Preface

Well… today Web is about communication, about meanings, about socialization, let’s say, about seman-
tics, and not mere computer connections and in its previous generation.

Almost everything turns around Web and of what relates with Web: we are meaning the develop-
ment of applications, business processes, governmental initiatives, research, defense, terrorism, and an
interminable set of subjects. And this is why one of the main concerns relies clearly on the way all the
information, useful or not, updated or not, should be organized on the Web and made available to the
user.

The semantic technologies are the most important contribution to the development of the Web, towards
a universally recognized medium of exchanging information, with impact on people, organizations and
society. It is becoming a rapidly growing area in IT, with emerging key developments, tools, techniques,
that are engineering the Web of the future, and determining a new way of acceding, using and exploring
information and creating knowledge.

The impact of IT on the society, on organizations of every stripe and on individuals is growing. Today,
key challenges of Semantic Web include, besides the technological dimension, the impact on people and
on society, which are revealing increased relevance.

A few years ago it would have appeared impossible to think about a global Web of semantically
structured information.

Today, the Web is recognized as a main support of business processes. *Business Process Management
Technologies* are progressively gaining its space; legacy systems and multiple databases are surviving
through important models of data integration; business processes are re adapting to the emerging business
paradigms and different enterprises inter-interact either through their interfaces or through functional
integration models. The social aspects, recognized as complex, appear as the most recent aspect, where
answers are sought in a new Web, called social Web.

**ORGANIZATION OF THE HANDBOOK OF RESEARCH**

This handbook of research is a compilation of 46 contributions to the discussion of the main issues, chal-
lenges, opportunities and developments related with this new technology able to transform the way we
use information and knowledge, from the social and technological dimensions, in a very comprehensive
way, and to disseminate current achievements and practical solutions and applications.

The 46 chapters are written by a group of 130 authors that includes many internationally renowned
and experienced authors in the Semantic technologies field and a set of younger authors, showing a
promising potential for research and development. Contributions came from 23 different countries: USA,
Latin America, several countries of Eastern and Western Europe, South Africa and several countries of
Asia. At the same time, the handbook integrates contributions from academe, research institutions and industry, representing a good and comprehensive representation of the state-of-the-art approaches and developments that address the several dimensions of this fast evolutionary thematic.

It is organized in four sections:

- **Section I - Semantic Web Components and Enabling Technologies** presents the main infrastructures, frameworks, protocols and components that enable or support the Semantic Web.
- **Section II - Social Semantic Web** introduces the social shaping of Semantic Web, its concerns, potential and challenges.
- **Section III - Challenges, Opportunities, and Impact** discusses new trends and new directions, influences and impact that semantic technologies and Web services are offering.
- And finally **Section IV - Applications and Current Developments** presents recent and state-of-the-art applications and exploitations of semantic technologies and Web services to different sectors of activity.

The first section, “Semantic Web Components and Enabling Technologies” includes 16 chapters that are briefly described.

**Chapter I**, “Semantic Approach to Knowledge Representation and Processing,” proposes a technique for knowledge representation and processing based on the semantic approach - hierarchical semantic form - that uses semantic contexts to implicitly define the meaning, facilitating a large scale processing of semantic knowledge represented in natural language documents.

**Chapter II**, “Challenges on Semantic Web Services,” discusses and suggests insights into new solutions to three main challenges in the area of Semantic Web services: composition, discovery and trust. For the first issue, the authors suggest to use program transformation coupled with services’ descriptions; for the second, it is proposed a solution based on a mapping algorithm between ontologies; and finally, for the last problem, a solution based on fuzzy voting model is outlined.

**Chapter III**, “A Service Oriented Ontological Framework for the Semantic Validation of Web Accessibility,” introduces SWAF, the Semantic Web Accessibility Framework, a base framework for supporting the integration of accessibility services into Web design and development processes. SWAF affords both tailoring accessibility to user needs and specifying the semantic validation of accessibility guidelines in different application situations.

In **Chapter IV**, “Semantic Web Technologies in the Service of Personalization Tools,” the authors explore a novel approach to the so-called recommender systems, based on reasoning about the semantics of both the users’ preferences and considered items, by resorting to less rigid inference mechanisms borrowed from the Semantic Web.

“Querying Web Accessibility Knowledge from Web Graphs”, **Chapter V**, introduces the Web Accessibility Knowledge Framework for specifying the relevant information about the accessibility of a Web page. This framework leverages Semantic Web technologies, together with audience modeling and accessibility metrics. Through this framework, the authors envision a set of queries that can help harnessing and inferring this kind of knowledge from Web graphs.

In “Ontology Evolution: A Case Study on Semantic Technology in the Media Domain”, **Chapter VI**, the authors introduce a general framework for ontology learning from text, that has been applied in the media domain, in particular to video, music and later on to game search to offer an extended user experience in machine-to-machine as well as user-machine interaction.

**Chapter VII**, “Attempting to Model Sense Division for Word Sense Disambiguation,” explores the potential of co-occurrence data for word sense disambiguation; the findings on the robustness of the
different distribution of co-occurrence data on the assumption that distinct meanings of the same word attract different co-occurrence data, has taken the authors to experiment (i) on possible grouping of word meanings by means of cluster analysis and (ii) on word sense disambiguation using discriminant function analysis.

Chapter VIII, “Association between Web Semantics and Geographical Locations: Evaluate Internet Information Consistency for Marketing Research,” introduces a quantitative metric, Perceived Index on Information (PI), to measure the strength of web content over different search engines, different time intervals, and different topics with respect to geographical locations. Visualizing PI in maps provides an instant and low-cost means for word-of-mouth analysis that brings competitive advantages in business marketing.

Chapter IX, “Visualization in Support of Social Networking on the Web,” explores the contribution visualization can make to the new interfaces of the Semantic Web in terms of the quality of presentation of content, discussing some of the underlying technologies enabling the Web and the social forces that are driving the further development of user-manipulable interfaces.

Chapter X, “Tracing the Many Translations of a Web-Based IT Artefact,” discusses the centrality of meaning in implementing an Internet-based self-service technology, and uses the actor-network theory (ANT) to describe the complex evolution of a Web-based service at a healthcare insurance firm.

Chapter XI, “Semantic Annotation of Objects,” compares various knowledge representation techniques, like frame-based formalisms, RDF(s), and description logics based formalisms from the viewpoint of their appropriateness for resource annotations and their ability to automatically support the semantic annotation process through advanced inference services, like error explanations and expressive construct modeling, namely n-ary relations.

Chapter XII, “Web Services Automation,” presents a methodology to support the use of automatic composition of complex Semantic Web services with natural language. Web service semantics are linked with natural language processing capabilities to empower users to write descriptions in their own language and in the sequel to have these descriptions mapped automatically into a well tuned Web service orchestra.

Chapter XIII, “Semantic Web Services: Towards an Appropriate Solution to Application Integration,” introduces the different techniques to overcome the application integration challenge, discusses the current trends in Semantic Web services and the most recent R&D projects, presents a selection of available tools and discusses the use of ESB as a suitable mechanism to deploy Semantic Web services.

Chapter XIV, “Semantic Visualization to Support Knowledge Discovery in Multi-Relational Service Communities,” describes the approach by Fraunhofer IGD and Siemens AG for multi-relational semantic services selection and semantic visualization, and its application in the project “TEXO” Business Webs in the Internet of Services.

Chapter XV, “Knowledge Protocols,” presents a knowledge exchange procedure for creating an integrated intelligent manufacturing system able to cope with changing markets that are unpredictable and diverse; knowledge protocols are presented for easing agent based communication and coordination to provide the development of distributed manufacturing applications.

Finally, Chapter XVI, “Multi-Agent Systems for Semantic Web Services Composition,” reports the major works and results achieved by multi-agent systems and discuss how their exploitation in the area of service-orientation systems could be very promising in different areas.

The second section of this handbook of research, “Social Semantic Web” includes the seven chapters described below.

Chapter XVII, “On the Social Shaping of the Semantic Web,” the author addresses the social shaping of the Semantic Web in the context of moving beyond the workplace application domain that has
so dominated the development of both information and communications technologies, and the social shaping of technology perspective.

Chapter XVIII, “Social/Human Dimensions of Web Services: Communication Errors and Cultural Aspects: The Case of VRL-KCiP NoE,” presents recent studies of the social and human dimension of Semantic Web services in the era of virtual organizations, analysing the risks arising from the modern communication process and discussing the cultural aspects of managing a virtual organization that determine the efficiency of the knowledge management processes. The authors consider the challenges and the associated effect on developing Web services from the social/human perspective and examine the impact on an organization’s cultural dimensions.

In Chapter XIX, “Socio-Technical Challenges of Semantic Web: A Culturally Exclusive Proposition?,” the authors explore how Semantic Web can disseminate learning and identify the causes of critical socio-technical and cultural challenges, looking at two major styles of learning and Semantic Web structure and giving recommendations for addressing these challenges.

Chapter XX, “Social Networks in Information Systems: Tools and Services,” analyses state-of-the-art social networks, explaining how useful social network analysis can be in different contexts and how social networks can be represented, extracted, and analyzed in information systems.

Chapter XXI, “The Generative Potential of Appreciative Inquiry as an Essential Social Dimension of the Semantic Web,” presents a framework of ideas concerning the expected form of knowledge sharing over the Semantic Web. Of specific interest is the perspective of appreciative inquiry, which should accommodate the creation of some appreciative knowledge environments based on the peculiar organizational concerns that would encourage or better institutionalize knowledge work among people in an organization.

In Chapter XXII, “Online Virtual Communities as a New Form of Social Relations: Elements for the Analysis,” the authors analyze the meaning of concepts such as virtual community, cyber culture, or contacted individualism, as well as the meaning and extent of some of the new social and individual behaviors which are maintained in the Net society as a consequence of the new communication technologies scope.

Finally, Chapter XXIII, “E-Learning and Solidarity: The Power of Forums,” explores solidarity as a social dimension in the context of e-learning and the Semantic Web, based on a study in higher education to identify where the students show more solidarity with each other - in online learning environments or in offline settings.

The third section, “Challenges, Opportunities and Impact,” contains the following twelve chapters.

In Chapter XXIV, “Applying an Organizational Uncertainty Principle: Semantic Web-Based Metrics,” the authors review the traditional theory of the interaction, organizational theory, and the justification for an organizational uncertainty principle. The organizational uncertainty principle predicts counterintuitive effects that can be exploited with the Semantic Web to formulate a set of metrics for organizational performance, which are applied in two case studies.

Chapter XXV, “Security in Semantic Interoperation,” investigates the currently used security methods in semantic interoperation, including the security methods employing Semantic Web representation languages such as XML, RDF and ontologies, and their application methods in semantic interoperation such as secure access control and secure knowledge management. It also discusses how to manage privacy, trust and reputation at the same time during semantic interoperation.

Chapter XXVI, “Semantic Discovery of Services in Democratized Grids,” presents the motivation and the technologies developed towards a semantic information system in the Grid4All environment, emphasizing on bridging the gap between Semantic Web and conventional Web service technologies, supporting developers and ordinary users to perform resources’ and services’ manipulation tasks, towards a democratized Grid.
Chapter XXVII, “Semantic Web and Adaptivity: Towards a New Model,” proposes a model that gives an abstraction to the functionalities and data involved in adaptive applications for the Semantic Web. As the quantity of provided information on the Web is getting larger, the need for adaptation in software is getting more and more necessary in order to maximize the productivity of individuals. With the Semantic Web, adaptation can be performed autonomously and in runtime, making the whole process transparent to the user.

Chapter XXVIII, “Semantic Technologies and Web Services: A Primer on Legal Issues,” aims at offering an overview of the legal framework that supports people’s access to Web services, according to the Semantic Web innovations. The basic aspects examined include: delegation, liability, privacy and e-identity, with a special focus on e-business.

Chapter XXIX, “The Influences and Impacts of Societal Factors on the Adoption of Web Services,” explores influences and impacts of societal factors on the adoption of Web service technology. Societal factors considered in the study are culture, social structure, geography, ethics, and trust. Common themes identified across these factors are need for mechanisms to support globalization management, to monitor and assess trustworthiness, and relationship management.

Chapter XXX, “The Geospatial Semantic Web: What are its Implications for Geospatial Information Users?,” provides a basic understanding of the needs and visions driving the evolution toward the Semantic Web and Geospatial Semantic Web (GSW), the principles and technologies involved in their implementation, the impacts of the GSW on the way we use the Web to discover, evaluate, and integrate geospatial data and services; and the needs for future research and development to make the GSW a reality.

Chapter XXXI, “Enabling Distributed Cognitive Collaborations on the Semantic Web,” illustrates and discusses an alternative approach to the development of the agent mediated Semantic Web, based on the premise that enhancing agents cognitive and interactional abilities is the key to make the digital world of agents more flexible and adaptive in its role to facilitate distributed collaboration.

Chapter XXXII, “Social Impact of Collaborative Services to Maintain Electronic Business Relationships,” looks at the impact and opportunities of semantic technologies and Web services to business relationships and how social Semantic Web techniques foster e-business and collaborative networks. It formulates a vision based on three stages developing digital business ecosystems. Semantic Web technologies, mainly modeling business partner profiles with ontology, combined with sound techniques of information retrieval and selected concepts and methods of social network analysis build the conceptual framework.

Chapter XXXIII, “The Semantic Web in Tourism,” presents a Semantic Model for Tourism (SeMoT), designed for building Semantic Web enabled applications for the planning and management of touristic itineraries, taking into account the new requirements of more demanding and culturally evolved tourists.

Chapter XXXIV, “Cross-Language Information Retrieval on the Web,” attempts to characterize the scenario of cross-language information retrieval as a domain, with special attention to the Web as a resource for multilingual research, suggesting also some major directions for cross-language information retrieval research in the future.

Chapter XXXV, “CRISS: A Collaborative Route Information Sharing System for Visually Impaired Travelers,” introduces CRISS (Collaborative Route Information Sharing System) which is a collaborative online environment where visually impaired and sighted people will be able to share and manage route descriptions for indoor and outdoor environments and describes the system’s route analysis engine module which takes advantage of information extraction techniques to find landmarks in natural language route descriptions written by independent blind navigators.
And the fourth and last section, “Applications and Current Developments,” contains eleven chapters.

**Chapter XXXVI**, “Modeling Objects of Industrial Applications,” presents the development and design of an industrial application based on new semantic technologies and explores the technological dimension of data acquisition, storing, access, and use; the data structure and integration and aggregating values from data necessary for the control of production processes.

In **chapter XXXVII**, “The Impacts of Semantic Technologies on Industrial Systems,” the authors review the state of the art of the research of ontologies, Semantic Web, and Semantic Web services, together with advances on the usage of semantic technologies in industry. The usage of semantic technologies is illustrated with two applications – semantics in multi-agent manufacturing systems and structural search in industrial data.

**Chapter XXXVIII**, “Towards Process Mediation in Semantic Service Oriented Architecture (SSOA),” focuses on the public process heterogeneity which describes the behavior of the participants during a conversation, and proposes a solution for dealing with it, explaining the functionality of the process mediator developed as a part of the Web service execution environment and its mediation scenario. This proposed solution is applied on federated enterprise resource planning systems to get the semantic extension from it.

**Chapter XXXIX**, “Social Networks Applied to E-Gov: An Architecture for Semantic Services”, proposes a software architecture, using a social network to map the relationships and interactions between citizens, accounting and storing this knowledge in a government ontological metadata network. It introduces a prototype to manage and handle e-gov-driven social networks, capable of providing graphical display of social networks, enabling the identification of different social links between citizens, creating a tool for government agencies.

**Chapter XL**, “Ontologies and Law: A Practical Case of the Creation of Ontology for Copyright Law Domain,” introduces the specificity of the development of a particular type of legal ontology, that is ontology of copyright law, the ALIS IP ontology, that should be seen as a miniature guide for anyone who will pursue a goal to create an ontology for any sphere of law.

**Chapter XLI**, “Technology Roadmap for Living Labs,” evaluates available ICT for use in a living lab and presents an implementation roadmap taking into account state-of-the-art technology and likely future trends.

**Chapter XLII**, “Technologies to Support the Market of Resources as an Infrastructure for Agile/Virtual Enterprise Integration,” proposes an architecture to support the operation of the market of resources - an environment developed by the authors to cope with the requirements of agile/virtual enterprise integration-, representing a fusion of the peer-to-peer architecture with the client-server architecture, as a variant of P2P architecture.

**Chapter XLIII**, “KC-PLM: Knowledge Collaborative Product Lifecycle Management,” defines a system and a methodology, the knowledge collaborative product lifecycle management (KC-PLM), to better support the complete product lifecycle in the industry, that intends to reduce the lead-time from new product development to production by providing and integrating knowledge platform, based on a semantic information repository, domain ontology, a domain specific language and on the user collaboration.

**Chapter XLIV**, “PolyOrBAC: An Access Control Model for Inter-Organizational Web Services,” proposes a new access control framework for inter-organizational web Services: “PolyOrBAC”, extending OrBAC (Organization-Based Access Control Model) to specify rules for intra- as well as inter-organization access control and enforcing these rules by applying access control mechanisms dedicated to Web services; it is also proposes a runtime model checker for the interactions between collaborating organizations, to verify their compliance with previously signed contracts.

In Chapter XLVI, “Technical Outline of a W3 Spatial (Decision Support) Prototype,” the authors propose the technical outline of a WWW spatial prototype, SAKWeb©, an Internet application of spatial analysis for geographical information systems users and decision support and discuss future trends for this application.

EXPECTATIONS

The book provides researchers, scholars, and professionals with some of the most advanced research developments, solutions and implementations of Semantic Web. It is expected to provide a better understanding of semantic technologies and Web services developments, applications, trends and solutions. This way, it is expected to be read by academics (i.e., teachers, researchers and students), technology solutions developers, and enterprise managers (including top level managers). The book is also expected to help and support teachers of several graduate and postgraduate courses of information technology.

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