Chapter Six

Analysis & Implications
CHAPTER 6

THE ANALYSIS & IMPLICATIONS

"Hierarchy adapts knowledge to the organization; a network adapts the organization to the knowledge."

6.1. Introduction

Knowledge management is composed of a range of practices deployed by organizations to identify, create, represent, classify and disseminate knowledge for reuse, awareness and learning to the benefit of information users. The Semantic Web is the new generation of the World Wide Web, based on the semantic network knowledge representation formalism, which enables packaging information in the form of object-attribute-value statements, so called triplets. By assuming that terms used in these statements are based on the formally specified meaning, i.e. Ontologies, these triplets can be semantically processed by machine agents. Most of the current Semantic Web applications are based on using such atomic statements as pure facts, which we can reason about. So, a machine agent can understand information that a concrete patient, who suffers from disease X, is treated by medicine Y. Moreover, the agent can use this information in the communication with other machine agents (e.g. to make an appointment with the doctor W), making the vision of the Semantic Web real [93].

But useful statements, which can be exchanged between agents, are not always related to concrete individuals - instances (e.g. patient X, disease Y), but also to a group of individuals with some common characteristics (e.g. statements about female patients
older than 60 who suffer from disease Y). Moreover, atomic statements could be combined in a more expressive way as simple conjunction (e.g. Precondition: the patient is male and suffers from X; Action: he has to be treated by medicine Y). On the implementation level this form can be represented using the If-Then statements, forming in that way reasoning atoms for inference and trust services on the Semantic Web.

From the web-user point of view, the existence of more expressible statements in a machine-readable format means possibility to find more easily such conditional statements that are relevant for current problem solving. Moreover, conditional statements can be used for "indexing" the content of web resources in a more expressive way than conjunction of keywords/concepts or general metadata. That will enable the formation of more sophisticated, context-aware, queries and consequently, it can improve precision and recall in the searching for knowledge. For example, the well-known document-indexing problem whether the document indexed by keywords can be resolved very easily by using proposed conditional statements.

In order to use conditional statements in a knowledge management scenario on the Semantic Web, one needs a machine-understandable representation of such statements as well as powerful mechanisms for creating and manipulating them. Nenad Stojanovic and Siegfried Handschuh analyzed the requirements for representing conditional information (i.e. knowledge) in a machine-understandable format and proposed an RDFS format for representing rules, RDFRule [94]. Briefly, that format enables the representation of Horn rules, extended by the uncertainty factor and some model/context information. Since each rule contains a set of premises and a set of conclusions (both of these sets can be empty), the proposed format can be used for the
description of conditional statement in the form of Precondition-Action. The novel framework and model, which were discussed in the previous chapter utilizes the semantic web for managing the various sources of knowledge, whereby enabling the knowledge management system. This also provides the usage of conditional descriptions for a more effective searching for knowledge. This methodology is elaborated in the next section.

6.2 Implications For Theory

The main process in a knowledge management system is the possibility to find knowledge sources, which are relevant for the problem at hand, as well as the process of providing knowledge sources, which can be used in resolving some problems. From the point of view of the knowledge formalization, these knowledge sources can be divided into two categories: formal modes in the portal and documents. In order to enable more efficient searching for the knowledge that is contained in this second category, the content of the documents is indexed by using some ontology-based statements. In our approach these statements have conditional form: Precondition-Action, which enables us to use the same logical mechanisms in the management of both categories of knowledge sources. Moreover, a searching for relevant knowledge can result in some expert rules and/or some documents.

Figure 6.1 sketches the implementational aspects for knowledge management on the Semantic Web, which reflects the variety of knowledge transformations in this distributed environment: knowledge can be collected from various sources and in different formats, then stored in the common representation formalism, processed in
order to compute interdependencies between knowledge items or to resolve conflicts, shared/searched and finally used for problem solving.

Figure 6.1: Implications for KM Framework Theory

Therefore, our knowledge management approach encompasses the following processes [95]: (1) Knowledge Capturing, (2) Knowledge Representation, (3) Knowledge Processing, (4) Knowledge Sharing and (5) Using of Knowledge. All processes are related somehow to domain ontology. Since ontology is a domain model, it contains a set of domain axioms, which are used for deriving new information – that is the task of an inference engine. In the following we describe these processes.
1. We identify four types of knowledge sources, which could be treated in the knowledge-capturing phase: expert knowledge, legacy (rule-base) systems, metadata repositories and documents. For each of them we associate Semantic Web tools:

   a) Expert knowledge in the form of rules can be captured using Simple Ontology Editors, which is enabled with rule-editing capabilities. SOE provides structure as well as vocabulary, i.e. lexical layer of the domain ontology, for the rule creation. Although these rules are related to domain ontology, they are not treated as axioms in that ontology. The ontological axioms should be always-true statements, which is not the case for expert rules.

   b) Legacy rule-bases are very valuable sources of sharable knowledge, which can be consulted in solving some problems, either for free or for some price. The focus is not on collaborative problem solving via querying the federation of rule bases, but in creating high-specific expert bases, by importing relevant (for the given task) rule chains from those rule bases. The prerequisite is to have a mechanism to convert legacy rule-bases into rule-interlingua. The potential candidate for the common-accepted rule markup is RuleML [96]. This tool translates the content of a relational database into an ontology represented in the RDF, for the support of this translation into RDFRule.

   c) Metadata spread on the web should be the primary knowledge source for sharing knowledge in the future. In order to make that sharing more efficient some mechanisms for knowledge packaging and knowledge trading/pricing are needed [97]. Crawlers are considered which has the capabilities to collect web documents (metadata)
that fit the given "knowledge" model, so that the adaptation to rule-crawling is straightforward.

d) The previous three types are related to formally stated knowledge, which can be processed by machine agents. Knowledge in the documents is informally represented, but the content of a document can be formally stated by ontology-based indexes. The underlying process is called semantic annotation. By using some information extraction (IE) techniques it is possible to make annotation semi-automatically. For example, we can extend existing tools with techniques for the extraction of the tabular content in order to convert tabular information into a set of rules automatically.

2. Knowledge Base (KB) is a relational database organized in a way that enables efficient storing and access to RDF metadata. This repository can be seen as a RDF repository.

3. Knowledge processing component enables efficient manipulation with the stored knowledge, especially graph-based processing for the knowledge represented in the form of rules, e.g. deriving dependency graph or consistency checking.

4. Knowledge sharing is realized by searching for rules that satisfy the query conditions. In the RDF repository rules are represented as verified RDF statements and while in RDF any statement is considered to be an assertion, we can view an RDF repository as a set of ground assertions in the form (subject, predicate, and object). Rules are also related to domain ontology, which contains domain axioms used for deriving new assertions. Therefore the searching is realized as an inferencing process. We intend to
use main memory, deductive, object oriented database system, which inferences using RDF inputs also. Our system treats facts and queries as rules without the rule body and the rule head, respectively. This facility enables using the editor as a query interface.

5. Usage of the knowledge is related to our semantic web-enabled knowledge portals scenarios [95], [98]. The main advantage of our approach is using a conditional statement for the semantic annotation of knowledge sources. In that way we put statements used in the annotation into the context of each other, which consequently leads to efficient searching for knowledge. Moreover, annotating knowledge resources using Precondition-Action statements enables semantic hyperlinking of each two resources, which satisfies the condition that the Precondition part of one annotation subsumes the Action part of the annotation of another resource. In that way querying for a problem can result in a composition of documents, which cover problem solving. This is a very important process in knowledge management or e-learning search.

6.3 Implications For Practice

Tacit knowledge capture is a process by which the expert’s thoughts and experiences are captured. Tacit knowledge capture involves the transfer of problem-solving expertise from some knowledge source to a repository or a program. A knowledge developer collaborates with an expert to convert expertise into a form in which it can be used to distribute the knowledge across the enterprise (e.g., KMS, expert system).

It is the tacit knowledge that is never quantified into a manual or other accessible form, but resides in the minds of the people who have worked with and developed that
information. The problem is that when someone leaves the company or takes a different assignment within the company, the intellectual capital in that person’s mind leaves also. To capture this tacit knowledge, knowledge acquisition techniques must be utilized.

Capturing the tacit knowledge of individuals in a way that can be leveraged by an organization is perhaps one of the most challenging aspects of KM. Organizations that successfully tap into this invaluable source of knowledge will receive great benefits in the performance of individuals within the organization and ultimately the organization itself.

Tacit knowledge can only be captured when it is found. Therefore, the key to successfully leveraging tacit knowledge within an organization is to accurately find the right people to solve that particular situation. Expertise management becomes a central tenet of tacit knowledge.

To begin to capture tacit knowledge we can channel informal discussions into a collaborative workspace (i.e., collaboration tools). Doing this replaces ad hoc interactions like sidebar conversations and blasting e-mail threads with a single, well-organized place where people can work together as teams that may extend to customers and partners. In this environment, people can share information about a current issue, problem, or topic. Workspaces have become much more integrated into communication channels typically used throughout the day, such as e-mail, instant messaging, blogging, posting a scrap, writing on the wall or doing a buzz, so ease of adoption concerns have been dramatically reduced.
By doing this, tacit knowledge is automatically captured and immediately usable. Therefore, the next time there is a similar critical business situation, knowledge workers can tap into these workspaces to retrieve relevant information to increase the quality of resolution while reducing resolution time.

The following are some aspects about capturing tacit knowledge and about the experts that we seek out for this knowledge within the organization:

- Knowledge developers should focus on how experts approach a problem by looking beyond the facts or the heuristics.
- When modeling the tacit knowledge, reevaluate how well knowledge developers understand the problem domain and how accurately they are modeling it.
- Understand the qualifications of a good domain expert:
  - Peers regard expert’s decisions as good decisions.
  - Every time there is a problem, the expert is consulted.
  - Expert sticks to the facts and works with a focus.
  - Expert has a knack for explaining things.
  - Expert exhibits an exceptional quality in explanations.
  - Expert knows when to follow hunches and sees the big picture.
  - Expert possesses good communication skills and thinks creatively.
  - Expert maintains credibility.
  - Expert operates within a schema-driven orientation.
  - Expert uses chunked knowledge.
  - Expert generates motivation and enthusiasm.
  - Expert shares expertise willingly.
The knowledge use case may be described at various levels of abstraction or concreteness. To develop an overall understanding of KMS, we must first focus on the high-level use cases. A high-level use case would be to "perform knowledge discovery in a database. The following is a set of tasks that the use case will perform:

- Retrieve and display strategic, tactical goals and objectives, and results of knowledge discovery
- Select entity objects representing business domains to be mined for new knowledge
- Explore data and clean for modeling
- Record and transform data
- Reduce data
- Select variables for modeling
- Transform variables
- Perform measurement modeling
- Select modeling techniques
6.4 Conclusion

In this chapter we presented an implication for theory of the framework for realizing a knowledge management system on the Semantic Web. The proposed framework is mainly based on existing Semantic Web tools. The approach introduces two new aspects, which could enhance applicability of the Semantic Web tools in real-world applications: (i) rules as the first class citizens on the Semantic Web and (ii) semantic annotation by using conditional statements. The benefits of the proposed approach are manifold: an integration platform for various rules sources and rules format, more precise search for knowledge sources by using conditional statements, machine-processable description of the content of the tabular- and graphic-based resources, a possibility to compose various knowledge sources in solving some rare difficult tasks.

We also presented an implication for practice by proposing a high level abstraction use case diagram. This represented the overall requirements of a knowledge management system in general and the acquisition of tacit knowledge in particular. The main focus of these implications are that they combine together to form a complete solution for a knowledge management system initiative.