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Building Expert Profiles Models Applying Semantic Web Technologies

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1. Introduction

Semantic Web (SW) is an emerging research field that has application in different domains such as e-government services, richly interlinked library systems, Web search engines, enterprise knowledge stores, and other. The term "Semantic Web" refers to the World Wide Web Consortium's (W3C) vision of the Web of linked data (called also the Web of Data) as "…an extension of the current Web in which information is given a well-defined meaning, better enabling computers and people to work in cooperation" (Berners-Lee, Hendler, & Lassila, 2001). Since then, many specifications, guidelines, languages, and tools have been developed that facilitate software development, improve performance and create new business opportunities.

This Chapter investigates the existing standard models for representing Human Resource (HR) data and especially in the context of competence management and discusses the process of building and publishing ontology-based expert profiles models. The expert profiles can be used for deploying advanced HR management services for in-house purposes, as well as integration and search of experts in the Linked Open Data (LOD) cloud. During the past 3 years, the Linked Data paradigm, promoted by Tim Berners-Lee (2006) as a part of the Semantic Web roadmap, evolved from a practical research idea into a very promising candidate for addressing one of the biggest challenges in the area of intelligent information management: the exploitation of the Web as a platform for data and information integration in addition to document search (Auer & Lehmann, 2010; Janev & Vraneš, 2011b). According to the statistics from March 2012 (see http://stats.lod2.eu/), the LOD cloud contains over 1,7 billion triples, integrates over 400000 namespaces and registers over 1,7 million instances of type "person".

The Chapter is organized as follows. After introducing the main requirements for managing competence data in enterprises in Section 2, we point to existing and emerging HR approaches and data representation standards (Section 3). Then, follows an example process for building an ontology-based enterprise knowledge stores (Section 4) and two examples for searching enterprise knowledge stores with Semantic Web tools (Section 5).

2. HR management requirements from business and technical perspective

Human resource management (HRM) is one of the basic business processes that consists of a wide range of administrative, organizational and employee acquisition and development activities. Administrative activities include management of different employee records (personal data, qualifications, holidays, business trips) and legal procedures of hiring / dismissal, as well as payment processing. Organizational activities cover strategic issues of enterprise organizations, systematization of working places, planning of team work, team formation and development, etc. Employee acquisition and development activities are directed towards definition of requirements, and standards that employees have to fulfil prior to employment, planning of necessary resources, education and development of employees, and employee performance measurement.

Herein, we would like to discuss the requirement for a comprehensive knowledge model for competence management from business and technical perspective.

2.1 Competence management business requirements

Competence management (CM) is an important research object in the more general area of human resource management. The idea of "competency" into the HR literature was introduced by the Harvard's psychologist David McClelland in early seventies of the last century (McClelland, 1973) and since then, development and use of competency based approaches within the corporate environment has been rapid (Draganidis & Mentzas, 2006).

2.1.1 Competence management on company level

Companies adopt different competency models and start competence and skills management initiatives in order to create a setting for the empowerment of their workforce and thus increase competitive advantage, innovation, and effectiveness (Houtzagers, 1999). A competency model is a list of competencies which are derived from observing satisfactory or exceptional performance for a specific occupation or task. Related to in-house competence management mainly aimed at building individual competence models are the following requirements:

- building central repositories which define competencies for certain communities;
- building services for identifying experts and finding out and continually recording what people ("experts") in an organization know ("expertise");
- making expertise available to users so they can answer questions or solve problems that exceed personal or workgroup capabilities;
- expertise gap analysis;
- planning the expertise development paths; etc.

2.1.2 Competence management for cooperation and integration of activities with partners on national and international level

In order to be competitive in the global knowledge economy, companies organize themselves in partner networks or even virtual enterprises that require interlinking of activities, or even existing information systems. Business processes in such networks often spawn different specific tasks that are to be solved by the network members. Therefore, it is essential that partner organizations prove themselves with complementary competencies both on an expert and an organizational level. Developing and maintaining competence profiles of all the relevant parties associated with specific task and topic can significantly improve the performance of the partner network or the virtual organization. Related to inter-enterprise cooperation, interoperability and integration are the following requirements:

- standard description of occupations and competences ;
- using multi-lingual dictionaries for building expert profiles;
- interoperability of knowledge models with similar schemas on the Web; etc.

2.2 Technical requirements

In order to achieve transparency and comparability of expertise, organizations need tools and technologies to express the core competencies and talents of employees in a standardized, machine processable and understandable format. Based on the competence management business requirements briefly introduced above, we can distinguish three types of expertise management services, namely (1) expert profiling and search, (2) organization profiling and search and (3) knowledge items search and retrieval. Technologies that play a role in implementation of these services originate from the fields of open systems architecture, Web services, information retrieval, data and text mining, clustering, natural language processing, ontology building, etc.

3. State-of-the-art analysis of HR standards and literature

3.1 Analysis of classical approaches to expertise management

The actual HRM solutions mainly focus on the integration of the distributed legacy databases, typically in the form of the data warehouse where the fact data (i.e. employee data) is arranged in order to answer the analytical queries efficiently. Personal profiles here usually rely on the self declared expertise. Employees keep track of their areas of expertise manually by maintaining a list of keywords or phrases and this list of key qualifications is being defined in the HR sector. This approach is error-prone since users are typically subjective/biased and reluctant to update the file regularly. Also, manually created lists cannot be an exhaustive description of the person’s expertise areas. In addition, content based approaches (Sim et al., 2006) to expertise extraction, profiling and finding have been introduced lately that focus on the automatical identification of the expertise entities in the semi-structured and unstructured documents containing the expertise information as well as on the annotation of the identified expertise entities with the semantic mark-up. The input documents are: (1) curricula vitae and résumé that have been published in formats such as text, PDF, DOC and HTML; (2) publications and other legacy documents (Balog et al., 2006; Balog & de Rijke, 2008); (3) e-mails, blog sites and other online social networking related context (Aleman-Meza et al., 2007; Schäfermeier & Paschke, 2011). The expertise extraction and profiling is based on the linguistic analysis, statistical and machine learning classification methods as well as on the inductive logic programming techniques to discover rules for extracting fields from documents (Fang & Xiang Zhai, 2007; Petkova & Bruce Croft, 2006; Jung et al., 2007). Inspired by different research fields such as expert finding, competency management, terminology extraction, keyword extraction and concept extraction (Bordea, 2010), Bordea and Buitelaar (2010) proposed a hybrid approach and the Saffron system for expert profiling and finding.

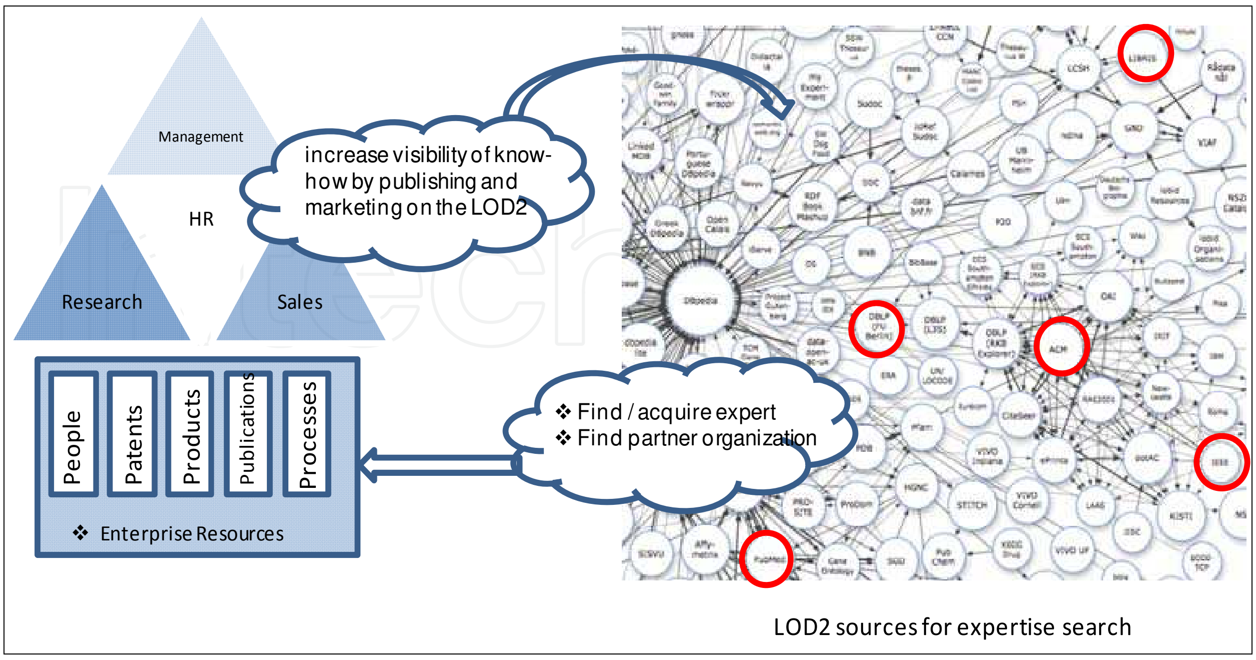

Fig. 1. Linking enterprise resources to the LOD cloud.

3.2 Review of standards and literature for ontology-based competence management

European Union, through its chief instruments for funding research (FP5 - The Fifth, FP6 – The Sixth and FP7 – The Seventh Framework Programs), has financed several projects that focused on ontology-based competency management. As a result of these projects, several prototype systems have been developed (Bizer et al., 2005; Draganidis et al., 2006) and few ontologies were made publicly available. The developed HR ontologies (Bizer et al., 2005; Müller-Riedlhuber, 2009) are based on widespread used standards and classifications of job profiles and industry sectors such as SOC (Standard Occupational Classification System, www.bls.gov/soc/), NAICS (North American Industry Classification System, see http://www.census.gov/epcd/www/naics.html), NACE (Statistical Classification of Economic Activities in the European Community, see http: //ec. europa. eu/ eurostat/ ramon/), HR-XML (HR-XML Consortium, www.hr-xml.org) and other.

Schmidt & Kunzmann (2006) developed the Professional Learning Ontology that formalizes competencies as a bridge between human resource development, competence and knowledge management as well as technology-enhanced learning. In (Bizer et al., 2005), Bizer developed a HR ontology, an e-recruitment prototype and argued that using Semantic Web technologies in the domain of online recruitment could substantially increase market transparency, lower the transaction costs for employers, and change the business models of the intermediaries involved. In (Paquette, 2007), the author presented a competency ontology and the *TELOS Software Framework for Competency Modelling and Management*.

Furthermore, the research work in the competence management domain in the last decade had a positive impact on several European Public Employment Services, e.g. see DISCO project (Müller-Riedlhuber, 2009). Some of them have already introduced (e.g. Germany, Norway) or are at the moment working on improvements of their matching (vacancies and job seekers) processes by shifting more emphasis to competences.

Acronym	HR Initiative
HR-XML	HR-XML Consortium Competencies Schema, http://ns.hr-xml.org/
SOC	The 2010 Standard Occupational Classification (SOC, www.bls.gov/soc) system is used by Federal statistical agencies to classify workers into occupational categories for the purpose of collecting, calculating, or disseminating data. All workers are classified into one of 840 detailed occupations according to their occupational definition. To facilitate classification, detailed occupations are combined to form 461 broad occupations, 97 minor groups, and 23 major groups.
O*NET	The Occupational Information Network (O*NET, http://www.onetcenter.org, based on SOC) is designed to be the nation's most comprehensive resource of occupational information, with a database system that includes 275 descriptors about each occupation.
DISCO	European Dictionary of Skills and Competencies, financed by EU Leonardo da Vinci programme & the Austrian Federal Ministry for Education, the Arts and Culture, http://www.skills-translator.net/
e-CF	European e-Competence Framework, a reference framework of 32 ICT competences, http://www.ecompetences.eu/.
ESCO	The European Skills, Competences and Occupations taxonomy (under development). A partial classification is already in use in the European job mobility portal EURES (http://ec.europa.eu/eures/). It exists in 22 languages and currently contains around 6000 skill descriptions and 5000 job titles.

Table 1. International HR initiatives

4. Explicit representation of an HR knowledge store

To represent information on the Web and to ensure interoperability between applications that exchange machine-understandable information, the Semantic Web uses the Resource Description Framework (RDF) as a general-purpose language. RDF describes information in terms of objects (“resources”) and the relations between them via the RDF Schema, which serves as a meta-language or vocabulary to define properties and classes of RDF resources. The next layer on top of the RDF/RDFS data model serves to formally define domain models as shared conceptualizations, also often called ontologies (Gruber, 1993). Ontologies are nowadays very often used for building integrated inter- and intra-organization business services, and to make the search and retrieval both efficient and meaningful. In this Section we will use the RDF and OWL languages to introduce the most important concepts and relations between concepts relevant for building an expert profile (see Figure 2).

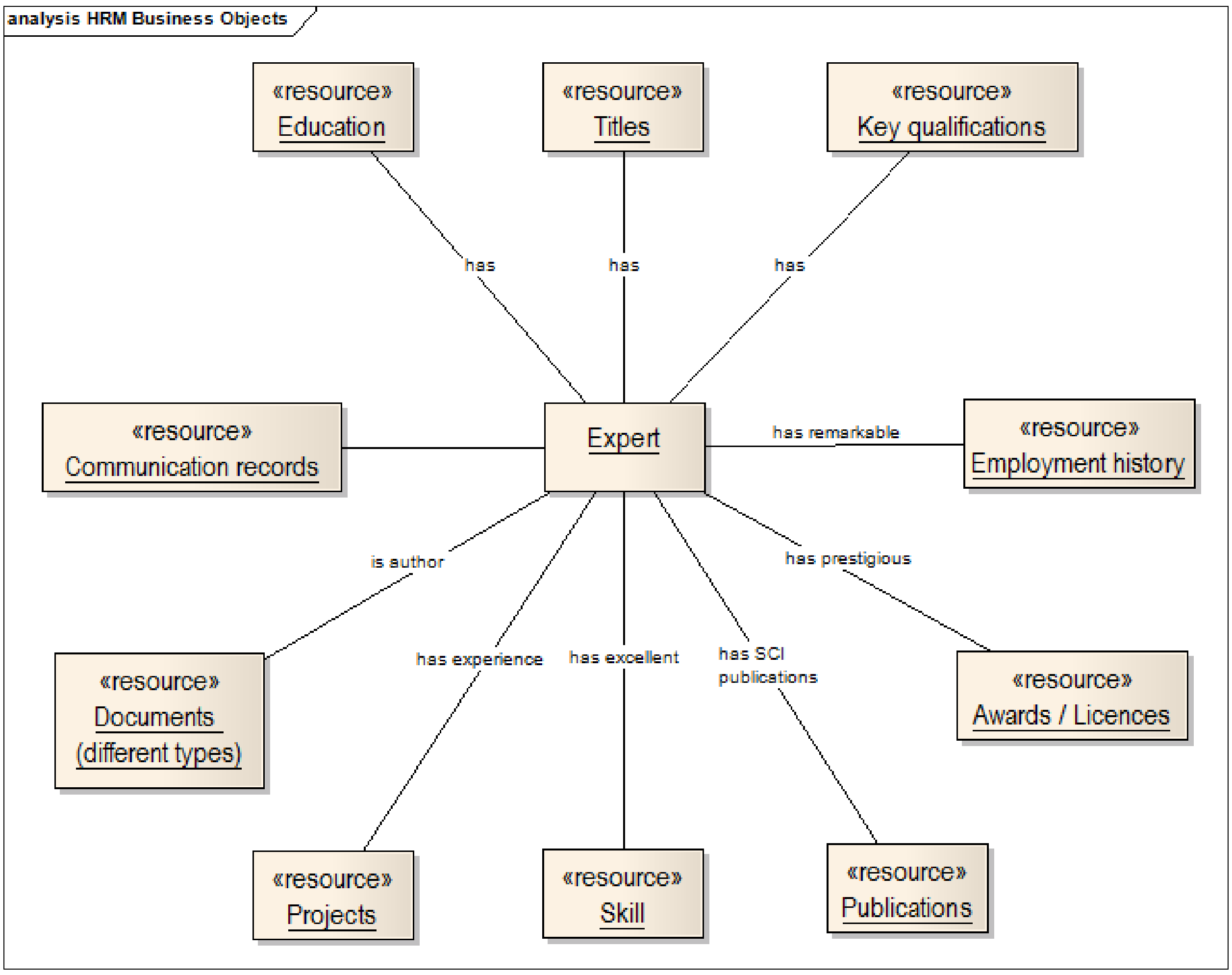

Fig. 2. UML representation of the concept Expert.

4.1 Creating a new ontological model

Unlike conventional object-oriented conceptual models like UML where attributes are bound to a specific class, classes and properties (as main entities of ontology) are equally important for ontology building. Therefore, prior to making a decision about the knowledge model design and structure, one have to enumerate the important terms that will be used, e.g. for the HR domain these are *Person*, *Organization*, *Document*, *Project*, *Publication*, *Author*, *Competence*, *Experience*, etc. After that, separate generalization hierarchies for classes and properties are designed. There are several possible approaches in developing a class hierarchy: the top-down, the bottom-up and the combination development process. The top-down development process starts with the definition of the most general concepts in the domain and subsequent specialization of the concepts. The bottom-up development process starts with the definition of the most specific classes, the leaves of the hierarchy, with subsequent grouping of these classes into more general concepts. The combination development process is a combination of the top-down and bottom-up approaches.

In a top-down manner, we can define the most general concepts/properties as subclasses / subproperties of entities from the public vocabularies FOAF, DOAC, and BibTeX (Aleman-Meza et al., 2007)and assign them meaning identical with the existing commonly used classes in the Semantic Web (see Table 2). In that way, the main "components" are defined as subclasses of the public concepts (*foaf:Person*, *foaf:Organisation*, *foaf:Document*, *foaf:PersonalProfileDocument*, *doac:Education*, *doac:Skill*, *doac:Experience, bibtex:Entry*), while links/relations between the components are defined as sub-properties of *foaf:interest*, *foaf:made/maker*, *foaf:topic*, *foaf:primaryTopic*, *foaf:homepage*, etc. Additional classes and properties specific to the domain of interest (e.g. in the ICT domain) can be defined manually with elements from the RDF Schema (www.w3.org/TR/rdf-schema/) or defined automatically in bottom-up manner e.g. using D2RQ server, http://www4.wiwiss.fu-berlin.de/bizer/d2r-server.

Acronym	RDF model
SIOC	The SIOC initiative (Semantically-Interlinked Online Communities, http://www.w3.org/Submission/2007/02/) aims to enable the integration of the online community information. SIOC provides the Semantic Web ontology for representing rich data from the Social Web in RDF.
FOAF	The FOAF (Friend of a Friend, http://www.foaf-project.org/) project is about creating a Web of machine-readable pages describing people, the links between them and the things they create and do.
DOAC	DOAC (Description Of A Career, DOAC Vocabulary specification, http://ramonantonio.net/doac/0.1/) is a vocabulary used for describing professional capabilities of a worker. It was designed to be compatible with the Europeans Curriculum so that those can be generated from a FOAF+DOAC file.
DOAP	DOAP (Description of a Project, DOAP Vocabulary specification (http://trac.usefulinc.com/doap/) is a RDF schema and XML vocabulary used for describing software projects and, in particular, open source.
Dublin Core	The Dublin Core Metadata Initiative (http://dublincore.org/) is an open organization engaged in the development of interoperable online metadata standards that support a broad range of purposes and business models.

Table 2. RDF models

For example, the Mihajlo Pupin Institute ontology (MPI) uses concepts from the DOAC+FOAF vocabulary and extends them with new concepts and properties defined in the *imp* and *skills* namespace as follows:

- general description of an expert (*imp:Person rdfs:subClassOf foaf:Person*);

- general description of an organization (*imp:Organization rdfs:subClassOf foaf: Organization*) and a community (*foaf:Group*);
- *imp:PersonalProfileDocument*, based on *foaf:PersonalProfileDocument* for expertise data integration on employee level;
- *imp:RnDProfile*, a disjoint concept of the *foaf:PersonalProfileDocument* for MPI core competences integration on organizational level;
- description of education (*doac:Education*) and skills (*skills: ComputerSkill, skills: LanguageSkill, skills: EngineeringSkills, skills: OrganizationalSkill, doac: SocialSkill*);
- general description of a document (*foaf:Document*);
- personal profile document (*imp:PersonalProfileDocument*);
- R&D profile document (*imp:RnDProfile*);
- various kinds of experience (*imp:WorkingExperience, imp:ScientificExperience rdfs:subClassOf doac:Experience*)
- relations between a person and his/her profile documents and expertise (*foaf:primaryTopic, foaf:topic, imp:topic_interest_project, imp:topic_interest_reference, imp:keyQualifications, imp:responsibilities OnProjects, imp:hasScientificRecord*);
- relations between a organization and its profile document (*foaf:primaryTopic*, *foaf:topic*, *foaf:homepage*);
- relations between a person and his/her expertise (*imp:degree, imp:graduationTitle, imp:useDBMS, imp:useModellingTool, imp:useProgrammingLanguage*);
- relations between a person and the document base (*foaf:workInfoHomepage, foaf:workplaceHomepage*); etc.

4.2 From implicit to explicit data representation

After the ontological knowledge base is designed, the next step is to populate the ontology i.e. import data into the ontology and create instances. Manually creating of ontologies is a time consuming task. Semantic Web community has delivered many high-quality open-source tools that can be used for automatic or semiautomatic ontology population i.e. to convert the facts trapped in the legacy systems or business documents into information understandable both for machines and people.

Professional HRM systems, e.g. the SAP Human Capital Management solution, cover the whole life-circle of an employee from her/his recruitment, training, development, and deployment to retirement. They enable tracking of employee movements and adequate tracking of changes in organizational structure. Furthermore, standard SAP HCM processes support skill management and give managers and HR professionals reporting and analysis options that provide a real-time insight into employee qualifications. As a result, the underlying (implicit) data base model is highly normalized and quite complex. Customizing the predefined SAP HCM functionalities or extending them with new client tailored functionalities require SAP consultancy efforts. Therefore, extracting the HR data in explicit format and enriching them with semantic information will make the data easily accessable and processable in other business applications. Table 3 gives an example how specific groups of data, called "infotypes" in SAP terminology, can be mapped to public or in-house defined domain classes.

SAP HCM - Personnel Administration		
Organizational Data		
IT-0001	Organizational Assignment	*imp:inOrganization* (*imp:Organization*)
IT-0034	Corporate Function	*imp:EmploymentType*
IT-0016	Contract Elements	*imp:Document*
Personal data		
IT-0002	Personal Data	*imp:Person*
IT-0006	Addresses	*imp:Address*
IT-0009	Bank Details	*imp:Bank*
IT-0021	Family / Related Person	*imp:hasFamilyMember* (*imp:Person*)
IT-0022	Education	*doac:education* (*doac:Education*)
IT-0023	Other/Previous Employers	*imp:PartTimeEmployment, imp:referer*
IT-0024	Qualifications	*imp:Skill, imp:LanguageSkill, imp:refer*
IT-0105	Communication	*foaf:holdsAccount* (*foaf:OnlineAccount*) *foaf:phone* *foaf:homepage* (*foaf:Document*)
IT-0185	Personal ID	*imp:globalID*
SAP HCM - Organizational Management		
P010	Organization	*imp:Organization*
P013	Position	*imp:JobPosition*
The Researcher file		
IT-9110	MPI scientific titles	*imp:hasScientificRecord* (*imp: ScientificExperience*) *imp:graduationTitle xsd:string*
IT-9120	Postgraduates studies - details	*doac:education* (*doac:Education*)
IT-9130	Key qualifications and Areas of Expertise	*imp:keyQualification xsd:string*
IT-9140	Memberships in scientific organizations	*imp:isMemberOf* (*foaf:Organization*)
IT-9150	Awards, Appreciations	*imp:hasAward*
IT-9160	Projects	*imp:responsibilitiesOnProjects* (*imp:ProjectReference*)
IT-9170	References	*imp:ScientificPaper*

Table 3. Establishing correspondence between implicit and explicit data representation

Figure 3 represent a screenshoot of mapping the facts from RDBMS tables to instances explicitly represented in the Institute „Mihajlo Pupin“ knowledge store (Janev & Vraneš, 2011a).

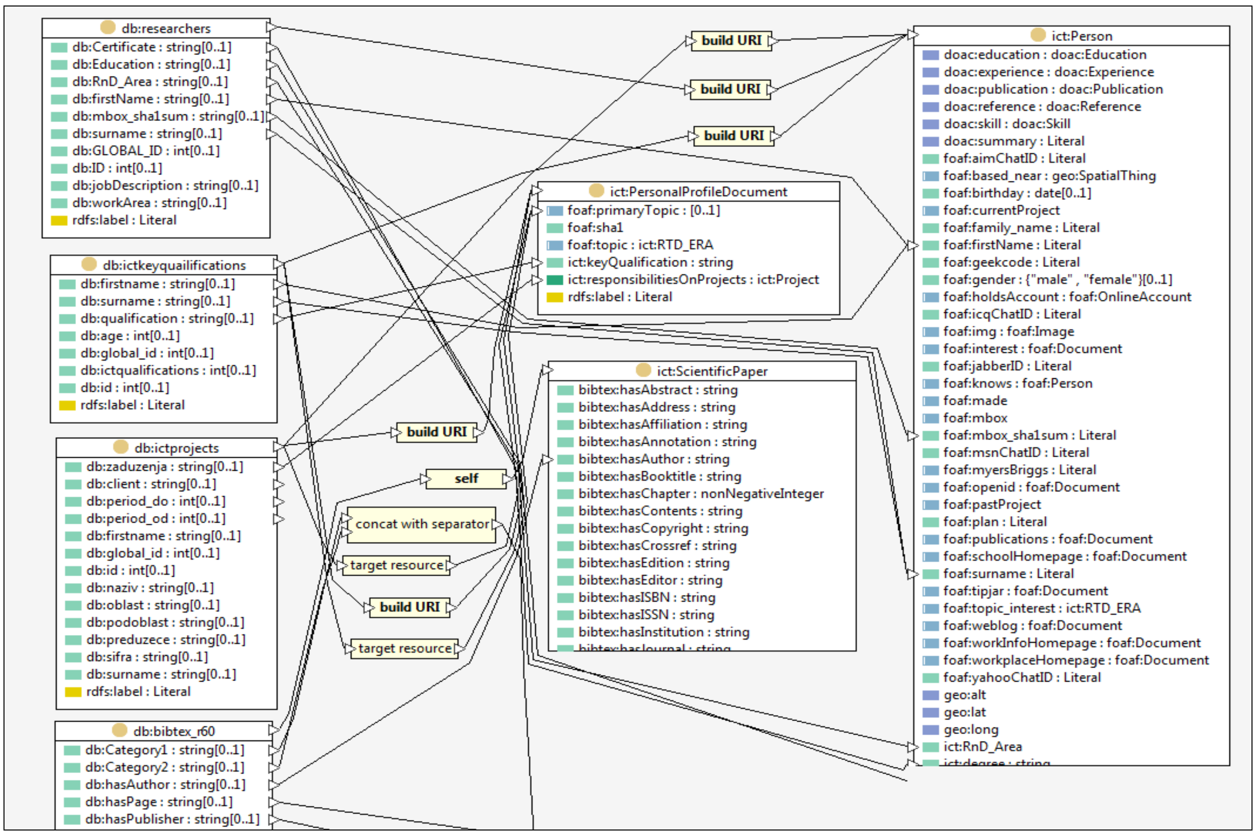

Fig. 3. Defining mapping rules with TopBraid SPINMap SPARQL-based language.

5. Publishing and searching enterprise knowledge stores with SW tools

Once represented as an RDF data store, the HR data can be linked in the (LOD) cloud and become available for further exploitation. Herein, we would like to discuss two possibilities for searching RDF models:

1. using OntoWiki tool (Auer, 2007);
2. using Sig.ma, a service and an end user application to access the Web of Data (Tummarello et al., 2010).

5.1 Navigating and querying the semantic knowledge models with *OntoWiki*

In order to publish the developed ontological models on the Web, maintain, search and retrieval in efficient and meaningful way the OntoWiki Knowledge Engineering open-source tool can be used (see ontowiki.net). The main goal of the *OntoWiki* is to facilitate the visual presentation of a knowledge base as an information map, with different views on instance data. *OntoWiki* provides a generic user interface for arbitrary RDF knowledge bases. Each node at the information map, e.g. RDF resource *foaf:Person*, is represented as a Web accessible page and interlinked to related digital resources, e.g. using the *rdfs:subClassOf* semantic property to other RDF resource *foaf:Agent*.

Selection opportunities include (see Fig.4):

- Semantically Enhanced Full-text Search (see the “Search” panel in the upper left corner); A semantic search has significant advantages compared to conventional full-text searches. By detecting classes and properties that contain the matched keywords, the semantic search delivers important feedback to the user how the search may be successfully refined;
- Browsing using semantic relations (see the “Navigation:Classes” panel in the lower left corner);
- Searching using faceted navigation method (see the “Filter” panel in the right most side). *OntoWiki* enables users to select objects according to certain facets i.e. all property values (facets) of a set of selected instances. If for a certain property the instances have only a limited set of values, those values are offered to restrict the instance selection further. Hence, this way of navigation through data will never lead to empty results;

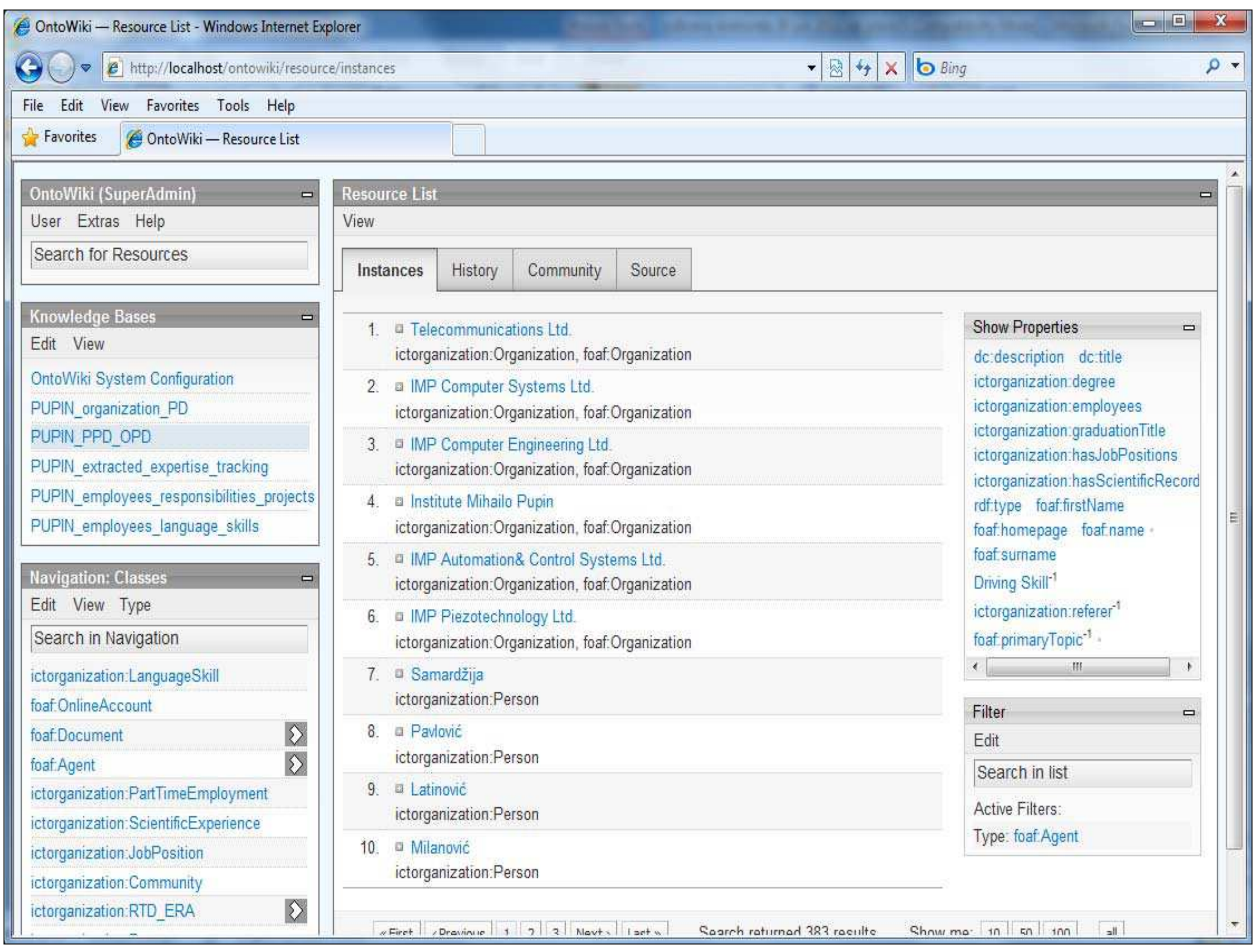

Fig. 4. Expertise search with OntoWiki.

Once a selection is made, the main content section will arrange matching content in a list view linking to individual views for individual instances. The right sidebar offers tools and complementary information specific to the selected content.

The main steps in the process of navigating and querying of a semantic model can be summarized as follows.

1. Select a knowledge base e.g. Organization and Personal profiles;
2. Select a semantic concept e.g. *foaf:Agent*;
3. Filter the entities using a semantic relation e.g. *rdf:type* in order to retrieve all instances of type *foaf:Person*;
4. Filter the entities with the faceted navigation filter e.g. retrieve the personal data for a person with a surname *Janev;*
5. After reviewing the results, the user may wish to continue navigating the information space by following relations between instances e.g. *foaf:PrimaryTopic^{-1}* can be selected to link the instance *Janev* with its personal profile document *1526-PPD* (see Fig. 5). Links to the MPI document base that stores the publications and other documents created in the MPI working process are framed in red (Janev et al., 2010).

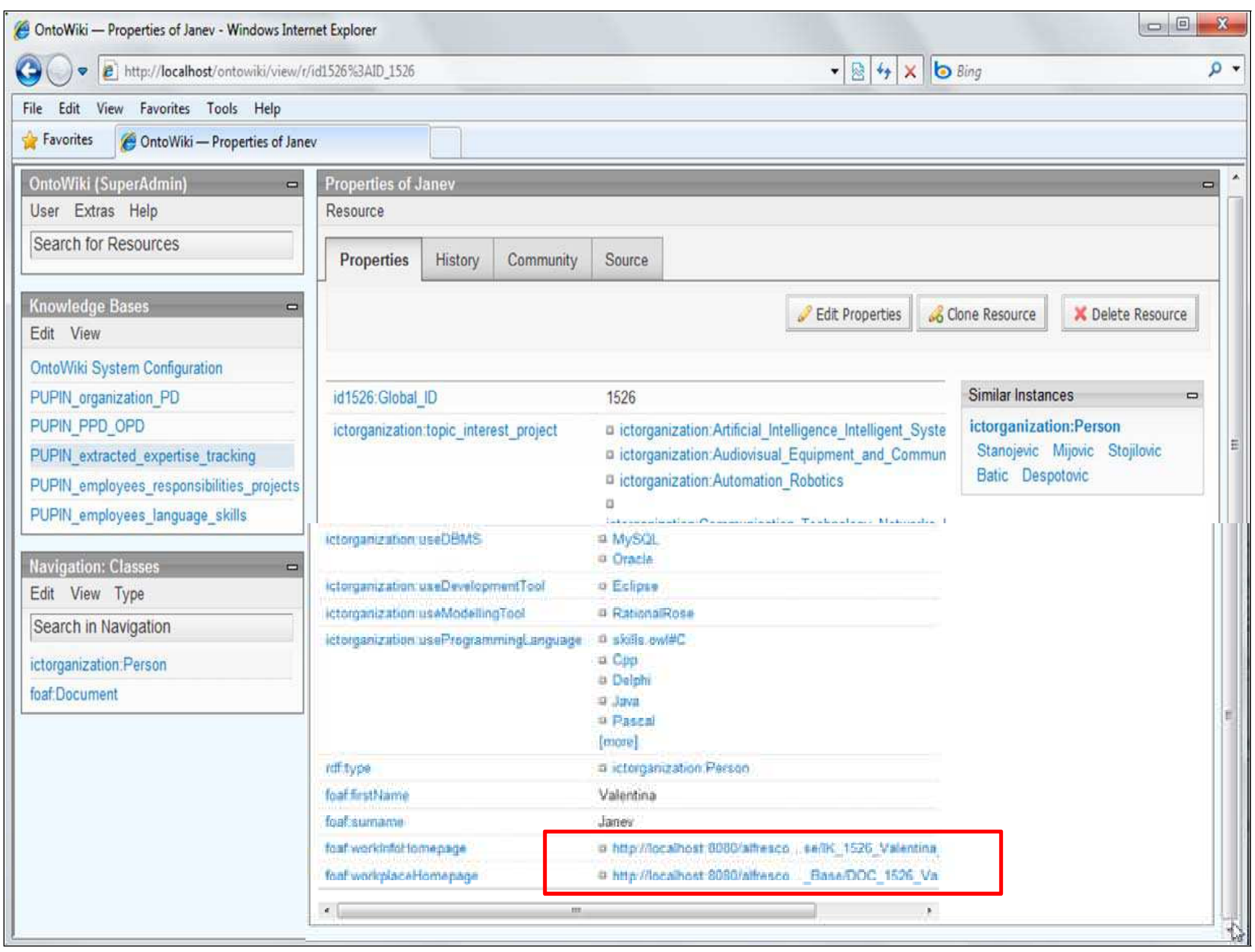

Fig. 5. Personal profile document of instance Janev-PPD.

5.2 Searching Web of Data using Sig.Ma

Once available on the Web, expert profiles can be searched with Semantic search engines, e.g. Sig.Ma.

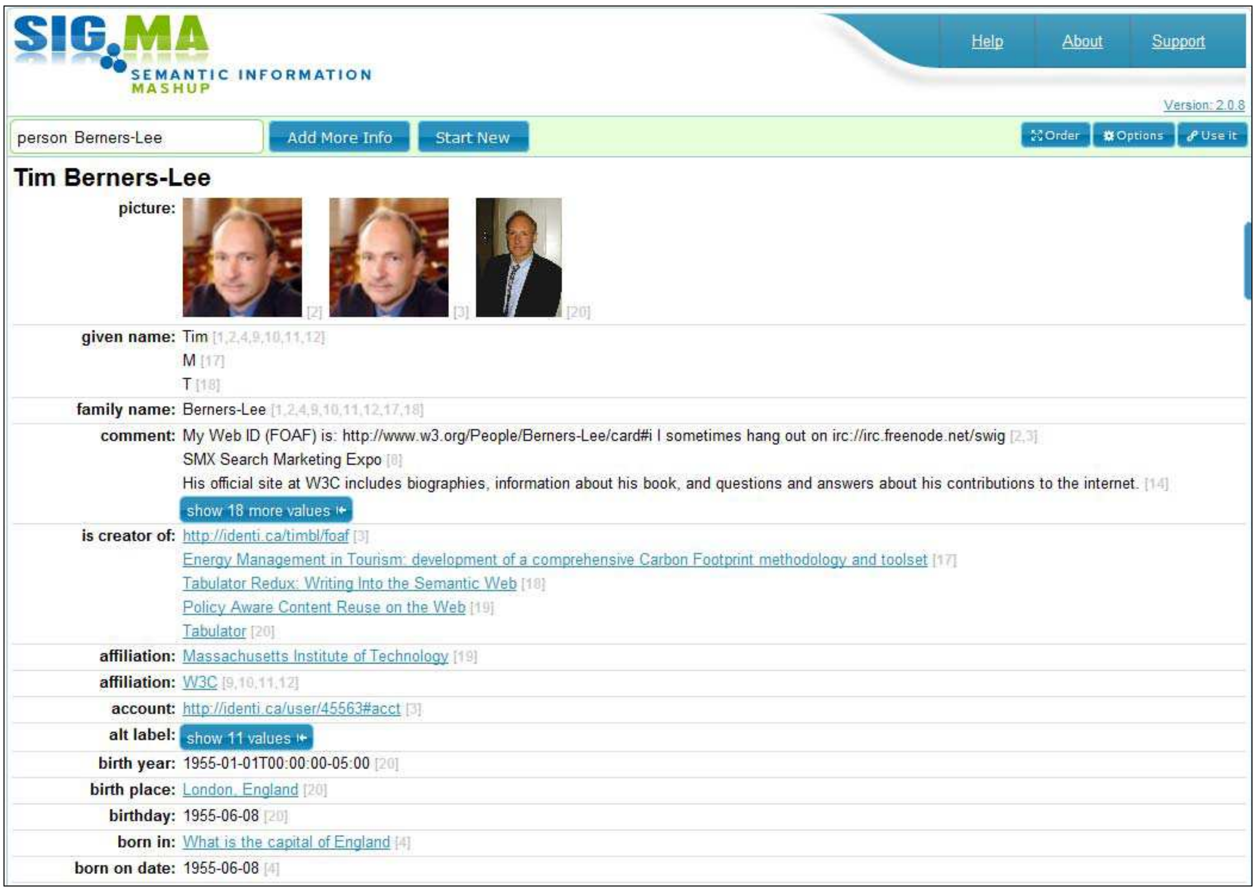

Fig. 6. An example of available personal profile document in the LOD cloud.

6. Conclusion

Taking into account the new trends in the design and implementation of enterprise information systems (based on adaptable, flexible, and open IT architecture, using open standards and emerging technologies), this Chapter introduced new insight into expertise management and proposed the Semantic Web-based approach to HR data representation, integration and retrieval.

Ontology-based approach to competency management: The proposed ontology-based approach to competency management includes establishment of a modular knowledge base of expert profiles and population of the knowledge base with information extracted from different HR related sources. The proposed approach based on emerging technologies and tools does not complement the existing information - integration approach (e.g. integrating the expert data in a form of a database) or the content management approach (e.g. integrating the experts' documents in a form of a document base), but it rather extends, enhances and integrates them with the aim to obtain a complete picture of the available resources.

Explicit, standard format of expert profile that facilitates data interoperability and expert search: As the interoperability between different knowledge organization schemas is one of the major Linked Open Data issues, the design of the semantic knowledge model in this Chapter was based on public vocabularies such as FOAF, DOAC, SIOC, DOAC, BibTeX, as well as common vocabularies for modelling case study specific data and relations such as DC, RDF, RDFS, and OWL.

Enhancing self-declared expertise with competences automatically and objectively extracted using text analysis: Taking into consideration that self declared expertise cannot be an exhaustive description of the person's expertise areas, the use of text analysis tools for updating the semantic expert profiles with uncovered *latent* knowledge should be considered.

Meaningful search and retrieval of expertise: Recently, a new search approach has emerged. It has been named faceted search that combines the navigational search paradigm and the direct, keyword search paradigm. Faceted search methods augment and improve traditional search results by using not just words, but concepts and logical relationships that are components of an ontology. Faceted navigation techniques and semantic relations shorten the search time, improve the relevance of search results, and deliver high-quality search services. This Chapter demonstrates the use of these methods in practice.

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8. References

Aleman-Meza, B. et al. (2007). Combining RDF vocabularies for expert finding. *The Semantic Web: Research and Applications*, Lecture Notes in Computer Science, Vol. 4519 (pp. 235-250). Berlin / Heidelberg: Springer

Auer, S., Dietzold, S., Lehmann, J., & Riechert, T. (2007). OntoWiki: A Tool for Social, Semantic Collaboration. CKC 2007

Auer S., Lehmann S. (2010). Creating knowledge out of interlinked data. Semantic Web Journal 1 (pp. 97–104)

Balog, K., & de Rijke, M. (2008). Associating people and documents. In C. Macdonald et al. (Eds.), *Proceedings of the 30th European Conference on Information Retrieval (ECIR 2008), Lecture Notes in Computer Science, Vol. 4956* (pp. 296-308). Berlin / Heidelberg: Springer

Balog, K., Azzopardi, L., & de Rijke, M. (2006). Formal models for expert finding in enterprise corpora. In S. Dumais, E.N. Efthimiadis, D. Hawking, and K. Järvelin (Eds.), *Proceedings of the 29th Annual International ACM SIGIR Conference on Research & Development on Information Retrieval* (pp. 43-50). ACM

Berners-Lee, T. (2006). *Linked Data*. Retrieved March 15, 2012 from http://www.w3.org/DesignIssues/LinkedData.html

Berners-Lee, T., Hendler, J., & Lassila, O. (2001). The Semantic Web*. Scientific American, May 2001*. Retrieved January 15, 2007, from http://www.sciam.com/article.cfm?id=the-semantic-web

Bordea, G., (2010). Concept Extraction Applied to the Task of Expert Finding. *The Semantic Web: Research and Applications, Lecture Notes in Computer Science*, 2010, Volume 6089/2010, 451-456, DOI: 10.1007/978-3-642-13489-0_42

Bordea, G., & Buitelaar, P. (2010). Expertise Mining. In *Proceedings of the 21st National Conference on Artificial Intelligence and Cognitive Science,* Galway, Ireland, 2010

Bizer, C., Heese, R., Mochol, M., Oldakowski, R, Tolksdorf, R, Eckstein, R. (2005). The Impact of Semantic Web technologies on job recruitment processes. *International Conference Wirtschaftsinformatik (WI 2005), Bamberg, Germany*

Draganidis, F., Chamopoulou, P., & Mentzas, G. (2006). An ontology-based tool for competency management and learning paths. In *Proc. I-KNOW '06, 6th International Conference on Knowledge Management, Special track on Integrating Working and Learning, 6th September 2006*, Graz , Austria

Draganidis F., & Mentzas, G. (2006). Competency based management: a review of systems and approaches. *Information Management and Computer Security 14(1)*: 51 – 64

Fang, H., & Xiang Zhai, C. (2007). Probabilistic models for expert finding. In *Advances in Information Retrieval, Lecture Notes in Computer Science, Vol. 4425* (pp. 418-430). Berlin / Heidelberg: Springer

Gruber, T.R. (1993). A translation approach to portable ontology specification. *Knowledge acquisition, 5(2):* 199-220

Houtzagers, G. (1999). Empowerment, using skills and competence management. *Participation & Empowerment: An International Journal (2):*27-32

Janev, V., & Vraneš, S. (2011a). *Semantic Web Tools and Technologies for Competence Management: The Case Study of R&D Organization*. LAP LAMBERT Academic Publishing GmbH & Co. KG, 2011. ISBN: 978-3-8454-4166-5

Janev, V., & Vraneš, S. (2011b). Applicability assessment of Semantic Web technologies. *Information Processing & Management*, 47:507–517, doi:10.1016/j.ipm.2010.11.002

Janev, V., Mijović, V., & Vraneš, S. (2010). Automatic extraction of ICT competences from unstructured sources. In J.E. Quintela Varajăo et al. (Eds.), *Proceedings of the CENTERIS 2010 - International Conference on ENTERprise Information Systems*, Part II, CCIS 110 (pp. 391-400). Berlin / Heidelberg: Springer

Jung, H., Lee, M., Kang, I.-S., Lee, S.-W., & Sung, W.-K. (2007). Finding topic-centric identified experts based on full text analysis. In A.V. Zhdanova, L.J.B. Nixon, M. Mochol, J. G. Breslin (Eds.), *Finding Experts on the Web with Semantics 2007, Proceedings of the 2nd Intl. ISWC+ASWC ExpertFinder Workshop (FEWS'07), Busan, Korea, November, 2007.* Retrieved August 5, 2008 from CEUR-WS.org/Vol-290/

McClelland, D. (1973). Testing for competence rather than for intelligence. *American Psychologist 20*:321-33

Müller-Riedlhuber, H. (2009). The European Dictionary of Skills and Competences (DISCO): an example of usage scenarios for ontologies. In *Proceedings of I-KNOW '09 and I-SEMANTICS '09, 2-4 September 2009, Graz, Austria* (pp. 467 – 479)

Paquette, G. (2007). An Ontology and a Software Framework for Competency Modelling and Management. *Educational Technology & Society 10* (3): 1-21

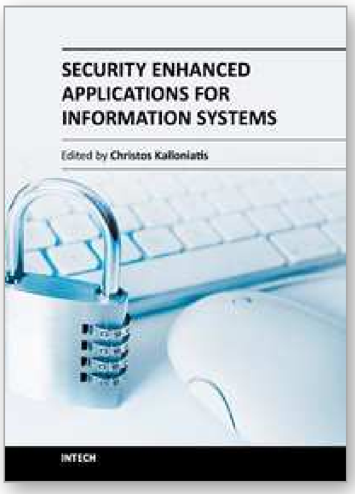
Petkova, D., & Bruce Croft, W. (2006). Hierarchical language models for expert finding in enterprise corpora. In *Proceedings of the 18th IEEE International Conference on Tools with Artificial Intelligence* (pp. 599 – 608). IEEE Computer Society

Sim, Y. W., Crowder, R. M., & Wills, G. B. (2006). Expert finding by capturing organizational knowledge from legacy documents. In *Proceedings of the IEEE International Conference on Computer & Communication Engineering (ICCCE '06), 9-11 May 2006, Kuala Lumpur, Malaysia*

Schmidt, A, & Kunzmann, C. (2006). Towards a Human Resource development ontology for combining competence management and technology-enhanced workplace learning. In R. Meersman and Z. Tahiri and P. Herero (Eds.), *On The Move to Meaningful Internet Systems 2006: OTM 2006 Workshops. Part I. 1st Workshop on Ontology Content and Evaluation in Enterprise (OntoContent 2006), Lecture Notes in Computer Science vol. 4278* (pp. 1078—1087)

Schäfermeier, R., & Paschke, A. (2011). Using Domain Ontologies for Finding Experts in Corporate Wikis. In C. Ghidini et al. (Eds.), *Proceedings of the I-SEMANTICS '11, 7-9 September 2011* (pp. 63 – 70). Graz, Austria: J.UCS

Tummarello, G., Cyganiak, R., Catasta, M., Danielczyk, S, Delbru, S., & Decker, S. (2010). Sig.ma: Live views on the Web of Data. *Web Semantics: Science, Services and Agents on the World Wide Web 8(4):* 355-364



Security Enhanced Applications for Information Systems

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Every day, more users access services and electronically transmit information which is usually disseminated over insecure networks and processed by websites and databases, which lack proper security protection mechanisms and tools. This may have an impact on both the users' trust as well as the reputation of the system's stakeholders. Designing and implementing security enhanced systems is of vital importance. Therefore, this book aims to present a number of innovative security enhanced applications. It is titled "Security Enhanced Applications for Information Systems" and includes 11 chapters. This book is a quality guide for teaching purposes as well as for young researchers since it presents leading innovative contributions on security enhanced applications on various Information Systems. It involves cases based on the standalone, network and Cloud environments.

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