – efficiency gain, effectiveness gain and business edge - outweigh the costs and risks associated with making the whole change, we have something to consider.

## 2.2. Business value of Semantic Technologies

The Semantic Wave Report 2008 [3] stresses a few points about the new value that can be extracted from semantic technologies. It has already been found that semantic technologies in general do indeed impact the measures of business performance that matter. Figure 1 shows that the value proposition is strong in all three categories:

| EFFICIENCY | EFFECTIVENESS | EDGE |
|---|---|---|
| *Cost savings*<br>Doing the same job faster, cheaper, or with fewer resources than it was done before | *Return on assets*<br>Doing a better job than the one you did before, making other resource more productive and increasing their return on assaets and attainment of mission | *Return on investment*<br>Changing some aspect of what the business does, resulting in growth, new value capture, mitigation of business risk, or other strategic advantage |
| **IMPACT OF SEMANTIC TECHNOLOGIES*** | | |
| 20-80% less labor hours<br>20-90% less cycle time<br>30-60% less inventory levels<br>20-75% less operating cost<br>25-80% less set-up & development time<br>20-85% less development cost | 50-500% quality gain<br>2-50X productivity gain<br>2-10X greater number or complexity of concurrent projects, product releases & units of work handled<br>2-25X increased return on assets. | 2-30X revenue growth<br>20-80% reduction in total cost of ownership<br>3-12 month positive return on investment<br>3-300X positive ROI over 3-years |

*Source: MILLS•DAVIS

**Figure 1 - Business value and the impact of semantic technologies**

According to aforementioned report, semantics drive value by allowing networked intelligence and going from information to knowledge-centric patterns of computing. The key sources of new value include knowledge modelling, techno-social-economic collaboration, declarative processes, and architectures of learning. Key dimensions for measuring the worth of semantic solutions include:

- **Capability**: Semantic technologies offer added value in many aspects: From search to knowing; from individual knowledge resources to an interconnected network of resources; from data to knowledge representations; from social computing to semantic-based social computing (Web 3.0); from syntactic to semantic architectures; etc.
- **Performance**: Storage moves from files to knowledge bases with rich mappings among them. The trend is toward high-performance semantic processing at scale and representations that support nearly unlimited forms of reasoning.
- **User experience**: User experience is the sum of interactions and overall satisfaction that a person has when using a product or system. Semantic user experience is the addition of intelligence and context-awareness to make the user interface more adaptive, dynamic, advisory, proactive, autonomic, and autonomous, and the resulting experience easier, more useful, and more enjoyable.
- **Life cycle economics**. Semantic technologies help reduce risks across all stages of the solution life cycle. Figure 2 shows the typical technology life cycle economics.

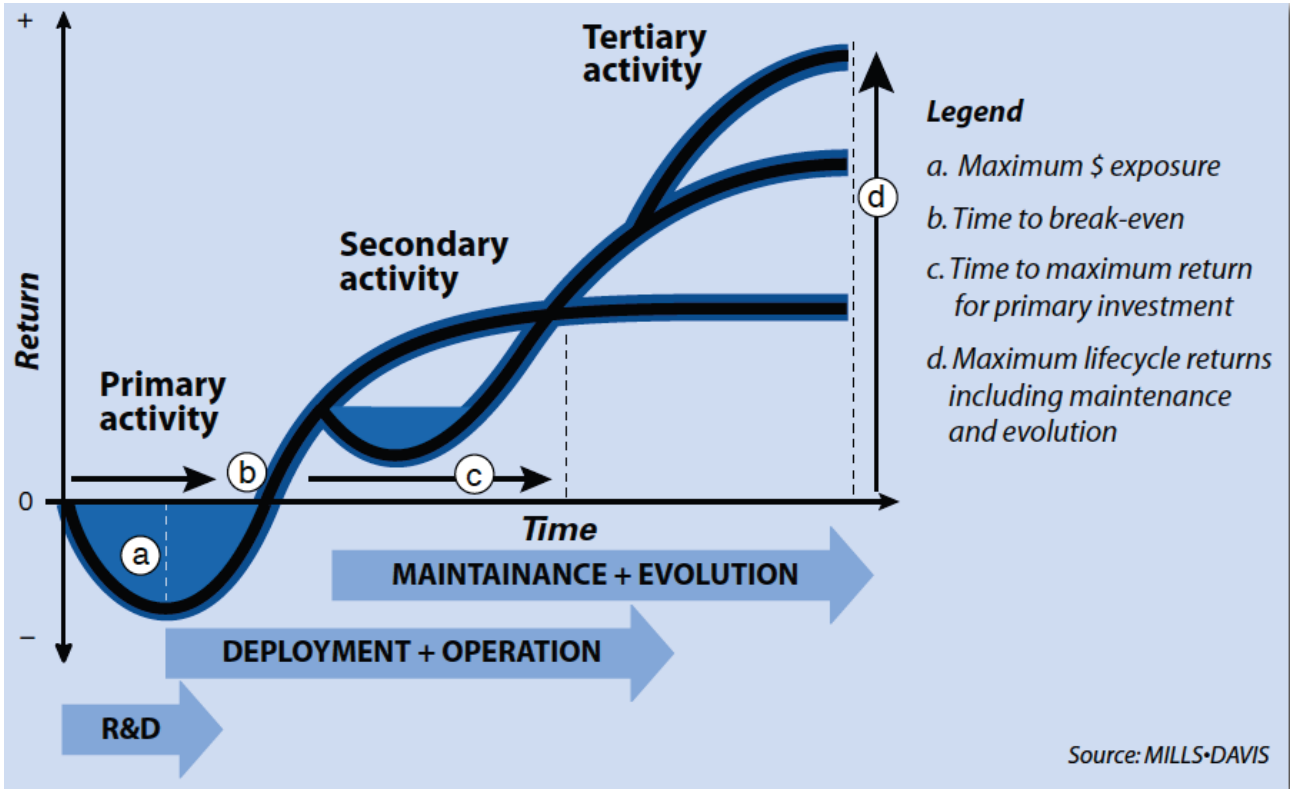



**Figure 2 – Life-cycle economic cycle**

Several recent studies state that semantic technologies are staring to show signs of maturity, and therefore going from R&D to being operational. The aforementioned report [3] remarks that during 2008 the media coverage, the rise and adoption of standards and standardization groups (W3C, OMG, ISO, OASIS), the appearance of tools and methodologies that support them (RDF, OWL, SPARQL, RulesIF, -and we can include here the NeOn methodology and linked best practices-), and the diversity of players, including some of the big ones (more specialists and system integrators), are clear indicators showing that semantics, although still having some R&D outstanding issues, are starting to reach to the market. Analysts such as Gartner include semantics among the top 10 strategic technologies for 2008. There have been many semantic-related events in 2008, including Web 3.0 conferences, interests in verticals such as e-Health or e-Government, and the communities of interest showed an increasing number of participants.

The following figure shows the current situation of the semantic technologies and the expected ROI for the coming years.

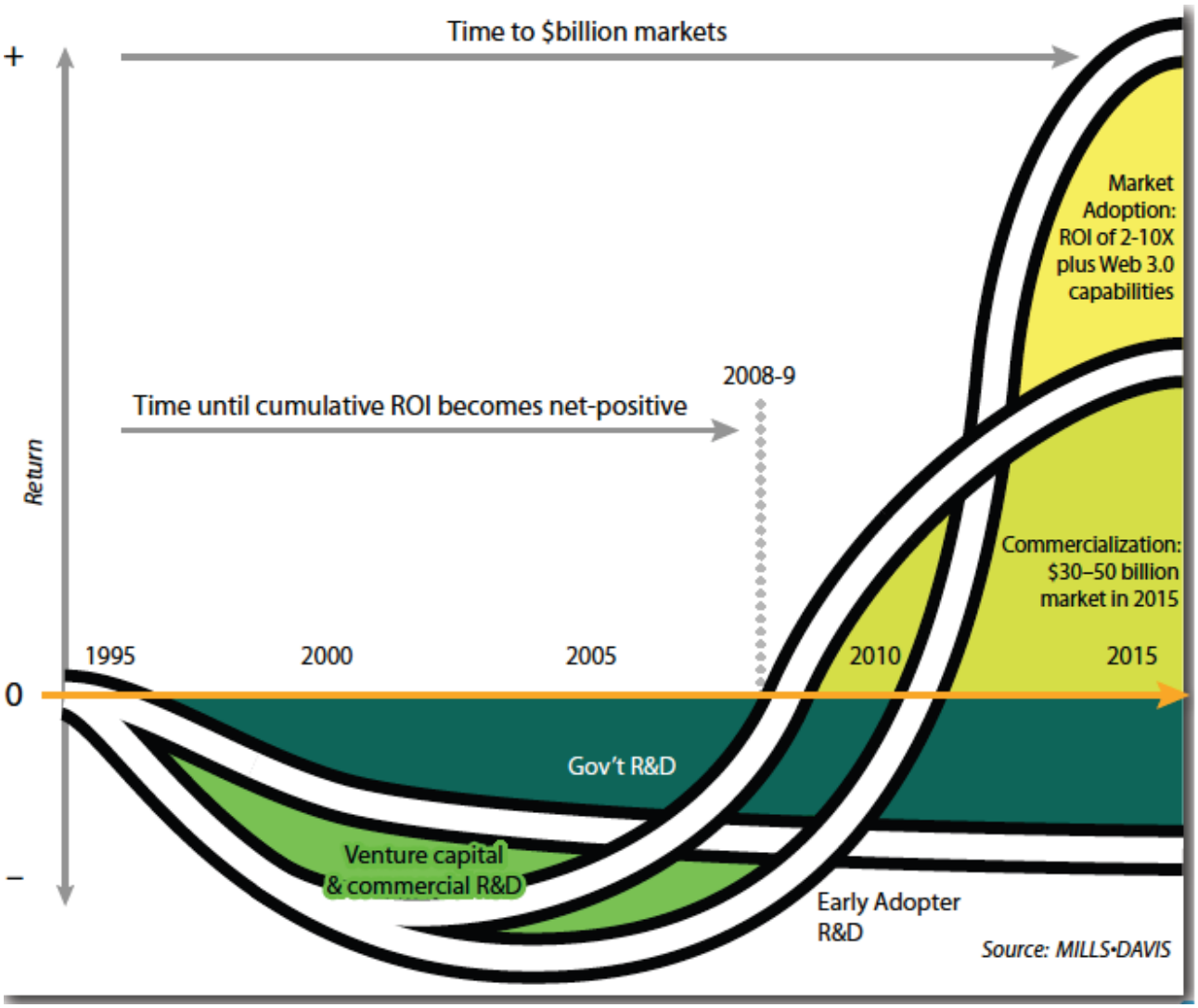
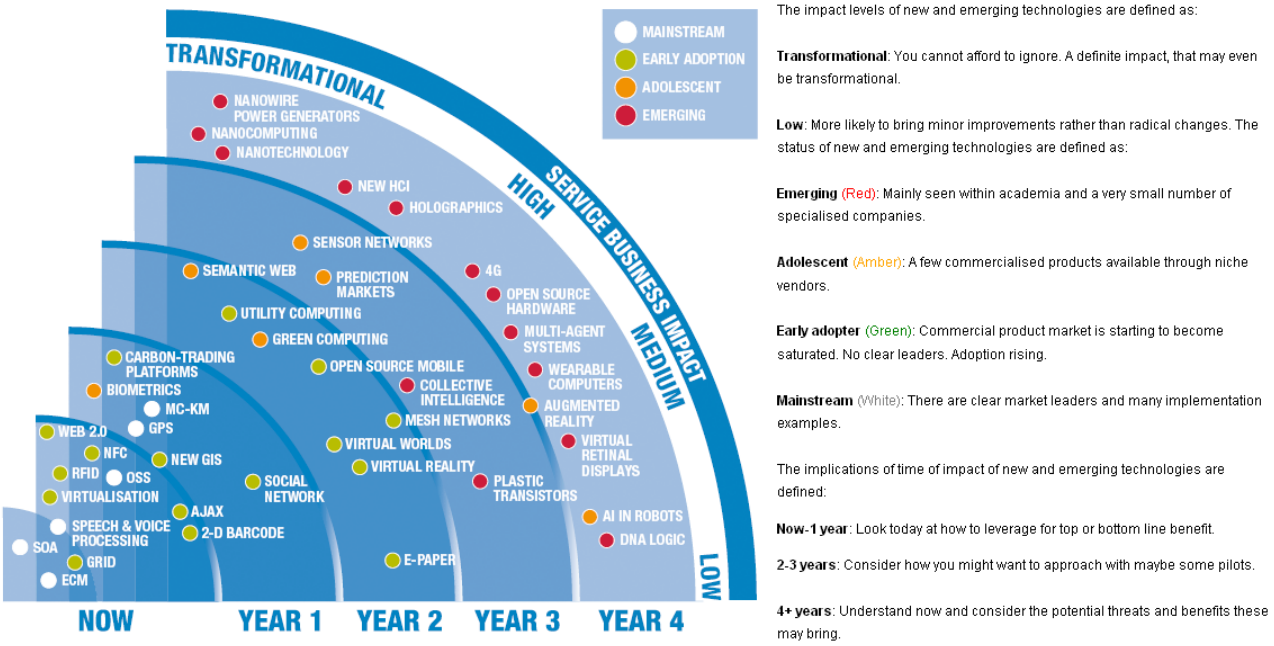



**Figure 3 - Semantic Technologies going mainstream**

As shown in Figure 3, Semantic Technologies are reaching now the stage where they start to be productive and the R&D investments start to level up. On the other hand, other technology radars and analysts are not so convinced of the semantic technologies maturity.

ATOS Origin has its own yearly technology lookout as shown in the Figure 4. The objective of the lookout is to provide a single, independent and authoritative source of information that will help ATOS clients make key decisions about their business.




The impact levels of new and emerging technologies are defined as:

**Transformational**: You cannot afford to ignore. A definite impact, that may even be transformational.

**Low**: More likely to bring minor improvements rather than radical changes. The status of new and emerging technologies are defined as:

**Emerging** (Red): Mainly seen within academia and a very small number of specialised companies.

**Adolescent** (Amber): A few commercialised products available through niche vendors.

**Early adopter** (Green): Commercial product market is starting to become saturated. No clear leaders. Adoption rising.

**Mainstream** (White): There are clear market leaders and many implementation examples.

The implications of time of impact of new and emerging technologies are defined:

**Now-1 year**: Look today at how to leverage for top or bottom line benefit.

**2-3 years**: Consider how you might want to approach with maybe some pilots.

**4+ years**: Understand now and consider the potential threats and benefits these may bring.

**Figure 4 - Semantic Technologies in the ATOS Radar 2008**

One of the main outcomes of this lookout is the technological radar that measures the impact levels of new and emerging technologies taking into account the opinion of ATOS experts and consultants worldwide. According to this radar, Semantic Web is a Transformational technology, meaning that industries can not afford to ignore and it is foreseen that it will definitely have an impact. On the other hand, it is an adolescent technology, because it has still few products commercialised. Although the Semantic Web is a couple of years off full realisation, niche applications such as semantic search, are already available. Businesses start to investigate and apply what Web 2.0 can do for them. The use of wikis, blogs and social interaction between workers in or among companies is a particular focus now in companies. In this sense, there is a tendency towards the so-called *intelligent* Internet, Intranet or *knowledge portals* using semantic technology interwoven with Web 2.0 (Web 3.0). However, we see this as a tendency that will become more visible in the future on the Web and in corporate software, but still adolescent.

This prediction is pretty much in line with Gartner's and it is a little less optimistic than Project 10X predictions. In any case, the tendency shows that Semantic Technologies are almost reaching the market and that it is a technology with a great transformational potential to the web and to the industries, which is good news for a project such as NeOn. From this perspective we could say that NeOn is "just-in-time".

## 2.3. How do NeOn case studies drive the three main elements of business value?

### *2.3.1.* Introduction to the case study business objectives

As it was outlined in the introduction, it is not very clear in a research project as NeOn, and even more complicated before the end of the project, when most of the tools and the methodology are still not stable, to measure clearly the indicators related with the three categories explained before. Therefore, the aim of this deliverable is more on evaluating the case studies opinions in a more qualitative way, rather than preparing an extensive economic study based on numbers.

NeOn targets one of the most important building blocks of Semantic Technologies: ontologies. Ontologies are traditionally expensive to design and populate, but once this has been done, they become an important asset for the organisation. NeOn addresses the methodological and technical aspects necessary to deal with ontologies, such as reuse, dynamics, evolution, collaboration and combination (mappings). Therefore, NeOn expects to have a clear economical impact, besides its relevant intangible value, in reducing the production costs of ontologies.

Henceforth, let us try to translate the added value of Networked Ontologies into efficiency gains, effectiveness gains and business edge from the NeOn case studies perspectives.

### *Fisheries Case Study business objectives*

FAO has collected data concerning all areas related to food and agriculture since its foundation in 1945. It is important that all this data (which keeps growing over time), and consequently the money and effort invested to gather it, is used at best and that it is publicly and easily used by FAO and the public. FAO expects to have important pay-offs on the long run by investing in: standards for sharing information; ontologies to enhance fisheries data with semantics; and networked ontologies to solve the long term data-silos problem.

FAO professional staff has costs from 120,000 USD/year to 200,000 USD/year. Setting free only one FTE/year from routine processing is a big economic advantage. Numbers for savings by improved decision making are difficult to estimate. An extension of the use of networked ontologies from the Fishery Pilot to other subject areas would increase enormously the numbers.

### *Invoice Management Case Study business objectives*

The Invoice Management case study under development in WP8, aims to create a software prototype applying NeOn technology and methods aimed at significantly contributing to solve the invoice interoperability problem in the pharmaceutical domain. Since a European directive back in 2002 authorized the use of digitally signed electronic invoices for commercial transactions, the use of electronic invoice has grown exponentially. However, its main adoption barrier has been identified as the heterogeneity of the means to represent and exchange invoice information, as well as the lack of invoice standards to be adopted by the main players of the sector.

To make it even worse, the range of ERP systems managing this information (SAP, ORACLE, PeopleSoft, Baan, Movex, openXpertya, etc) and the different languages for exchange of electronic business documents that exist in the market (EDIFACT, UBL, IDOC, etc) are extremely diverse. I2Ont applies the pharmaceutical networked ontologies to enable organizations involved in economic transactions to exchange arbitrary electronic business documents by automatically extracting the information contained in them out of the details of their particular representation formats and technologies, thus saving large amounts of money in the process.

One of the most challenging entry barriers for uptake by real users in the domain, with no background on ontological engineering, is the gap between domain knowledge (e-business and economic transactions in the pharmaceutical domain) and the formalisms used to acquire and represent such knowledge. Inspired by Newell's definition of "the knowledge level" back in the eighties this case study has intended to develop a highly usable, intelligent user interface that enables experts on e-business and financial staff to alleviate their invoice interoperability problems by means of networked ontologies, relieving them from caring about the way invoice knowledge is formally represented, stored, mapped and, in summary, processed. I2Ont allows domain experts to work and think exclusively at the level of their expertise, i.e. electronic invoices.

The solution proposed herein is grounded on a combination of networked ontologies and a graph-based visualization and navigation paradigm. Networked ontologies provide a formal, semantic backbone between different electronic invoicing formalisms and models, including support for the main invoicing standards, like EDIFACT and UBL, and sectorial approaches like Pharmainnova's.

The user interface allows for a simple navigation across the relevant invoicing concepts and the formal invoice model described in the ontology network allows ensuring correctness and completeness of the correspondence between the different electronic invoice representations. Previous approaches to the invoice interoperability problem required implementing specific transformations between the formats and models of each pair of organization exchanging electronic invoices. This was cumbersome and little scalable. On the contrary, I2Ont learns by example, i.e. sample electronic invoices are used to define the mappings between electronic invoice data and ontology concepts. Subsequent electronic invoices received by the system, with a format and model compliant with such sample invoices, are transparently imported as instances of the invoicing ontologies by means of applying the mappings defined during the learning phase. From that point on, invoices are automatically exported to whatever invoice format and model known by the system without needing to implement ad hoc (and costly) transformations.

***Semantic Nomenclature Case Study business objectives***

Knowledge intensive sectors, such as the pharmaceutical, have typically to face the problem of dealing with heterogeneous and vast amounts of information. In these scenarios integration, discovery and an easy access to knowledge are the most prominent factors. The use of semantics to classify meaningfully the information and to bridge the gap between the different terminological representations that different stakeholders have is widely accepted. Efforts in this direction have been taken in several countries and fostered by some organizations. The use of SNOMED CT as a de-facto terminological standard is partially solving the problem, but still the different national and regional terminologies are not entirely mapped to their SNOMED counterparts. Besides, mappings are not always straightforward, and the different models are not equivalent. The e-Health terminologies are too large, and sometimes focused on commercial products descriptions, while other stakeholders, such as hospitals, would prefer to refer to clinical drugs instead of commercial ones.

The semantic nomenclature case study's main goal is to serve as a proof of concept of this approach in a twofold way: a) by means of linking modules extracted from commercial and governmental terminologies to other terminologies and medical ontologies in a network; and b) prototyping a Web-based application that allows the usage of knowledge extracted form the network.

The main value of this case study is therefore to provide an approach to the pharmaceutical sector to bridge the gap between different drug terminologies. This value in itself is required by many stakeholders, such as governments, hospitals and companies exploiting pharmaceutical resources. But also the semantic interoperability in e-Health is one of the burning subjects in which the NeOn approach to modular, simple and dynamic network of ontologies is likely to provide added business value.

### *2.3.2.* Efficiency gain

Networked Ontologies can have a dramatic impact on labour hours, cycle time, inventory levels, operating costs, set-up and development time, and development costs. These cost savings are sustainable, long-term and linear cost savings. Regarding semantic technologies in general, case examples show 20-90% reductions in these measures.

In the scope of the two NeOn case studies, the case study leaders see the efficiency gain in the following ways:

### *Fisheries Case Study*

Processing large data amounts about fish stocks, gears, vessels and other related information is work intensive. Through networked ontologies with clearly codified knowledge it is expected to process data with much less human effort and to concentrate human effort on evaluation instead of processing

### *Invoice Management Case Study*

According to the KIN representatives in the project, associated to the Pharmainnova cluster of laboratories and users of the current Web application of electronic invoicing provided by this cluster, they are in dear need of enhancing the invoice interchange among the cluster members and ease the ERP integration.

KIN providers have problems in their own ERP to generate the invoice files that the Pharmainnova application needs. Usually they decide not to spend money in adapting their own systems to comply with the Pharmainnova requirements, mainly because this is not a priority for them. They introduce the invoice manually, which is a slow, error-prone and costly process. The idea within the case study is that every stakeholder in the invoice management chain would be able to define their own invoice model (an ontology), and through the NeOn Toolkit+I2Onto tool they would easily map their model to the general invoice model of Pharmainnova.

From this network of ontologies, it would be easy to bridge the gap between the different models without any extra investment from any of the providers.

Besides, by ontologising other standards such as EDIFACT, the invoice information introduced in the network may be easily translated to other formats (EDI in this case). According to KIN, their clients using EDI are currently asking for invoices in this particular format, and the inversion they have to do to without NeOn in order to provide this is important. And there are clients that use even non-standard formats, which give a hint of the benefit of using the NeOn approach in their case.

The following table shows some estimations iSOCO consultants did comparing different solutions to the invoice management problem to the semantic solution proposed in NeOn:

| | ***Manual Invoice Management*** | ***Electronic Invoice Management*** | ***Semantic Invoice Management*** |
|---|---|---|---|
| **Invoice cost** | 1,5 € per invoice | 0,5 € per invoice | 0,5 € per invoice |
| **Integration** | No integration | Only some formats are integrated | All formats are integrated |
| **Errors** | High | Medium | Low |
| **Resources** | Manual Administrative Workers | Middle ware for each format | Non specialized or administrative resources are needed |
| **ROI (estimated)** | - | 6 months | 3 months |

### *Semantic Nomenclature Case Study*

NeOn technology could have a prominent role fostering the semantic interoperability in e-Health. In this sense, the use of a dynamic and modular network of ontologies is a key benefit that NeOn is able to provide in order to solve terminological mismatches. Instead of having big, monolithic, unmanageable and difficult to map knowledge bases, the approach followed in the case study is towards a network of more modular ontologies, linked together using a reference ontology that helps bridging the gap between the different set of terminologies.

Once the network of pharmaceutical ontologies is created, it is easily extensible with new ontological resources. In this sense, it is expected that the efficiency of the solution, both in terms of maintenance and use, will help to pave the way for solving some of the semantic interoperability problems in e-Health for the future.

### *2.3.3.* Effectiveness gain

Semantic technologies can drive dramatic improvements in quality, service levels, and productivity. Combined with process improvements, these can allow existing staff to handle a greater number (or complexity) of concurrent projects, product releases, and units of work handled. Case examples show increases in effectiveness and return on asset (ROA) from 2-50 times.

The user-driven development approach described in the previous item also results in the improvement of the quality of work and increases productivity enabling to emphasize on value-adding activities such as creativity and management.

In the scope of the two NeOn case studies, the effectiveness gain can be seen in the following ways:

#### *Fisheries Case Study*

FAO is a knowledge organization. FAOs employees are knowledge workers. They need information about the entire range of knowledge that covers agriculture, natural resources, food and nutrition, rural development and more. The networked ontologies in the fishery domain will be starting point for not only a semantic access to knowledge, but also for a much more effective processing of information streams, getting new and better predictions. NeOn is the entry point for FAO to boost the migration from traditional information systems to semantic-based ones. The Fishery department provides with an exemplary use case. A comprehensive result of research for efficient aquatic resource assessment will gather a broad range of data from unbounded data to statistical time series.

#### *Invoice Management Case Study*

Their final objective of this case is to be able to automate the whole invoice management life-cycle. Therefore this application would reduce significantly administrative task and operational costs, giving the possibility to derive human resources to other added-value tasks.

The effectiveness gain for the pharma sector can be summarised as follows:

- Facilitate invoice interoperability between organizations exchanging invoices in different formats and models
- Reduce entry barriers in the Pharmainnova cluster
- Enable users themselves to define how their invoices should be interpreted

#### *Semantic Nomenclature Case Study*

As in the use case of FAO (fisheries domain), the pharmaceutical domain is knowledge-intensive. In particular, the number of drugs described only in Spain can be counted in hundreds of thousands. There are different terminologies to annotate drugs, their active ingredients, usage, dosage and the interactions among them. There is no international consensus that enables interoperability between these descriptions. Besides, the use of these drug descriptions differs depending on who will be using it. For instance, hospitals are more interested in clinical drugs

information, while companies and governmental bodies are more concerned with commercial drugs.

Having this landscape in mind, the improvement in accessing to the right drug information from multiple networked ontologies offers a clear set of benefits, emphasising the possibility of accessing to richer information, and the chance of giving the adequate view to the user with different levels of granularity.

### *2.3.4.* Business edge

The strategic value of semantic technologies is the ability to create new advantages. Case examples evidenced this in several ways, for example: 2-30x revenue growth; 20-80% reduction in total cost of ownership (TCO); 3-12 month positive ROI; 3-300x positive ROI over 3-years; risk mitigation and reduced vulnerability to fraud, liability, or litigation.

The factors of operating in a rapidly changing, global business environment are driving companies to co-operate and to create a competitive advantage by using and managing information in new ways. There is a market shift from product to services that gives place to the formation of complex value chains and virtual organizations without geographical and cultural limits. NeOn adds value in going beyond the single and static ontologies, understanding and supporting aspects of the ontology lifecycle in distributed environments involving large numbers of networked ontologies. This approach has a strong impact in a strongly collaborative domain, going further efficiency and effectiveness and allowing gaining strategic advantages, such as new value capture, managing complex processes between many parties.

This is very clear in the pharmaceutical case studies. In the **Invoice Management** case study, the introduction of the NeOn technology would allow the providers of Pharmainnova to emit their invoice in their own format without doing any extra work once they provide their own model. This is a step forward compared with the current situation, where there are multiple invoice models and providers and laboratories have to modify their own ERP systems in order to comply with requirements from other systems. As a matter of example, using the **Semantic Nomenclature** case study approach, hospitals would be able to integrate their own drug terminology with emerging international terminological standards, making the interoperability easier to achieve at a lesser cost, first among their current systems, but also to the systems of other hospitals or governmental bodies. Semantics in general and networked ontologies in particular are key technologies towards interoperability in e-Health.

On the other hand, **FAO** is already now one of the leading agencies in the area of international influence on fishery, aquaculture and marine resources. Implementing of networked ontologies in this area will make it still easier to partnership with more organizations and to attract donor money. NeOn offers a solution to federate different repositories under a common queryble data infrastructure. Moving to a conceptual level of data representation makes it possible to draw connections (e.g. dependencies, constraints, relations) at a higher level, enabling data retrieval and data processing capabilities. This is cutting edge in our area and will give FAO competitive advantages.

# 3. Interviews with case studies participants

Several interviews to key people that are working in the NeOn case studies have been done in order to get a qualitative first impression of their day-to-day use of NeOn technology. We have posed them three questions about the business value of NeOn:

Q1. In your opinion, based on the work performed in your case study within NeOn, how could networked ontologies help your company?

Q2. How could an integrated toolkit of networked ontologies, such as the NeOn toolkit, influence the adoption of the NeOn methodology in your organization?

Q3. How do you think NeOn could carry out a pervasive market entry? What is needed in order to achieve this goal?

The purpose of this section is having an insight of the possible value of NeOn for the verticals (fisheries and pharma domains) according to people involved in the case studies. For that, the people for the interviews have been chosen according to their business background.

## 3.1. FAO interview

Johannes Keizer, Head of the Information and Knowledge Management Group at FAO

**A1. In your opinion, based on the work performed in your case study within NeOn, how could networked ontologies help your company?**

Our needs are accessing information, organising information, processing information, repackaging information. Networked ontologies will have an enormous importance in all 4 areas, specifically for processing information and inferring new knowledge. The expected advantage of ontologies is to better share knowledge according to standard methods and tools. The expected advantage of a network of ontologies is then to be able to link together, quickly and effectively, information that currently requires much effort to connect and to use in a uniform way. A typical example is when a user queries a database or related resources: the experienced user may get the maximum out of the database, by combining her previous knowledge about the domain and use the result of each of her queries to produce new ones, more refined and to the point. A network of ontologies should allow the user to get to the same results (or even more informative ones) by a shorter sequence of queries. Moreover, such a streamlined process would also enable less experienced user to find information relevant to the topic they are interested in. Hopefully, a clever and appropriate use of inference within the network would also facilitate information finding.

**A2. How could an integrated toolkit of networked ontologies, such as the NeOn toolkit, influence the adoption of the NeOn methodology in your organization?**

One of the reasons of the non-use of advanced semantic tools and Ontologies is the lack of user friendly integrated tools to manage Ontologies and their use. In our organization people have to take care of content, not of tools. We have to resolve 2 problems: integration and user friendliness. If the tools are not integrated, people will not go to look for the single bits and pieces, so integration of resources is a key aspect. But also user-friendliness is an enormous issue.

**A3. How do you think NeOn could carry out a pervasive market entry? What is needed in order to achieve this goal?**

All what I said to the second question is valid. Furthermore the power of the application will be important. How good NeOn is in mapping, how good Neon is in workflow management, and so on. Furthermore the building of a NeOn community will be a condition which is mandatory. Software is old a month after its release. If there is not a thriving community which will further develop the NeOn toolkit, NeOn will have no impact on the market.

### 3.2. iSOCO interview

Jesús Contreras, Innovation Director at iSOCO

**A1. In your opinion, based on the work performed in your case study within NeOn, how could networked ontologies help your company?**

iSOCO is a technology solution provider with focus on Semantic Technology for Enterprise (STE) operating mainly in the Spanish market focused in the pharmaceutical, financial and public sectors. Pharmaceutical industry is traditionally a big IT consumer and it is an ideal beachhead for entering the mainstream market with new technology, such as STE. Invoice management using semantic technology allows for clear example on how STE can help pharmaceutical industry to drastically reduce costs and therefore improve their financial balance. NeOn is allowing iSOCO to gain market position as an innovative company with compelling solution for the pharma sector.

**A2. How could an integrated toolkit of networked ontologies, such as the NeOn toolkit, influence the adoption of the NeOn methodology in your organization?**

One of the key questions that iSOCO is asked whenever we introduce semantic technology in a particular solution is the maintenance of the semantic resources. The ontology lifecycle and its change management are key when facing the IT decision taker during the commercial process. This is the point where NeOn toolkit is helping to introduce advanced solutions to iSOCO customers. With a complete platform for multiple ontology management, such as the NeOn toolkit, it is possible to offer complete management and maintenance toolkit.

**A3. How do you think NeOn could carry out a pervasive market entry? What is needed in order to achieve this goal?**

NeOn is helping a lot in the task of reaching the mainstream market with a new technology. NeOn itself is providing on the one hand technology support for managing semantic based solution and on the other hand real use cases in the pharma industry for the track record. NeOn as such is not going to stay in the market; it is an extreme facilitator for achieving real success in STE exploitation.

### 3.3. KIN interview

Joan Candini, IT Manager at KIN

**A1. In your opinion, based on the work performed in your case study within NeOn, how could networked ontologies help your company?**

Regarding the specific problem of invoicing in the Pharmainnova cluster, it is quite clear to us that a system that would help bridging the gap between the different invoice formats and the ERP integration is a promising technology.

**A2. How could an integrated toolkit of networked ontologies, such as the NeOn toolkit, influence the adoption of the NeOn methodology in your organization?**

Our main and final objective for using NeOn technology is to have a system able to automate the whole invoice management life-cycle. Therefore, this application would reduce significantly administrative task and operational costs, giving the possibility to derive human resources to other added-value tasks.

For KIN the cost-savings aspect is very important. As we are a laboratory and not an IT provider, our main focus is not the researching in a new technology in itself, but in the application of this technology to solve specific problems we have. As we believe this is the case with NeOn, we are happy to foster the introduction of a technology that helps us in this aspect.

**A3. How do you think NeOn could carry out a pervasive market entry? What is needed in order to achieve this goal?**

I understand that you want to know what actions had to be taken in order to get to the market NeOn results. From the KIN perspective the actions are the following:

- Dissemination in events targeting software developers in the pharma domain: It would be advisable to focus in software developers in the first place, because they are the ones that are going to develop applications on top of ontologies.
- To establish strategic alliances with key branded IT companies working in the same domain. The deployment of NeOn-based technology would be much easier if we go hand-by-hand with them.
- Deploying a NeOn-based solution in a well-know client: Clients tend to be conservative, so implementation references are mandatory in most cases to achieve a market share.

In practical terms, clients are more interested in the benefits of a given technology rather than in understanding how the technology actually works. It is quite possible that if there is a business need and networked ontologies are a solution, companies will adopt it. But first we have to adopt a business language, talking about benefits, problems, solutions, return of investment and so on. For now, I think we should keep working what are the business needs we aim to solve, and then publicise the solution in a business language. The integration of semantic technologies in companies is quite promising, but it will be introduced at a slow pace and assessing the profitability in each of the steps.

### 3.4. ATOS interview

Tomás Pariente, Project Manager and IT coordinator in semantic technologies at ATOS

**A1. In your opinion, based on the work performed in your case study within NeOn, how could networked ontologies help your company?**

We are a consultancy and IT company, therefore our aim is not implementing solutions for our own company (that would be a side-objective), but to provide solutions to our clients. In this respect, and focusing in the pharmaceutical domain, it is clear to us that the semantic interoperability in e-Health will not be achieved by using a single terminology or a single unified model of the domain. Hence, the emergence of technologies that allow interlinking and reasoning on different e-Health models and terminologies is a key factor to the success on these initiatives. The usage of Semantic Technologies, and in particular the NeOn approach, would help much towards this success.

**A2. How could an integrated toolkit of networked ontologies, such as the NeOn toolkit, influence the adoption of the NeOn methodology in your organization?**

The reason why we chose a semantic nomenclature case study in the first place is because we think that e-Health is a domain where NeOn technology would be perfectly applicable. There are

plenty of ontologies around in this domain, which gives ample possibility of reuse of ontologies and knowledge. Besides, some of these ontologies and terminologies are too big to be maintained as single ontologies, and there are multiple models representing similar medical or pharmaceutical knowledge. Therefore, the usage of the NeOn methodology to create a network of modularised, dynamic and mapped ontologies is of great interest for this domain.

**A3. How do you think NeOn could carry out a pervasive market entry? What is needed in order to achieve this goal?**

Well, this is a tricky question. I would say that we should somehow go from the technical aspects of semantic technologies to the business side. This is even clearer in the case of networked ontologies and semantic technologies, indeed very shallow terms for most of our clients. In my experience, most of the clients understand about benefits, ROI, and cost savings, and a little bit about the technology. They would like to see their problem solved with a stable and well-referenced technology. This is not the case with semantic technology, seen everywhere as the eternal promise that never comes to fulfil the expectations of the market. So, I think we should start by talking the language of the market, far away from the R&D language, giving indicators, references and clearly stating what can (and can not) be achieved with this technology.

# 4. Experiences while demonstrating the case study prototypes

Although NeOn is in the third year, the case studies have not delivered their final prototypes yet. The first version of the prototypes was not really mature, so the demos to end users have been in general limited and focused more on showing the future work rather than the current versions. Having said so, there are some experiences while demoing the different case studies. In this deliverable, partners involved in WP7 and WP8 have been asked in order to get a preliminary feeling of the users' reaction to the case study results. On the other hand, WP4 is providing their own set of usability studies [4] [5] with a big sample of users and more focused in a quantitative and statistical analysis of the results. Also in WP9, a study of the usability of the core NeOn Toolkit from the case study perspective has been provided [6] Therefore, we are not aiming in this section for a quantitative analysis of the demonstration, but to show the main reactions of the users in the opinion of the case study partners.

## 4.1. Fisheries case study (WP7)

In the case of the fisheries case study, during Y3 we had available a preliminary set of unconnected ontologies plus an early prototype of the FSDAS system. Both the network of ontologies and the FSDAS have evolved to a more mature stage by the end of Y3. However, users had only seen the first prototype and ontology network. Therefore, end users are still sceptical with the project results. The data processing by automatic tools has to show its validity.

On the other hand, end users are also fascinated by the idea of a decision support tool for estimating fish stocks. Regarding the life cycle management system, constant improvements have been experienced throughout the last 6 months. There is now a huge expectation that the NeOn toolkit will become THE tool to manage networked ontologies.

The main conclusions then are:

- FAO users are still sceptical about the validity of the NeOn approach, because the first prototypes and ontologies were not really attractive and usable.
- There is a big expectation among FAO users for the second prototype.

## 4.2. Invoice management case study (WP8)

Before iSOCO gave demo and training sessions with the employees of KIN, end users did not know much about the work developed in the NeOn Toolkit. But they had high expectations and above all the willingness to learn new approaches in respect to electronic invoicing. During these sessions, all the uncertainties of the users were cleared and at the end of the workshop they were amazed by how easy it is to work with the plugin i2Ont. They asked several questions about the future of the NeOn Toolkit and our next steps for i2Ont. Now they have big expectations for the future work that will be delivered soon.

End users were really impressed how easy new ontologies can be created using the NeOn Toolkit; especially the ability to auto-complete properties and classes they considered as very helpful. They showed great surprise when they recognized the multitude of available plugins for all kinds of purposes. However, users got a little bit disaffected when they realized that there are still some

small bugs complicating the use of the NeOn Toolkit. Nevertheless, they expressed the wish and the will to use the tool whenever it is ready to work without problems in any possible situation. Several users mentioned that there are still some aspects easier to handle in Protégé, like the creation of disjoint classes. They have the opinion that the NTK is not yet completely mature, but that it is going to be their tool of choice whenever it is perfected.

A summary of the experiences while demoing the invoice management case study is the following:

- End users were able to see the business value of the case study results with respect to the current situation of the invoicing system in the Pharmainnova cluster.
- End users would like to see a more mature version of the NeOn Toolkit and i2Onto plugin.

### 4.3. Semantic Nomenclature case study (WP8)

Although there is no end-user partner associated to this case study, ATOS performed a series of demos during Y3. As in other case studies, the Semantic Nomenclature prototype was not mature, and the network of ontologies was not ready almost until the end of Y3. Therefore there will be more demos during Y4, and the ones given until new were more focused on showing the future enhancements rather than the current status.

On the other hand, we have detected during this year an increasing interest in semantic interoperability among many stakeholders in e-Health domain. Governmental bodies in many countries (Australia, UK, USA, etc.) are launching or consolidating different approaches towards achieving semantic interoperability in e-Health. The Spanish Ministry of Health is fostering a Semantic Interoperability committee of experts in order to create and follow up a roadmap towards the semantic interoperability in e-Health. In this framework, several universities and hospitals experts have been informed and shown the NeOn approach towards using networked ontologies, and in particular the semantic nomenclature take and first prototype. Most of the users were positively impressed by the possibility of bridging the gap between different terminologies and the reasoning possibilities that modular and interconnected ontologies offer. However, they would like to see the advances of the second prototype.

As a summary, the lessons learned in this case study are the following:

- Semantic interoperability in e-Health is a hot subject.
- The Semantic Nomenclature approach has been positively received among experts.
- Experts are waiting for a more mature version.

# 5. Conclusions

In this report we have shown several radars and studies about the adoption and maturity of semantic technologies. These radars showed that semantic technologies are reaching the markets at a slow pace, although they are already completely mature in some aspects (with some parts still under research). The NeOn tools and methodologies are expected to be another step towards this maturity. During the last years there is a market shift from products to services that gives place to the formation of complex value chains and virtual organizations without geographical and cultural limits. NeOn adds value in going beyond the single and static ontologies, understanding and supporting aspects of the ontology lifecycle in distributed environments involving large numbers of networked ontologies. This approach has a strong impact in a strongly collaborative domain, going beyond efficiency and effectiveness and allowing to gain strategic advantages.

In the light of the NeOn case studies (WP7 and WP8) we have explored these different dimensions of business value. As people from the use cases see it, the usage of networked ontologies can give more strategic advantages to their respective domains. In this sense, both the fisheries and pharmaceutical are knowledge intensive domains where the NeOn proposition could have a significant impact. However, this impact has to be measured more accurately by the end of the project and beyond, because at this stage it is still a perception from the user perspective rather than a true fact.

The case study partners coincide in users having strong expectations in the NeOn results. However, users want to be shown future version of the case study prototypes and ontologies in order to check the NeOn proposition. Hence, there is a big emphasis falling on proper business exploitation and dissemination, and in demoing the case studies results among end-users and clients of the organizations in order to show the project results in application verticals.

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