# Part 2

# Semantic Web Applications

# 15 Semantic Technology Adoption: A Business Perspective

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**Abstract:** In the past decade, significant budgets have been invested in the development of Semantic Technologies. In this chapter, relevant factors are laid out for semantic technology adoption and a framework is provided for describing and understanding the value proposition of semantic technology from a business point of view. An overview will be shown of the current semantic offering in the market place, and this will be interpreted in terms of the framework. Finally, three adoption horizons will be introduced for when semantic technology can be expected to reach the mainstream market and what role it will play in organizations. Overall, the conclusion is that there is some uptake of the technology, but that the mainstream market is still not reached. This is partly because of a lack of understanding by industries of in what situations semantic technologies can add value to their business. This is the reason for introducing a new framework that is aimed at enabling industries to more easily relate semantic technologies to their business.

## 15.1 Introduction

The value proposition of semantic technology is to enable applications and the Web to expose more intelligent behavior. As the name says, semantic technology adds meaning to content in such a way that it becomes machine understandable. This makes it possible to delegate tasks to computers that previously needed the intervention of humans. The classic paper of Berners Lee, Hendler, Lassila published in *Scientific American* in 2001 [1] gives a clear example of this. In that paper, personal software assistants act on behalf of people to schedule an appointment, a process which requires contacting various other software agents, repeated interactions, and careful decision making. Since the late 1990s, much research effort has been dedicated to developing and maturing Semantic Web technology. This chapter analyzes, from the context of mid-2009, whether this sustained R&D effort has led to significant market acceptance. To what extent has the growing Semantic Web had commercial impact, what are the drivers for future adoption, and what can the semantic technology community do to increase uptake of this technology in the market? The recent announcement of Google's plans to use RDFa in their Rich Snippets product, Yahoo!'s launch last year of Searchmonkey, and Microsoft's acquisition of PowerSet are certainly indications of the steady mainstream market adoption of semantic technology.

Rather than speaking of Semantic Web, the term Semantic Technology will be used, since the application of the technology goes beyond its Web instantiations. However, a restriction is made to technologies which make essential use of the Semantic Web languages RDF and OWL, and their variants.

At a high level, there are three main application areas for semantic technology: Information and Knowledge Management, Enterprise Application Integration, and Social Semantic Web. In each area, semantic technology holds promise:

- The promise of semantic technology for information and knowledge management lies in helping people address a constant problem in today's information society, which is to have through sift to increasingly larger amounts of information, both in professional and personal lives. More and more time is spent analyzing increasing amounts

of available information in order to find the information that is needed. It is common for professionals to spend several hours a day on reading and replying to e-mail, searching and navigating the Web, and gathering relevant information to make the best decisions. There are also corresponding information-intensive examples in personal affairs – for example, booking a holiday often requires a substantial effort of information gathering on the Web and analyzing the corresponding information against personal constraints to find the best combination.

- The promise of semantic technology for application integration problems is to significantly reduce the effort associated with managing data interchange between applications. Semantic technology can be used to annotate application inputs and outputs and characterize functionality in a machine-understandable language. This opens the way to automatic service discovery and composition (in SOA-style architectures) and thus promises to significantly reduce the cost associated with system evolution and maintenance. When paired with a planning system, Semantic Web technology can deliver automatic composition and choreography of semantically annotated Web Services.
- The promise of semantic technology for Social Semantic Web applications is to allow people to have a better online experience. Thus, semantic technology is used to enhance the common human activities of content creation, publishing, linking data to other data, forming communities, purchasing satisfying things, browsing, socializing, dating, etc. One common thread in this application area is to enhance the effectiveness of advertising for products that are likely to be desired, either by automatically creating profiles or providing a better framework for people to create profiles of themselves.

The chapter is organized as follows. The first section reviews factors and processes relevant for bringing new technology to the market. Then, in the next section, a framework (semantic map) will be presented that allows businesses to understand the value proposition of semantic technology along with a characterization of business situations in which the technology is applicable. The next section surveys the current semantic technology offering as provided by 100 companies (2009), and interprets this offering in terms of the framework presented. Finally, the chapter ends with a description of three horizons according to which semantic technology is expected to enter the mainstream market. There are two appendices: a list of the 100 suppliers of semantic technology and a categorization of their offerings in terms of sector, technology, and area of application.

## 15.2 Bringing High-Tech to Mainstream Market

### 15.2.1 Key Factors for Making Business with New Technology

Having stated the promise of semantic technology, what are the factors to be taken into account when one wants to use it in business? Creating business value using semantic

technology is in many ways no different from creating business value with any type of new technology. There are three important aspects to take into account:

- *Customers*: think about the customers that will use the new product or service that is enabled by the new technology. Technology as such does not provide anything: it is its capability to solve real customer problems that decides its business potential. Notions such as cocreation (that involves final customers throughout the product ideation, conception, development, and testing stages) and agile software development (in which software is developed in short cycles of a few weeks – sprints – where each sprint is validated with customers) are useful methodologies to become more customer centered.
- *Business models*: think about the business model of the new product and services. What is its place in the value chain, and what part of the value chain can it monetize? And of course, the costs of creating, selling, delivering, and maintaining the product needs to be less than the revenue it generates.
- *Technology*: how easy or difficult is it to have others replicate your product or service? Does the technology provide a competitive advantage compared to other technologies around? Is the IPR adequately protected?

The sweet spot for making business with new technology is to find the right balance between those three factors. Look at it as the intersection, that is, a product needs to be successful on all three aspects. A product that customers like and has a sound business model, but that lacks differentiating technology, is very easy to replicate by competitors, and if successful, will certainly take place (this is often referred to as *marketing* innovations). A product based on a differentiating technology and that customers love, but does not satisfy the business dimension, cannot be profitable simply because the costs will outweigh the potential revenues. And products that have sound business models and differential technology, but that customers do not like, will never reach a large market to become sustainably profitable.

### 15.2.2 Key Processes for Making Business with New Technology

But once there is an adequate product positioning with a potential market, the process starts to convince potential clients to adopt the product. Geoffry Moore in his book *Crossing the Chasm* [2] gives an excellent account of the process of how markets adopt new technology. He describes the so-called technology adoption life cycle according to which high-tech products are adopted through subsequent stages from early markets to mainstream markets (*Fig. 15.1*). Each of those markets has different types of customers. Early markets consist of innovators, real technical people who love technology for the sake of technology (the typical alpha and beta testers), and of visionaries, people who believe new technology can make a breakthrough in their business, and therefore are willing to take a certain risk. Mainstream markets are inhabited by two types of customers: pragmatists,

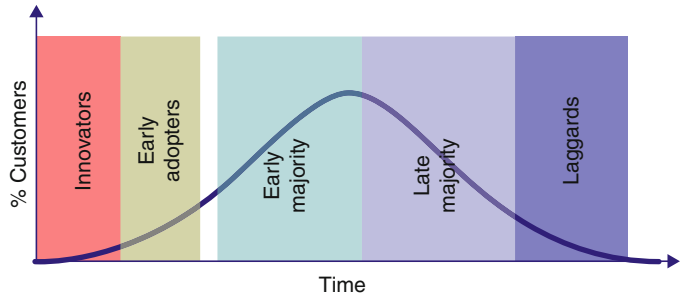



**Fig. 15.1**

**The technology adoption life cycle of crossing the chasm [2] (explains how technology is adopted by the market place)**

who believe that new technology can make a percentage difference in their business, but only are willing to adopt the technology if there is sufficient evidence from their peers that the product works and does not introduce additional risks. The conservative customers of the mainstream market only buy new technology products if not adopting them will cause them problems in their business. Finally, the late market consists of *laggards*, who never buy technology unless it is embedded in devices they already know. Moore claims that there is a gap between the early adopters and the pragmatists in the sense that many high-tech products reach early adopters but never make the big step to the mainstream market, and thus fail to be profitable. In his book he claims the percentage of failure to "cross the chasm" to be as high as 90%.

Another relevant notion to help making business with new technology is Open Innovation [3], which is the opposite of the NIH (not invented here) syndrome. Over the past decades, research has been globalized, as has happened to many business activities. Whereas in the 1970s it was possible to have the best researchers in a certain area all together at the same place (e.g., Xerox PARC, Bell Labs), in today's globalized society that is virtually impossible. In order to still be able to tap on the best talent worldwide, successful research often requires depending on others for parts of the technology or business required for a new product. What better evidence for this than the acquisition activity of companies famous for their innovation pace such as Google, IBM, Apple, etc? In many of the research and development initiatives related to semantic technology, open innovation is not the main paradigm.

### 15.2.3 Key Buyer Roles for Making Business with New Technology

In order to bring any new technology product to the market (including products using Semantic Technology), a sine qua non condition is to convince clients. In many cases, clients will be enterprises and it turns out to be a complex process to sell to them even if

they are early adopters. Though details of sales processes are not relevant here, it is important that researchers and developers of Semantic Technology are aware of the following principal roles that are involved in selling new technology products to enterprises. Depending on the size of the enterprise, roles can be combined into one person or be distributed over several persons.

- *The users*: Users are the people who will enjoy the functionalities of the product. They should love the offered functionality, user interface (ease of use), speed, etc.
- *The IT department*: You convince a user with functionality, but the IT department decides on how to implement that functionality: with your product or with another (your competitors). Technical specifications of the product are relevant, but the enterprise's IT policy is equally important. It is not always the most popular (users) and technically superior product that is the winner.
- *The budget keeper*: Once users want the product and the IT department accepts it from a technological point of view, you still need a final "go"– decision that a certain amount of the company's budget be spent on the new functionality. Usually, in the case of new products, there is no corresponding "new" budget which you can draw from. Your product will compete with other products that may have nothing to do with your product, but simply may have higher priority.

  In order to make a sale, all of those client roles have to be convinced.

## 15.3 Specific Aspects of Semantic Technology for Making Business

So far we have seen a variety of reasons why it is difficult for high-tech to reach mainstream markets. But there are also specific aspects of Semantic Technologies that may explain why it is hard for these technologies to be adopted by enterprises in the mainstream market. In a recent research project [4], a study was made to find this out by consulting both IT managers and suppliers of Semantic Technology. The results show that both vendors and executives have problems describing in simple, strategic terms how Semantic Technologies might fit within a business. This inability is slowing the uptake of STEs (Semantic Technologies for Enterprises) in companies – leaving the less alert IT manager behind operationally, and minimizing the market opportunity for vendor suppliers. In order to solve this barrier of STE uptake, the "STE Strategy Map" has been developed to help managers and vendors remedy the situation.

### 15.3.1 Semantic Technology has a Classic Problem: It is Hard to Explain

Operational executives want to know whether technology is suitable for their company and can make operations more efficient. Technology vendors want to reach the

operational executives and make a sale. The problem is, in the context of STEs, these two parties do not seem to have much common ground or language. Among many people interviewed, the word "Semantic" conjures one of two images: security software (among those who confuse it with "Symantec") and the aging buzz-phrase "Semantic Web." Many IT managers and executives simply do not understand the potential of semantics within their business. This would require a sit-down meeting with them in order to explain it. And, unfortunately, most vendors do not have such an opportunity.

The results are twofold:

- IT managers are missing that "a-ha!" moment where they see how STEs could provide them real benefits and have a place within their companies.
- With time passing, vendors for semantic technologies are watching as much of their technology offering risks becoming a commoditized add-on for major software vendors such as Microsoft and SAP.

Apparently, suppliers of STEs have not been successful in explaining for what businesses STE is applicable to provide benefits.

What is required then is a framework for discussion which will bring these two parties closer together in a much shorter period of time. This framework will need to explain:

- What kinds of companies need STEs, and what kinds do not
- What kinds of activities STEs can perform
- The point at which regular software ends and STEs begin
- The point at which STEs end and labor-intensive work begins

So far, such a framework has not been provided earlier and most researchers and suppliers characterize semantic technologies in terms of one or more fundamental components. These include standards such as Resource Description Framework (RDF) and Web Ontology Language (OWL), and technologies such as taxonomies and ontologies, and composite technologies such as natural language processing engines. The added value of the framework is that it takes a use-case scenario perspective: STEs help bridge business contexts or help employees execute more conceptual activities in the business often reserved for people. The framework is presented in the next sections and referred to as the "STE Strategy Map."

## 15.3.2 Bridging Vendors with IT Managers: The STE Strategy Map

### 15.3.2.1 Corporate Dimensions: How to Describe a Company in Semantic Terms

In order to first establish a context by which both IT managers and semantic vendors can describe a company, two basic dimensions are suggested: that of "context" and "concept."

- *Defining "Context"*: Within an organization, a "context" has its own knowledge resources, business processes, and definitions for terms. A small accounting company may have some small functions for marketing and HR, but its primary context will be "accounting." For a large multinational on the other hand, there are independent knowledge bases and processes for different departments (*Fig. 15.2*).
- *Defining "Concept"*: Within an organization, certain activities may be conceptual, and others are not. Simple calculations are not conceptual, but developing a corporate strategy is (*Fig. 15.3*).

### 15.3.2.2 How Semantic Technologies Support Business Activities

Businesses where STEs are needed and likely to flourish generally try to apply IT in support of one or both of the following types of activities:

- *Activities where concepts and conceptual understanding are important*: For example, reviewing legal documentation or contracts, or searching information for concepts

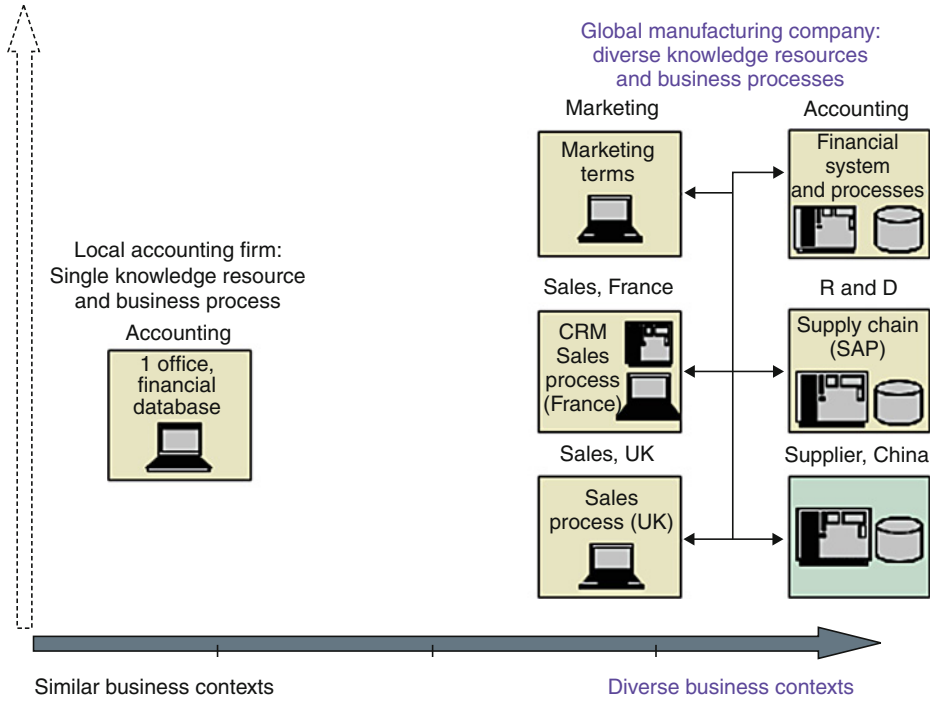



**Fig. 15.2**
**Contexts within a business**

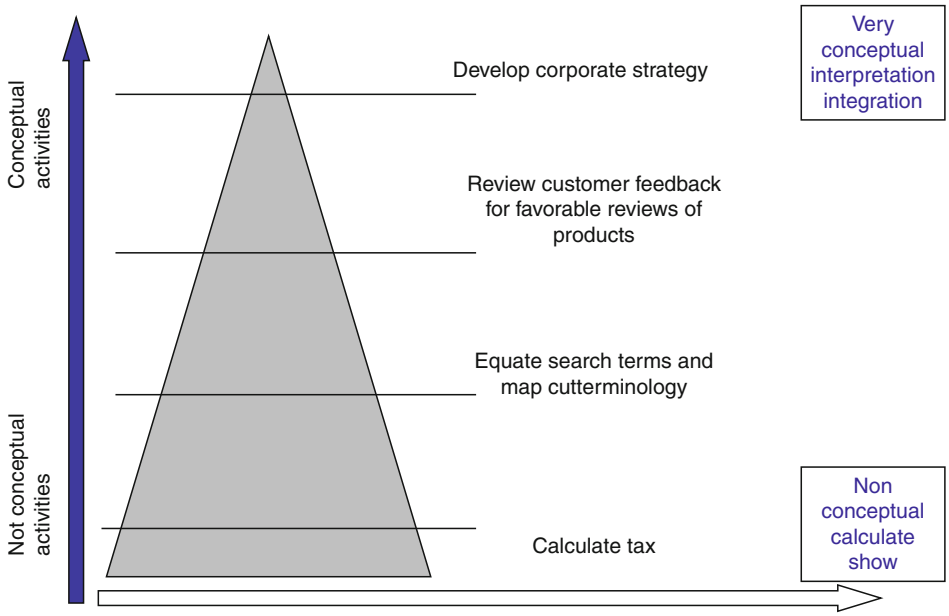



**Fig. 15.3**

**Conceptual and nonconceptual activities in a business**

and data related to the topic of focus. Generically speaking, activities where the actor is trying to interpret, infer, augment, and aggregate information.

- *Activities that span a diverse range of business contexts*: For example, working across R&D, marketing, and operations departments to develop a new product line. Generically speaking, activities that help discover, harvest, create, present, transmit, or act across diverse knowledge resources and business processes.

Working with these basic dimensions, one can derive a few rules of guidance regarding the identification of which businesses are fertile grounds for STEs:

1. Semantic Technologies for Enterprises (STEs) are IT systems that support business activities that are some combination of "conceptual" and "contextual."
2. Businesses that engage in neither conceptual nor diverse contextual activities are not fertile grounds for STEs.
3. Businesses that have IT systems, or need for IT systems, to conduct conceptual or diverse contextual activities, may be fertile grounds for STEs.
4. In order for STEs to flourish, the company must have a certain degree of maturity in its approach to information. It must have not only at least a moderately large volume of information, but view this information as an asset around which to build activities and processes. Otherwise, conceptual activities or multi-contextual activities cannot be run using IT.

### 15.3.2.3 The Semantic Map, and Why It Has Curves

Conceptually, while STEs need some element of Concept and/or Context, technological and operational constraints are also relevant for STE. Primary research and analysis has helped derive some basic constraints that put curves in the Strategy map (*Fig. 15.4*).

Based on this, there are some fundamental tenants that CIOs, IT managers, and the vendors that sell to them, should remember:

1. *STEs have limits to their "intelligence."* There are activities that are too conceptual for STEs. By the time the software has been developed to execute a highly conceptual task, the organization has burned up just as much if not more labor time in development and configuration as it would have in actually having a person execute the task. Furthermore, software is limited in how "artificially intelligent" it is. So there is an upper limit to how conceptual the task can be before a person must execute the task, making it a labor-intensive activity.
2. *Trying to get STEs to span to diverse contexts has operational and conceptual boundaries.* Conceptual tasks across multiple contexts become similarly difficult to implement using STEs. For instance, when working specifically with "ontologies," there is potential for logical conflicts to arise within complex ontologies. Furthermore, few people in an enterprise have the breadth and depth of understanding necessary to create or administer ontologies that span multiple contexts. If they do, they seldom have the time to spare endlessly tweaking ontologies.

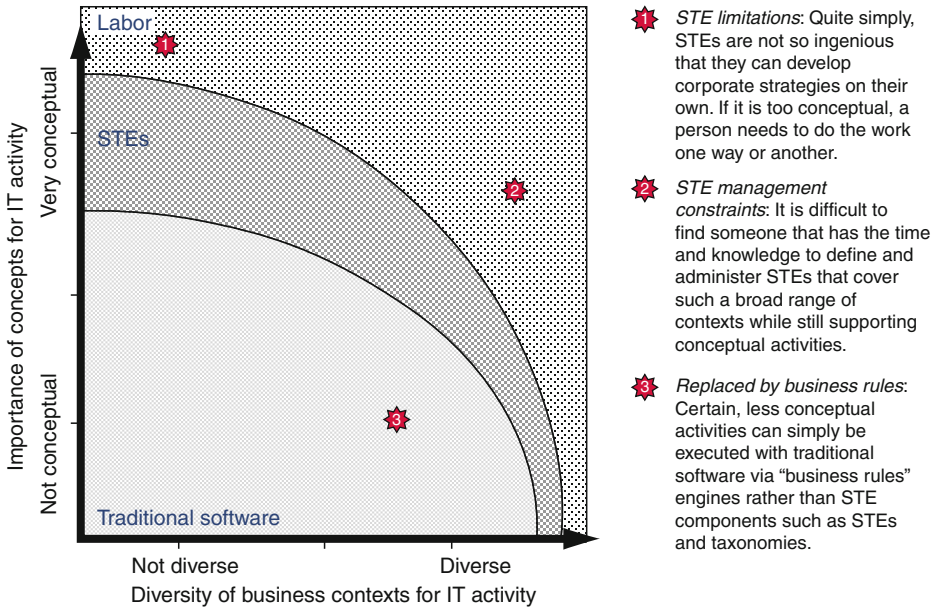



**Fig. 15.4**
**The curved map: constraints on semantic technologies**

3. *If it is a simple enough activity, regular software will suffice.* If an activity becomes simple enough, business rules and "traditional software" can replace semantic technologies.

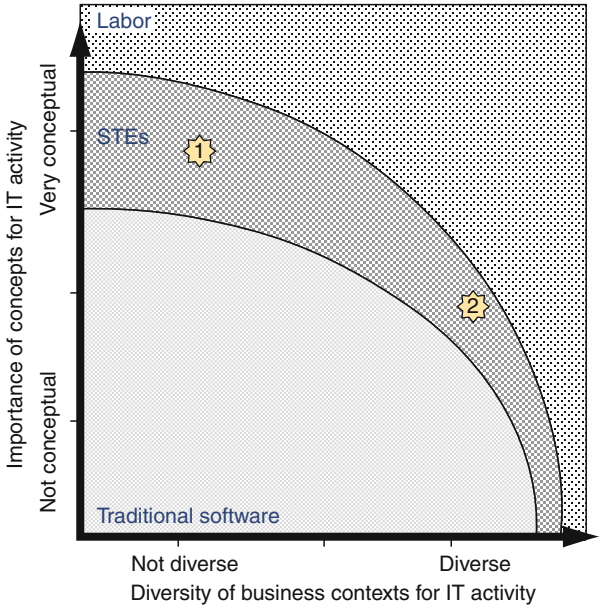
#### 15.3.2.4 How-To: A Simple Way of Finding Opportunities for STEs

Once the corporate context and the Semantic Map are understood, they can be used to determine whether there are specific opportunities for STEs. To do this, it is possible, for instance, to consider various pain points that a company might have, as well as the likely IT responses to those pain points. It is then possible to determine whether the IT response falls in the strategic "sweet spot" for STEs:

Both the responses in *Fig. 15.5* to IT pain points (1 and 2) fall within the Semantic "sweet spot," for which STEs can be effectively deployed.

### 15.3.3 Predicting the Roadmap: Where Are Semantic Technologies Going?

IT managers will undoubtedly wonder whether this technology is real and where it might be going in the long term. With a Strategy Map, they can at least begin the dialog with




1. *Analysis of contracts*

A company needs to check thousands of contracts for legal requirements. It uses STEs to analyze legal contracts. This is an IT activity that requires an understanding of legal concepts and words, but is focused on one department and context: legal.

2. *Business intelligence and KPI analysis across a global company*

A company needs to understand how various KPIs across multiple divisions and offices align. For instance, if the sales office in Portugal is doing well, does that correlate with the product company meeting its goals a month earlier? A conceptual layer, such as "unsustainable performance," or "cash-conservative behavior" might be used for a more strategic analysis.

**Fig. 15.5**
**Corporate pain points with semantic answer**

vendors to become convinced themselves of whether STEs hold potential for their company. In general, research indicates that the field is real, that there exist certain pain points well suited for STEs, and that business is starting to take a look. As one of the interviewees pointed out, Semantic technologies are finding their way into the implementation of mainstream software:

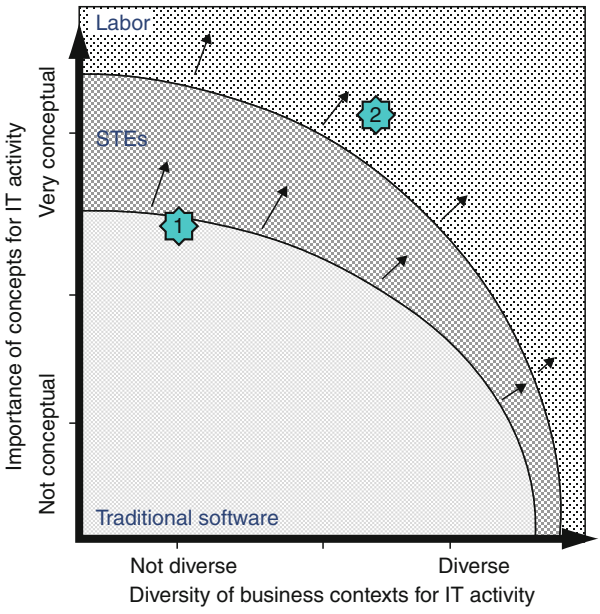
- "When we implement a new version of SAP, and our customer says 'this is what we want,' there are already RDF markups on the inside . . . in the new SAP implementations, RDF and semantic technologies are appearing as requirements."

Depending on dialog and future business development efforts, Semantic technology may continue growing and winning a place on the market, or be swallowed up by the mainstream software vendors (Fig. 15.6).

## 15.4 Semantic Offering in the Market

### 15.4.1 STE Suppliers with Offering in the Market

The previous section has identified the "area" where it makes sense to apply semantic technology; for solving problems that (1) are currently out of reach of traditional software (conceptual dimension) and (2) have a multi-context nature (diversity of business




1. *Traditional software builds in semantics*

Major software vendors for traditional software, are reviewing semantics as a potential part of their development roadmap.

2. *Semantic software expands its boundaries*

Semantic software can also continue in its growth, improving technologies to generate tags and ontological relationships between entities. Over time, it is possible that the maintenance of taxonomies and ontologies becomes a more standard operational activity, starting with semantically enabled search.

**Fig. 15.6**
**A roadmap for semantic technology**

contexts for IT activity). This section surveys current semantic technology providers analyzing whether and how their offering fits the strategic map. In other words, the theory (semantic map) will be matched against the reality (the offerings).

About 100 companies are analyzed. The tables below group the providers based on geography: USA, Europe, and rest of the world. The appendix provides more detail on the companies in terms of sectors, technologies, and areas of application.

**US-Based Companies**

| | | | |
|---|---|---|---|
| AdaptiveBlue | Cougaar Software, Inc. | Intellisophic | Semantech |
| Agilense | CyCorp | Invention-machine | Semantic Arts |
| Amblit | Digital Reasoning | Kirix | Semantic Research |
| Ask | DowJones | Knowledge Based Systems, Inc. | Siderean Software Inc. |
| AskMeNow | EMC Corporation | Knowledge Foundations | TeraDact |
| Autonomy | Endeca | LinkSpace | Teradata |
| BBN Technologies | Expressor | LucidMedia | Textwise |
| Boeing | Fortent | Metatomix | Thetus |
| Cambridge Semantics | Franz | Microsoft | Thomson Reuters |
| CheckMI | Full Capture Solutions | Motorola | TopQuadrant |
| Cognition | Hakia | Oracle | WAND |
| Collexis | Hewlett-Packard Company | Progress Software | XSB |
| Connotate | IBM | Radar Networks | Yahoo! |
| Content Analyst | Image Matters | RiverGlass Inc. | Zepheira |
| Contivo | Intelius | Sandpiper Software | Zoominfo |
| Convera | Intellidimension | SchemaLogic | |

**EU-Based Companies**

| | | | |
|---|---|---|---|
| Aduna | Exalead | Nokia | SmartLogic |
| Altova | Expert System | Norkom | Talis |
| Aspasia Systems | Intelligent Software Components | Ontoprise | Thales |
| Biowisdom | iSense | OntoText | TrueKnowledge |
| Digital Pebble | Lingway | Reuse Company | Whatever |
| Empolis | Mandriva | SAP | Ximetrix |
| | Mondeca | Siemens | Zemanta |

**Rest of the World Companies**

| | | | |
|---|---|---|---|
| Netbreeze | Celtx | EffectiveSoft | Saltlux |
| IQSer | Reinvent | JustSystems | InfoSys |
| Ontos | Semantic System | Ontopia | |

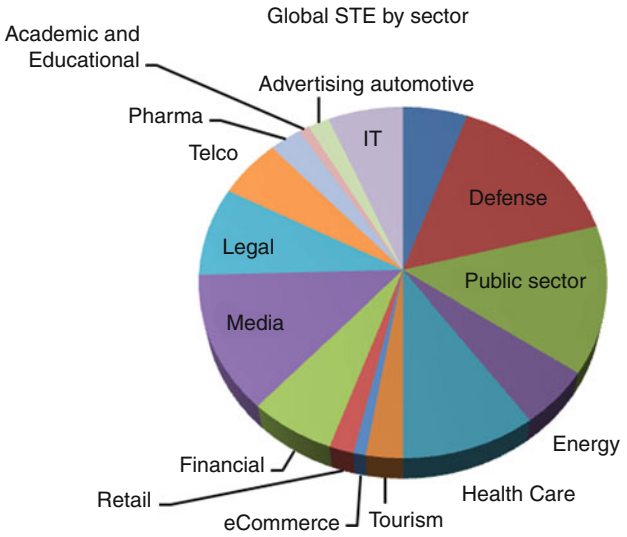



**Fig. 15.7**
**Semantic offering according to sector**

A first impression of what the current market offers in terms of semantic technology can be obtained by looking at the sectors the offerings apply to. The pie chart shown above (*Fig. 15.7*) illustrates that the most represented sectors include Defense (15%), Public sector (14%), Media (13%), and Health care (10%). The fact that defense is number 1 is not surprising because traditionally, many new transformational technologies are first investigated and applied to defense, especially in the USA through the DARPA program. In terms of the Semantic Map, in the defense sector both the conceptual dimension as well as the "diversity of business context" dimension are relevant. Think, for example, of "Intelligence" applications that require conceptual capacity (beyond keywords) and a quick integration of different data sources. In the Media sector, the important problems are related to managing the content explosion, both textual and multimedia (photo, video, audio). Providing automatic support to managing this content requires conceptual capabilities of the solutions. In the public sector, problems are diverse and their automation involves both conceptual capabilities as well as putting together multiple business contexts, such as the integration or coupling of diverse IT systems. In the health-care sector, typical problems require the automatic integration (patient) data from different sources and formats, which is a manifestation of multiple business contexts.

If the offerings are looked at from a high-level technology perspective, the top five technologies (see figure below) covered include Search (20%), Modeling (15%), Data Integration (15%), Information Extraction (13%), and Document Tagging (12%). In the semantic map framework, four of those technologies are mostly related to the "conceptual" dimension, while Data Integration is related to the "diverse business contexts" dimension (*Fig. 15.8*).

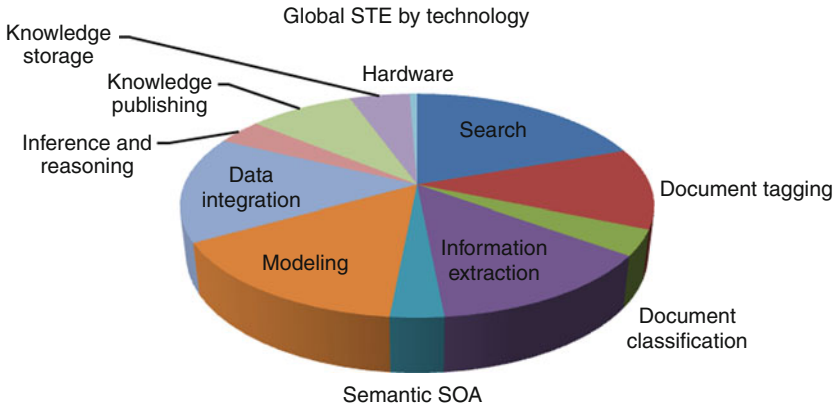



**Fig. 15.8**
**Semantic offering according to technology**

Probably the most relevant dimension for relating the current offering to the Semantic Map is the application area. An analysis of the offering reveals the following areas.

- *Knowledge Management*: Semantic technology allows the transformation of traditional knowledge management from a lexical to a conceptual level. More on Knowledge Management can be found in Knowledge Management in Large Organizations.
- *Information Access*: Search engines supported by semantic technology improve the user experience by better understanding queries taking into account the meaning of terms. More on search engines can be found in Semantic Web Search Engines.
- *Content Management*: Semantically extended content management systems may improve the user experience and the administration labor on web portals. The Media sector is one of the most promising sectors for STE adoption. A use case from the BBC World Cup 2010 website can be found in Storing the Semantic Web: Repositories.
- *Document Management*: Similar to content management, document management may also improve using semantic technology for automatic document classification, retrieval, or information extraction. More on automatic information extraction can be found in Semantic Annotations and Retrieval: Manual, Semiautomatic, and Automatic Generation.
- *Customer Relation Management*: Semantic technology for understanding user/customers need, comments, claims etc.
- *Productivity Tools*: E-mail, desktop, or agenda management tools are experimenting with semantic technology for moving to a conceptual level.
- *Security and Intelligence*: Next-generation security and surveillance systems are based far more on the information content and meaning, rather than on signal processing and telecommunication defense.
- *Social Networks*: The formalization of social relations using semantic technology allows for a better automatic processing for preferences, recommendation, and advertisement.

- *Enterprise Application Integration*: Application integration is one of the biggest pain points of IT managers from the budget point of view. Integration using semantic data or Semantic Web Services may drastically decrease the needed effort for full IT infrastructure exploitation. More on Semantic Web Services can be found in Semantic Web Services.
- *Business Intelligence*: Related to the CRM area. Semantic technology may help in the intelligent integration of heterogeneous business knowledge coming from different departments for a consolidated business view on the company's results.
- *Business Process Management*: Similar to application integration, the formalization of enterprise business processes may allow for a cheap and quick adaptation of existing processes and the development of new processes according to business needs.

The figure below (*Fig. 15.9*) shows how these application areas can be plotted on the Semantic Map. From top to bottom, until "productivity tools" the areas are mostly conceptual. From "business intelligence" to "Enterprise Application Integration," the areas have a more "diverse context" character.

If the offering is analyzed from the application area perspective, as can be seen in the figure below (*Fig. 15.10*), the top five are: Information Access (32%), Knowledge Management (19%), and then Enterprise Application Integration, Content Management, and Security and Intelligence, all three with 11%. This is consistent with the "technology"

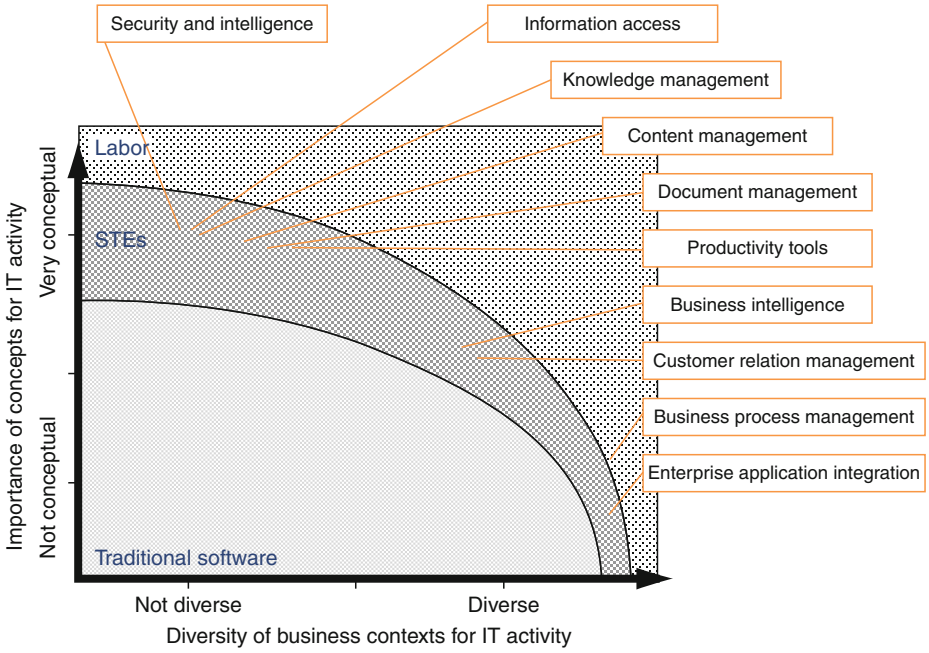



**Fig. 15.9**

**Positioning of application areas on the semantic map reveals two clusters: the more conceptual areas and the "diverse context" areas**

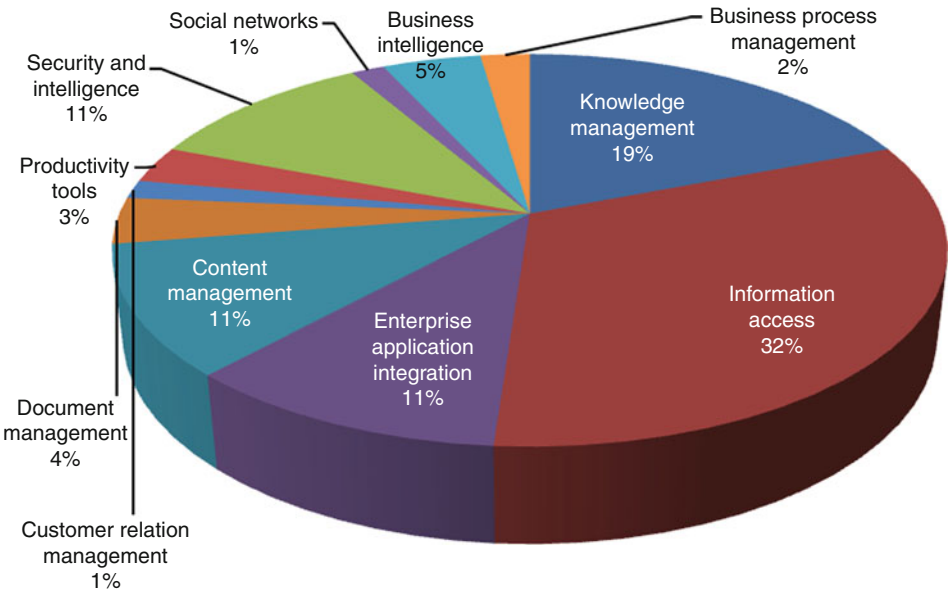



**Fig. 15.10**
**Semantic offering according to area**

perspective where "Search" is the largest category. The importance of Security and Intelligence is related to the defense sector.

While semantic technology is not yet in the mainstream market, analysis of the offering of 100 companies in the field shows that the majority of the solutions are in the "conceptual" space, that is, they offer solutions for problems that have a conceptual character and cannot be solved by traditional software. For the majority of the market, these problems are currently solved by people, not by software. A significant smaller number of offerings aim at problems related to integrating diverse business contexts. This is not surprising since "conceptual" offerings mostly apply to unstructured information that is usually not considered as enterprise-critical information, yet promises improvement in productivity. Data integration is usually applied on company-critical information stored in different databases, and before companies at large decide to use a new approach such as Semantic Technology to deal with their company-critical information, more experience and trust need to be gained.

This is actually a trend that can be projected on how and when semantic technology will be adopted by the mainstream market, which is the subject of the next section.

## 15.5 Adoption Horizons of Semantic Technology

Semantic technologies allow the addition of intelligence to traditional applications by managing the meaning of data. As has been explained, semantic technology is starting to have some impact in noncritical and internal environments in the scope of companies and organizations, where data and processes are controlled. As of 2009, some business

managers are testing its potential; other IT managers are testing its scalability and reliability. Semantic technologies allow for data or knowledge integration and if the current testing turns out to be successful, STE will be able to expand its scope both to more critical processes and to the external relationships of organizations with their environment (providers, customers, partners, etc.).

There are three possible phases in the adoption of semantic technology according to its penetration into organizations' structures. In the *first phase* some internal processes may use semantic technologies to enhance their capabilities. This technology is already in place and there is some track record in real environments [5].

In the *second phase*, semantic technologies allow for small ecosystem creation. Companies may integrate their value-chain processes using semantic technologies or vocabularies. Sector-based standards will boost the construction of dedicated semantic islands. There are some sectors (e.g., Health, Media, and Defense) that are already reaching this stage of STE penetration, even if the technology is still not mature and ready for massive deployment.

In the *third phase* full integration takes place of information systems using semantic technologies and vocabularies. Initiatives as Linked Data are some of the ongoing initiatives in this sense. More on linked data can be found in Semantic Annotation and Retrieval: Web of Data.

As of 2009, for the first phase (internal, noncritical), early adopters have deployed several semantic solutions and are now testing it in real settings. For the second phase (intercompany), the solutions are in prototypical stage and being evaluated by some early adopters. Those solutions might reach the mainstream market in the period 2012–2015. For the third phase (full integration, inter, intra, and worldwide), current solutions are still in research stage, and are not expected to reach market before 2015. The following sections will provide more detail of each of the phases along with two example use cases that illustrate typical applications.

### 15.5.1 First Phase: Short-Term Adoption of Semantic Technology

Short-term adoption refers to ongoing deployments of STE-based solutions in real environments. There are some market-ready solutions using semantic technology mainly dealing with companies' internal or noncritical processes such as knowledge management, innovation, or intranets. Also some companies are testing semantic technologies on their critical production systems, especially those with information integration and management requirements (e.g., pharmaceutical laboratories).

The increasing amount of knowledge-intensive work and more collaborative paradigms in companies are boosting the need for more intelligent information/knowledge retrieval and management systems. Companies are looking for new technologies and paradigms in order to foster employees' efficiency for knowledge acquisition and management. That is the case of communication, collaboration, and social networking technologies present in Web 2.0 that are being adopted within corporations and organizations.

There has arisen a new market for communication, collaboration, knowledge management, and social networking solutions for the enterprise. This new market, sometimes called Enterprise 2.0 or Social Software in the Workplace, is still an immature and heterogeneous concept, but according to some forecasts [6] may achieve $4,6 billion by 2013, similar in size to the current Content Management Systems (CMS) market.

Enterprise 2.0 is a good example of how STE can penetrate the mainstream market in a short period with the following capabilities and tools:

- Semantic wikis for enterprise vocabulary and modeling
- STE underlying enterprise blogs publication
- Semantic document management
- Complex knowledge management applications
- Innovation and idea management
- Communication and collaboration tools

The usage of semantic technologies for internal processes as innovation is described in the business case above (*Table 15.1*).

Some pharmaceutical laboratories (e.g., Eli Lilly) use semantic technologies to speed up the drug development process as described above (*Table 15.2*).

### 15.5.2 Second Phase: Midterm Adoption of Semantic Technology

The upcoming networked economy is based on the ability of companies to transform information into knowledge and take profit from it. The agile and flexible reconfiguration of resources according to this knowledge has become key in the rapidly changing environment. In the midterm, semantic technology may enable the integration of several organizations in the same sector (vertical integration) or area (horizontal integration). Sectors or areas with an already existing controlled vocabulary or under strong regulation are better positioned for STE uptake.

Health, public administration, and defense are traditionally well-regulated sectors with a high penetration of controlled vocabularies and standards (*Table 15.3*).

### 15.5.3 Third Phase: Long-Term Adoption of Semantic Technology

At the long-term horizon, one can foresee the Semantic Web vision come true. Many of the semantic islands developed in previous phase may join in a common structure. The linked data [7] initiative has drastically pushed this vision into a reality. Despite scalability and maintenance issues, there already is available a common formalism for connecting semantically enabled domains. Companies in this phase will be able to extend their information systems to a general Web database.

**Table 15.1**

**Use case on innovation process with STE support**

| Name | Collaborative innovation |
|---|---|
| Sector/Verticals | Any |
| Area/Horizontal | Knowledge Management |
| Target Customer | HR Director, Innovation Director, CEO |
| Decision Taker | • Functional: HR Director, Innovation Director |
| | • Technical: IT Manager |
| | • Final User: Employee |
| Description | In a customer-facing business, competitors often copy successful products and services within months after being introduced. This creates the need to improve existing products or processes, and introduce new ones quickly and frequently. Time to market is a critical factor, and technology plays an important role in speeding up the innovation process. The HR Department runs an innovation program through which they give financial rewards to employees who contribute the best ideas |
| | When an employee enters a new idea, the system analyzes the text and recognizes the relevant concepts from the perspective of the business. This happens in real time, enabling the user to be shown other ideas that contain the same concepts (not words!). It provides employees with a simple tool for checking whether their idea is actually new, or if it is a variation or complement of an existing idea |
| | The concepts are defined and related in an enterprise ontology, which includes products, channels, departments, clients, etc. In the same way, employees can search for ideas that contain relevant concepts, and concepts are highlighted in real time to provide feedback to the user |
| | Search and analysis can also be performed on dates, individual employees, departments, etc. Moreover, the system is able to give an explanation as to why it thinks certain ideas are similar by showing the semantic relations between the concepts in the new idea and existing ones |
| Benefits | More efficient ideation process, tapping efficiently from all employees |
| Reference Users | Bankinter (Spain), Telefonica R&D (Spain), Repsol (Spain) |

Currently, there are some ongoing initiatives in this sense, very much related to linked data (LD) standard in public (*Table 15.4*) and media (*Table 15.5*) sectors. Governments are publishing public data into the LD framework allowing third parties to construct intelligent applications on top (see, for example, http://data.gov.uk). More on the take-up of linked data in government can be found in eGovernment.

## 15.6 Conclusions and Summary

This chapter has reviewed relevant factors for bringing high-tech in general, and Semantic Technologies in particular, to the market place. The analysis is based on significant

**Table 15.2**

**Use case on critical drug development process in a pharmaceutical lab**

| Name | Drug target assessment tool |
|---|---|
| Sector/Verticals | Health care: Pharmaceutical |
| Area/Horizontal | Knowledge Management |
| Target Customer | Scientists |
| Decision Taker | Technical: IT investment committee |
| Description | A drug target assessment tool that is part of a drug discovery infrastructure built using Microsoft's Composite Application Block technology. The implementation uses internally developed ontologies, and industry standard terminologies such as MESH. The ontologies are stored within the Oracle RDF Data Model, and linked to the diverse data sources that require integration |
| | The drug target assessment tool enables parallel assessment of candidate profiles across many scientific and business dimensions of interest. The interface allows scientists either to search directly for a given term and see all related data, or navigate to the term of interest through the ontology |
| | The results of queries display a set of entities as a graph to assist the user in visualizing and navigating among the relationships between the entities. This approach enables scientists to discover information as they navigate through available knowledge, rather than necessarily having to have a specific query in mind at the outset |
| | The tool gives researchers the ability to integrate diverse sources of data, view all data relating to entities of interest no matter where they are sourced, and the flexibility to incorporate additional unanticipated datasets in the research process |
| Benefits | • Efficiency – reduced research wastage and opportunity costs |
| | • Effectiveness – more accurate and flexible research process |
| | • Cost – lower R&D cost per new drug |
| Reference Users | Eli Lilly |

experience in working with Semantic Technologies and products (the vendor side), as well as on interviews with key business players (the client side). The main conclusions are:

1. In general, researchers and developers in the area are focusing more on the technology and less on the problems to be solved in terms of market needs, a situation that slows down the adoption rate of the technology.
2. There exists a gap between what vendors say they offer and what IT managers and CIOs understand they need in their business. That is, it is unclear for what types of companies Semantic Technologies provide a benefit. In order to bridge this gap, this work has identified the appropriate problem space in enterprises where it makes – business wise – sense to apply Semantic Technology today.

**Table 15.3**

**Health care use case using STE**

| Name | Patient safety application for hospital management |
|---|---|
| Sector/ Verticals | Health care |
| Area/ Horizontal | Knowledge Management |
| Target Customer | Health systems |
| Decision Taker | Functional: Hospital Management |
| | Technical: IT Manager |
| Description | The health domain is traditionally one of the most advanced fields where the semantic technologies find a good breeding ground for testing and deploying compelling applications. This sector has defined communication standards (HL7, etc.), controlled vocabularies (GALEN, FMA, etc.), classification and reference norms (IDC, MESH, CPT, COSTAR, DSM IV, READ 3, etc.) and there even exist semantic models for the whole sector (SNOMED CT, UMLS, etc.). Making eHealth systems interoperable using common standard data formats and protocols facilitate a significant step forward in the achievement of a satisfactory health care: improving the care provided to patients, reducing medical errors, and saving human and economic costs. Experiences of fully automated local health systems with a lack of underlying standard for data exchange have shown that the gap between consumer expectations and the actual service delivery remains to be bridged |
| | Hospital patient management systems including STE help in the prevention of adverse events increasing patient safety. The semantic vocabulary and inference system alerts when possible mistakes may occur by establishing alarms or prevention maps for professionals reducing the possibility of human error |
| Benefits | Improve quality of health services. Prevent from legal costs |
| Reference Users | National Health Service, UK |

3. Current offerings of semantic technology in the marketplace, as of 2009, are in large part related to problems that require the structuring of nonstructured information, and less to integration of companies' data.

The last part of the chapter identifies three phases through which semantic technology can enter the mainstream market.

In the rest of this book, the reader will find concrete experiences of applying Semantic Technologies to different business scenarios. It is an interesting exercise to contrast those business applications with the findings of this chapter. Applications that will be discussed include: Web search, eScience, Knowledge Management in large organizations, eBusiness, eGovernment, Multimedia Broadcasting and eCulture, and Semantic Web Services.

**Table 15.4**

**Linked data use case for public administration**

| Name | UK Government linked data initiative |
|---|---|
| Sector/verticals | Public administration |
| Area/horizontal | NA |
| Target customer | Third-party companies for added-value application development |
| Decision taker | – |
| Description | Massive publication of public government data by the UK public administration (http://data.gov.uk). Data are published according to ST standards and can be used for intelligent application development. At this time (January 2009) it includes almost 3,000 datasets published by diverse global and local administrations |
| Benefits | |
| Reference users | UK Government |

**Table 15.5**

**Linked data use case for media industry**

| Name | BBC linked data dump |
|---|---|
| Sector/verticals | Media |
| Area/horizontal | NA |
| Target customer | Third-party companies for added-value application development |
| Decision taker | – |
| Description | BBC has published data about its programs (http://www.bbc.co.uk/programmes) and music (http://www.bbc.co.uk/music) in RDF format for further exploitation |
| Benefits | |
| Reference Users | BBC |

## 15.7 Cross-References

- eBusiness
- eGovernment
- eScience
- Knowledge Management in Large Organizations
- Multimedia, Broadcasting and eCulture
- Social Semantic Web

## Acknowledgment

The work reported in this chapter has been partially funded by the European Commission in the context of the Value-IT project.

## Annex 1: STE Suppliers Company Listing

### Company Selection

Companies were selected from the following sources.

#### STE-Related Web Pages

- Semantic Exchange: http://www.semanticexchange.com
- Semantic Report: http://www.semanticreport.com
- Semantic Website: http://www.semanticweb.com

#### EU-Funded Project and Commercial Reports

- Neon, Knowledge Web Deliverables
- Semantic Wave 2008 Report: Industry Roadmap to Web 3.0 and Multibillion Dollar Market Opportunities.: http://www.project10x.com/index.php

#### Conference Assistants

- International Semantic Web Conference (ISWC)
- European Semantic Web Conference (ESWC)
- Semantic Technology Conference (SemTech)
- European Semantic Technology Conference (ESTC)

Universities and public research centers are excluded from this study. Private research centers, R&D departments of big IT players have been included, since they usually transfer new technologies into the commercial portfolio (as was the case of Oracle, Yahoo!, SAP, etc.).

According to ones understanding of the STE, the following types of companies have been excluded from this listing:

- Natural Language Processing (NLP) technology based companies that may use the term of "semantics" for part of the NLP.

- Web development companies that may use microformats or RSS functionalities sometimes tagged as Semantic Technologies.

## Company Description Fields

For each company included in this report, the following information is described:

- *Name*: Company name.
- *URL*: Corporate website. Almost all information included in this report was extracted from the corporate website of the companies.
- *Sectors*: According to company solutions and customers, the following sectors have been identified: Automotive, Defense, Public Sector, Energy, Health Care, Tourism, eCommerce, Retail, Financial, Media, Legal, Telco, Pharma, Academic and Educational, Advertising, IT.
- *Areas*: For each company, where information available, one or more semantic solution areas have been assigned related to their products or services: Knowledge Management, Information Access, Enterprise Application Integration, Content Management, Document Management, Customer Relation Management, Productivity Tools, Security and Intelligence, Social Networks, Business Intelligence, Business Process Management.
- *Technologies*: For each company, where information available, one or more semantic technologies have been assigned related to their products or services: Search, Document Tagging, Document Classification, Information Extraction, Semantic SOA, Modeling, Data Integration, Inference and Reasoning, Knowledge Publishing, Knowledge Storage, Hardware.

| Supplier | URL | Areas | Technologies | Sectors |
|---|---|---|---|---|
| AdaptiveBlue | http://www.adaptiveblue.com | Productivity Tool | | |
| Aduna | http://www.aduna-software.com | Information Access, Content Management | Knowledge Publishing, Modeling | Public Sector, Media |
| Agilense | http://www.agilense.com | Enterprise Application Integration | Data Integration, Knowledge Publishing | |
| Altova | http://www.altova.com | | Modeling | |
| Amblit | http://www.amblit.com | Content Management | Modeling | |

| Supplier | URL | Areas | Technologies | Sectors |
|---|---|---|---|---|
| Ask | www.ask.com | Information Access | Search | |
| AskMeNow | http://www.askmenow.com | Information Access | Search, Data Integration | |
| Aspasia Systems | http://www.aspasia-systems.de | Knowledge Management | | |
| Autonomy | http://www.autonomy.com | Information Access | Search | Media, Retail, Telco, Public Sector, Automotive, Finance, Defense, Legal, IT, Energy, Health, Pharma |
| BBN Technologies | http://www.bbn.com | Information Access, Content Management, Document Management | Search, Document Tagging, Information Extraction, Inference and Reasoning | Defense |
| Biowisdom | http://www.biowisdom.com | Knowledge Management, Information Access | Information Extration, Knowledge Publishing | Health |
| Boeing | http://www.boeing.com | | | |
| Cambridge Semantics | http://www.cambridgesemantics.com | Productivity Tools | Data Integration, Modeling | |
| Celtx | http://www.celtx.com | Modeling | Media | |
| CheckMI | http://www.checkmi.com | | | |
| Cognition | http://www.cognition.com | Information Access | Search, Document Tagging, Information Extraction | Health, Legal |
| Collexis | http://www.collexis.com | Knowledge Management, Social Networks | Search, Data Integration, Information Extraction, Knowledge Publishing | Health, Defense, Legal |

| Supplier | URL | Areas | Technologies | Sectors |
|---|---|---|---|---|
| Connotate | http://www.connotate.com | Business Intelligence, Information Access | Search, Knowledge Publishing | Finance, Legal, Defense, Media |
| Content Analyst | http://www.contentanalyst.com/ | Information Access, Knowledge Management, Document Management | | Legal, Education, Media |
| Contivo | http://www.contivo.com | Enterprise Application Integration, Business Process Mangement | Data Integration, SOA | |
| Convera | http://www.convera.com | Information Access | Search, Information Extraction | Media |
| Cougaar Software, Inc. | http://www.cougaarsoftware.com | Enterprise Application Integration | Data Integration | Defense |
| CyCorp | http://www.cyc.com | Security | Modeling, Reasoning | Finance |
| Digital Pebble | http://www.digitalpebble.com | Information Access | Information Extraction, Document Classification | |
| Digital Reasoning | http://www.digitalreasoning.com | Information Extraction | Document Tagging | Defense |
| DowJones | http://www.dowjones.com | Information Access, Knowledge management | Search, Modeling, Document Tagging, Knowledge Storage | Media, Financial, Energy, IT |
| EffectiveSoft | http://www.effectivesoft.com | Knowledge Management | Document Tagging, Document Classification, Information Extraction | |
| EMC Corporation | http://www.emc.com | | | |

| Supplier | URL | Areas | Technologies | Sectors |
|---|---|---|---|---|
| Empolis | http://www.empolis.com | Information Access, Content Management | Search, Document Tagging, Information Extraction | Telco, Manufacturing, Media, Public Sector |
| Endeca | www.endeca.com | Security and Intelligence, Information Access | Search, Document Tagging, Information Extraction | Retail, Financial, Automotive, Defense |
| Exalead | http://www.exalead.com | Information Access | Search, Knowledge Visualization | Media, Public Sector, Finance, Health, IT |
| Expert System | http://www.expertsystem.net | Knowledge Management, Security and Intelligence, Information Access | Search, Document Tagging, Information Extraction, Document Classification | Automotive, Telco, Defense, Tourism, Media |
| Expressor | http://www.expressor-software.com | Enterprise Application Integration | Data Integration | |
| Fortent | http://www.fortent.com | Business Intelligence, Security and Intelligence, Knowledge Management | Data Integration, Search, Reasoning, | Finance |
| Franz | http://www.franz.com/ | Information Access | Modeling, Knowledge Storage | |
| Full Capture Solutions | http://www.fullcapture.com | | | Financial |
| Hakia | http://company.hakia.com | Information Access | Search | |
| Hewlett-Packard Company | www.hp.com | | | |
| IBM | http://www.ibm.com | Information Access | Search, Modeling, Semantic SOA, Knowledge Storage | |

| Supplier | URL | Areas | Technologies | Sectors |
|---|---|---|---|---|
| Image Matters | http://www.imagemattersllc.com | Knowledge Management, Information Access, Business Process Management, Enterprise Application Integration | | |
| InfoSys | http://www.infosys.com | Information Access, Content Management | Search, Knowledge Publishing | |
| Intelius | http://www.intelius.com | Security and Intelligence | | |
| Intellidimension | http://www.intellidimension.com | | Knowledge Storage | |
| Intelligent Software Components | www.isoco.com | Knowledge Management, Business Intelligence, Content Management | Search, Information Extraction, Modeling, Knowledge Publishing | Finance, Public Sector, Tourism, Energy |
| Intellisophic | http://www.intellisophic.com | | | |
| invention-machine | www.invention-machine.com | Knowledge Management | | Automotive, Energy, Health |
| IQSer | http://www.iqser.ch | Business Intelligence, Knowledge Management | | |
| iSense | http://www.isense.net | Content Management | Information Extraction | Advertising |
| JustSystems | http://www.justsystems.com | Content Management, Enterprise Application Integration, Business Process Management | | Defense, Financial, Public Sector |
| Kirix | http://www.kirix.com | Productivity Tools | Data Integration | |

| Supplier | URL | Areas | Technologies | Sectors |
|---|---|---|---|---|
| Knowledge-Based Systems, Inc. | http://www.kbsi.com | Knowledge Management | Information Extraction | Defense, Public Sector |
| Knowledge Foundations | http://www.knowledgefoundations.com | Knowledge Management | Information Extraction | |
| Lingway | http://www.lingway.com | Information Access, Knowledge Management | Search, Document Tagging | Health, IT |
| LinkSpace | http://www.linkspace.net | Information Access | Search | Defense |
| LucidMedia | http://www.lucidmedia.com | Content Management | Document Tagging, Document Classification | Advertising |
| Mandriva | http://www.mandriva.com | Information Access, | Data Integration, Search | IT |
| Metatomix | http://www.metatomix.com | Information Access, Knowledge Management | Data Integration | Legal, Financial |
| Microsoft | www.microsoft.com | | | |
| Mondeca | http://www.mondeca.com | Knowledge Management, Content Management, Information Access | Modeling, Search, Reasoning | Legal, Media, Defense |
| Motorola | http://www.motorola.com | | Knowledge Publication | |
| Netbreeze | http://www.netbreeze.ch | Information Access | Document Tagging, Information Extraction, Search | Pharma, Financial |
| Nokia | http://www.nokia.com | | | |
| Norkom | http://www.norkom.com | Security | | Financial |
| Ontopia | www.Ontopia.net | | Modeling, Knowledge Publishing | |

| Supplier | URL | Areas | Technologies | Sectors |
|---|---|---|---|---|
| Ontoprise | http://www.ontoprise.de | Knowledge Management, Information Access, Content Management | Modeling, Knowledge Storage, Inference and Reasoning, Information Extraction | Automotive, Telco |
| Ontos | http://www.ontos.com | Business Intelligence, Document Management, Enterprise Application Integration | Document Tagging, Information Extraction, Semantic SOA | Finance, Legal |
| OntoText | http://www.ontotext.com | Information Access | Document Tagging, Modeling, Information Extraction, Language Understanding, Knowledge Storage | |
| Oracle | http://www.oracle.com | Enterprise Application Integration | Knowledge Storage, Data Integration | |
| Progress Software | http://www.progress.com | Enterprise Application Integration | Data integration | Defense, Finance, IT, Telco, Health, Media, Public Sector |
| Radar Networks | http://www.twine.com | Knowledge Management | Modeling, Data Integration | |
| Reinvent | http://www.reinvent.com | Content Management | Modeling, Publishing | Tourism |
| Reuse Company | http://www.reusecompany.com | Knowledge Management, Intelligence, Customer Relation Management | Modeling, Data Integration, Information Extraction | Public Sector, Energy |
| RiverGlass Inc. | http://www.riverglassinc.com | Knowledge Management, Intelligence | Search, Document Tagging, Information Extraction | Defense |

| Supplier | URL | Areas | Technologies | Sectors |
|---|---|---|---|---|
| Saltlux | http://www.saltlux.com | Information Access | Search, Information Extraction, Document Tagging | Telco, Legal, Public Sector |
| Sandpiper Software | http://www.sandsoft.com | | Modeling, Data Integration | |
| SAP | http://www.sap.com | Enterprise Application Integration | Data Integration, Semantic SOA | |
| SchemaLogic | http://www.schemalogic.com | Information Access, Document Management | Search, Modeling | IT, Media, Defense |
| Semantech | http://www.semantech-inc.com | Enterprise Application Integration | | |
| Semantic Arts | http://www.semanticarts.com | Enterprise Application Integration | Semantic SOA | Public Sector, Health Care |
| Semantic Research | http://www.semanticresearch.com | Intelligence, Knowledge Management | Knowledge Publishing, Modeling, Knowledge Storage | Education, Defense |
| Semantic System | http://www.semanticsystem.com | | Hardware | |
| Siderean Software Inc. | http://www.siderean.com | Content Management, Knowledge Management, Information Access | Data Integration, Modeling, Knowledge Publishing | |
| Siemens | http://www.siemens.com | | Modeling, Data integration | Health, Energy |
| SmartLogic | http://www.smartlogic.com | Information Access, Knowledge Management | Modeling, Document Classification, Knowledge Publishing | Public Sector, Media, Finance |
| Talis | http://www.talis.com | Document Management | | Academic |
| TeraDact | http://teradact.com/index.htm | | | |

| Supplier | URL | Areas | Technologies | Sectors |
|---|---|---|---|---|
| Teradata | http://www.teradata.com | Enterprise Application Integration, Customer Relation Management | Data Integration | |
| Textwise | http://www.textwise.com | Information Access | Document Tagging, Information Extraction | |
| Thales | http://www.thalesgroup.com | Intelligence and Security | | Defense, Health, Public Sector |
| Thetus | http://www.thetus.com | Knowledge Management, Information Access | Search, Data Integration, Modeling, Knowledge Publishing | Defense |
| Thomson Reuters | http://www.thomsonreuters.com | Intelligence, Information Access, | | |
| TopQuadrant | http://www.topquadrant.com | Information Access | Modeling, Data Integration | Defense, Public Sector, Pharma, Automotive |
| TrueKnowledge | http://www.trueknowledge.com | Information Access | Search | |
| WAND | http://www.wandinc.com | Information Access | Modeling | eCommerce |
| Whatever | http://www.whatever-company.com | Knowledge Management, Social Networks | Search | |
| Ximetrix | http://www.ximetrix.com | Content Management | Search, Document Tagging, Knowledge Publishing | Public Sector |
| XSB | http://www.xsb.com | Information Access, Enterprise Application Integration, Business Intelligence | Data Integration, Information Extraction, Document Classification, Inference and Reasoning | |

| Supplier | URL | Areas | Technologies | Sectors |
|---|---|---|---|---|
| Yahoo! | www.yahoo.com | Information Access | Search, Document Tagging, Data integration | |
| Zemanta | http://www.zemanta.com | Productivity Tool | Content Tagging | Media |
| Zepheira | http://zepheira.com | | | Education |
| Zoominfo | http://www.zoominfo.com | Information Access | Data Integration, Search | |

# Annex 2: Company Listings by Sector, Technology, and Application Area

## STE Companies by Sector

Companies are assigned one or multiple sectors according their offering and their customers. The following table shows the weight of some sectors of all selected companies, and then by address split into USA, EU, and others (*Table 15.6*).

**Table 15.6**

**STE companies by sector**

| | Global | | USA | | EU | | Others | |
|---|---|---|---|---|---|---|---|---|
| Sector | 110 | 100% | 60 | 100% | 40 | 100% | 10 | 100% |
| Automotive | 6 | 5% | 4 | 7% | 2 | 5% | 0 | 0% |
| Defense | 17 | 15% | 13 | 22% | 3 | 8% | 1 | 10% |
| Public Sector | 15 | 14% | 5 | 8% | 8 | 20% | 2 | 20% |
| Energy | 6 | 5% | 3 | 5% | 3 | 8% | 0 | 0% |
| Health Care | 11 | 10% | 6 | 10% | 5 | 13% | 0 | 0% |
| Tourism | 3 | 3% | 0 | 0% | 2 | 5% | 1 | 10% |
| eCommerce | 1 | 1% | 1 | 2% | 0 | 0% | 0 | 0% |
| Retail | 2 | 2% | 2 | 3% | 0 | 0% | 0 | 0% |
| Financial | 7 | 6% | 4 | 7% | 1 | 3% | 2 | 20% |
| Media | 14 | 13% | 7 | 12% | 7 | 18% | 0 | 0% |
| Legal | 9 | 8% | 6 | 10% | 1 | 3% | 2 | 20% |
| Telco | 6 | 5% | 2 | 3% | 3 | 8% | 1 | 10% |
| Pharma | 3 | 3% | 2 | 3% | 0 | 0% | 1 | 10% |
| Academic and Educational | 1 | 1% | 0 | 0% | 1 | 3% | 0 | 0% |
| Advertising | 2 | 2% | 1 | 2% | 1 | 3% | 0 | 0% |
| IT | 7 | 6% | 4 | 7% | 3 | 8% | 0 | 0% |

## STE Companies by High-Level Technology

For each company a technology has been assigned according to the services or solutions it offers. Each company may have assigned more than one technology or any technology at all (*Table 15.7*).

**Table 15.7**

**STE companies by high-level technology**

| Technology | Global | | USA | | EU | | Others | |
|---|---|---|---|---|---|---|---|---|
| | 163 | 100% | 94 | 100% | 50 | 100% | 19 | 100% |
| Search | 32 | 20% | 19 | 20% | 10 | 20% | 3 | 16% |
| Document Tagging | 19 | 12% | 9 | 10% | 6 | 12% | 4 | 21% |
| Document Classification | 6 | 4% | 2 | 2% | 3 | 6% | 1 | 5% |
| Information Extraction | 22 | 13% | 10 | 11% | 8 | 16% | 4 | 21% |
| Semantic SOA | 5 | 3% | 3 | 3% | 1 | 2% | 1 | 5% |
| Modeling | 25 | 15% | 14 | 15% | 9 | 18% | 2 | 11% |
| Data Integration | 25 | 15% | 21 | 22% | 4 | 8% | 0 | 0% |
| Inference and Reasoning | 6 | 4% | 4 | 4% | 2 | 4% | 0 | 0% |
| Knowledge Publishing | 14 | 9% | 6 | 6% | 5 | 10% | 3 | 16% |
| Knowledge Storage | 8 | 5% | 6 | 6% | 2 | 4% | 0 | 0% |
| Hardware | 1 | 1% | 0 | 0% | 0 | 0% | 1 | 5% |

**Table 15.8**

**STE companies by area**

| Area | Global | | USA | | EU | | Others | |
|---|---|---|---|---|---|---|---|---|
| | 132 | 100% | 76 | 100% | 40 | 100% | 16 | 100% |
| Knowledge Management | 25 | 19% | 14 | 18% | 9 | 23% | 2 | 13% |
| Information Access | 42 | 32% | 26 | 34% | 13 | 33% | 3 | 19% |
| Enterprise Application Integration | 14 | 11% | 11 | 14% | 1 | 3% | 2 | 13% |
| Content Management | 14 | 11% | 4 | 5% | 7 | 18% | 3 | 19% |
| Document Management | 5 | 4% | 3 | 4% | 1 | 3% | 1 | 6% |
| Customer Relation Management | 2 | 2% | 1 | 1% | 1 | 3% | 0 | 0% |
| Productivity Tools | 4 | 3% | 3 | 4% | 1 | 3% | 0 | 0% |
| Security and Intelligence | 14 | 11% | 8 | 11% | 4 | 10% | 2 | 13% |
| Social Networks | 2 | 2% | 1 | 1% | 1 | 3% | 0 | 0% |
| Business Intelligence | 6 | 5% | 3 | 4% | 1 | 3% | 2 | 13% |
| Business Process Management | 3 | 2% | 2 | 3% | 0 | 0% | 1 | 6% |

## STE Companies by Area

*Table 15.8*

## References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