

# A HUMAN RESOURCE ONTOLOGY FOR RECRUITMENT PROCESS

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## ***Abstract***

*In this paper we propose a model of ontology for the human resource domain. We emphasize the benefits resulting from the application of Semantic Web technologies in the recruitment process. We use currently available standards and classifications to develop a human resource ontology which gives us means for semantic annotation of job postings and applications. Furthermore, we outline the process of semantic matching which improves the quality of query results. Finally, we propose the architecture of an evaluation system based on Semantic Web technologies.*

**Keyword:** human resource ontology, HR-XML, e-recruitment, semantic annotation.

**JEL Classification:** M<sub>15</sub>, O<sub>15</sub>.

## **1. Introduction**

Human Resource Management (HRM) or, more specifically, competence management is an important function of knowledge management because it reasons about an organization’s most important resource – the knowledge and skills of its staff. Typically such functions as staffing, project staffing, human resources development and more are supported by competence management, i.e. the reasoning about availability and absence of required competencies both on the level of an organization as well as on the level of individual members of the organization.

Traditionally, in personnel management more coarse-grained reasoning was applied. Job postings internally as well as externally contained a job type (e.g. programmer, database manager or accountant) or a certain university degree that was required were used to describe which competencies an applicant should have. The US Office of Personnel

Management (1999) reports on fundamental changes in the Human Resource Area and argue that competencies may help organizations to focus on the characteristics their employees must possess in order for them to be successful and that competencies also provide a means to measure employee performance and to align performance with business strategies. Consequently, recent versions of Enterprise Resource Planning (ERP)-systems provide modules for competency management. However, the supported functionality is scarce.

There is some research on requirements for a more sophisticated competence management for companies. Bergenhenegouwen et al. (1996) investigate the potentials arising from detailed competence management and Lindgren et al. (2004) derive requirements for competence managements system from several case studies and the cited study.

In many cases the information about competencies are exchanged between different organizations. The HR-XML consortium (Allen and Pilot 2001) has defined different XML-Schemes to exchange HR-related information between organizations. These definitions, however, do not include definitions of certain competencies but only a method how to link claimed competencies to an external definition. Therefore competencies should be “standardized” additionally to understand what a certain competence means. In HR-XML the term taxonomy is used and usually taxonomies are only used to describe competency hierarchies.

Ontologies are a stronger form of knowledge representation by applying additional relations and constraints between concepts. They are a means to support understanding between communicating partners. An ontology for HRM can define concepts such as “competency”, “job” and certain attributes of such concepts as well as the relationships between these concepts. Thus we may define which competencies are required for a certain job and which knowledge and experience is required to achieve a certain level of competence.

Nowadays many business transactions are carried out via Internet. Human resources management has also discovered Internet as an effective communication medium. The section 2 briefly describes a typical recruitment process and suggests areas for application of the Semantic Web technologies. Subsequently, in section 3, we present our human resource ontology founded on currently available standards and classifications. In section 4 we outline the process of semantic matching which improves the quality of query results. Finally, we propose an architecture of a prototype recruitment portal based on Semantic Web technologies.

## **2. The Recruitment Process**

From an organization's viewpoint, a typical recruitment process can be divided into four main phases: describing the requirements of the job position, publishing the job posting, receiving of applications, and final decision making.

Nowadays, job postings are written in form of free text using uncontrolled vocabulary. In contrast, semantic annotation of job postings using concepts from a controlled vocabulary, based on Semantic Web technologies, results in language independent descriptions and better machine processability, i.e. improved matching of job postings and applications.

There are as many ways to post a job offer on the Web as places where an applicant can look for a job. There are Web sites and online portals financed by publishing fees, corporate Web sites, and portals run by state job centres like the German Federal Employment Office (BA) and the Swedish National Labour Market Administration (AMS). Job exchange portals differ substantially according to market scope and positioning, supported functionality, and selection methods. To maintain an overview on so many portals is next to impossible. With the Semantic Web one would publish an RDF annotated job posting only on the organization's web site, which in turn, would be crawled by various job portals. Consequently, job postings would reach more potential applicants, which would result in higher market transparency. Moreover, both employers and applicants would benefit from a semantic description of job postings and applications. Applicants could reuse their semantically annotated profiles, that is to say, to send them to different employers instead of filling in different web forms. Employers would also benefit from automated matchmaking between job requirements and applications, which would deliver a ranked list of best matching candidates and thereby reduce administrative costs.

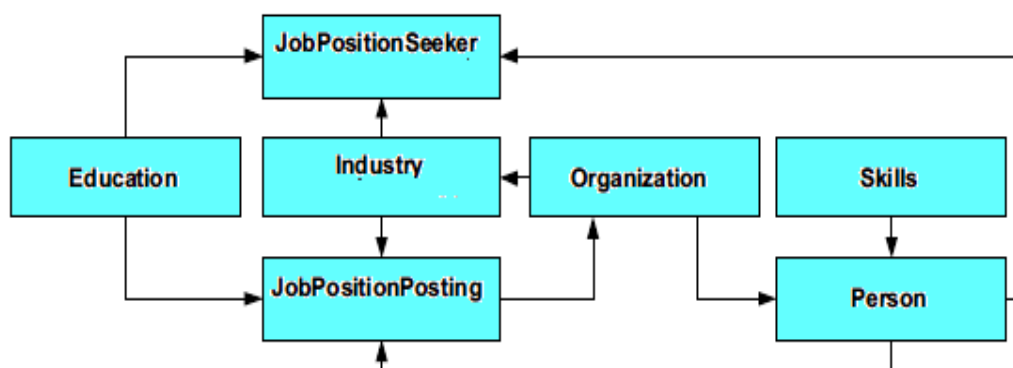
## **3. Human Resource Ontology**

As a first step in realizing our human resource scenario, we have created a human resource ontology (HR-ontology) by integrating some existing widespread standards and classifications. To avoid redundancy we decided to form sub-ontologies (see fig. 1.) which are used in both job posting and job application descriptions. Our HR-ontology is mainly based on the German version of the HR-XML standard developed by the HR-XML Consortium.

HR-XML is a library of more than 75 interdependent XML schemes which define data components for various HR transactions, as well as options and constraints governing the use of these components. We adapted the Job Position Seeker and Job Position Posting segments

from HR-BA-XML (German version of HR-XML) with respect to requirements of our scenario.

In the course of our work we have realized that the recruitment process today is no longer restricted to the national level. Hence, to specify the Industry sub-ontology we use, the German Classification of the Industry Sector (WZ2003) and the North American Industry Classification System (NAICS). As occupational classification we utilize the Romanian Classification of Occupations (COR), the German Occupation Code (BKZ) and the Standard Occupational Classification (SOC) System.



*Fig. 1. Sub-ontologies within the HR-ontology*

In the Skills sub-ontology we defined concepts representing competencies, which are used to describe job requirements as well as applicant's skills. This ontology also provides means for specifying the competence level of a certain skill. Furthermore, we developed a *Person* sub-ontology for describing personal information of job applicants and an *Organization* sub-ontology to specify the employer companies.

Our HR-ontology is modelled with the Web Ontology Language (OWL). Descriptions of job postings and applicant's profiles are stored in RDF (Resource Description Framework) format using the pre-defined vocabulary from our HR-ontology.

#### **4. Semantic Matching of Job Postings and Job Applications**

Having job position postings and job position seekers described using controlled vocabulary from our HR-ontology allows us to perform semantic matching, i.e. the calculation of the degree of semantic similarity between an applicant's profile and job requirements. Consequently, for a given job position a ranked list of the best matching candidates can be delivered as a result, and vice versa.

Inside both a job posting as well as a job application we group pieces of information into “thematic clusters”, e.g. information about competencies and skills, information regarding the industry sector of the job position, and job position details. In our approach, we compare each thematic cluster from a job posting with the corresponding cluster from a job application. The final similarity between an applicant’s profile and a job posting is calculated as the sum of the similarities between these thematic clusters since information provided within each cluster is represented using controlled vocabulary from our ontology.

HR-ontology, we compute the similarity between thematic clusters based on the similarity between their concepts. In our method, using some ideas from, we determine the similarity between two concepts by their respective positions in the concept hierarchy and additionally by the similarity between their properties (relations with other concepts).

An example property of a concept from the “skills cluster” (e.g. java programming) is the competence level (having another concept as its value, e.g. beginner). Furthermore, within the user interface (see fig. 2.) users are given the opportunity to specify the importance of different concepts (job requirements). The concept similarity will be then justified by the indicated “weight”, i.e. the similarity between more important concepts will have greater influence on the cluster similarity.

## 5. Architecture of the Evaluation System

To examine the impact of the application of Semantic Web technologies on the job market we are currently developing a recruitment platform. The technical architecture of our system (see fig. 2.) is divided into: data layer, application logic, and front-end layer. This architecture is similar to with additional functionality for automatic crawling of job postings from different web sites.

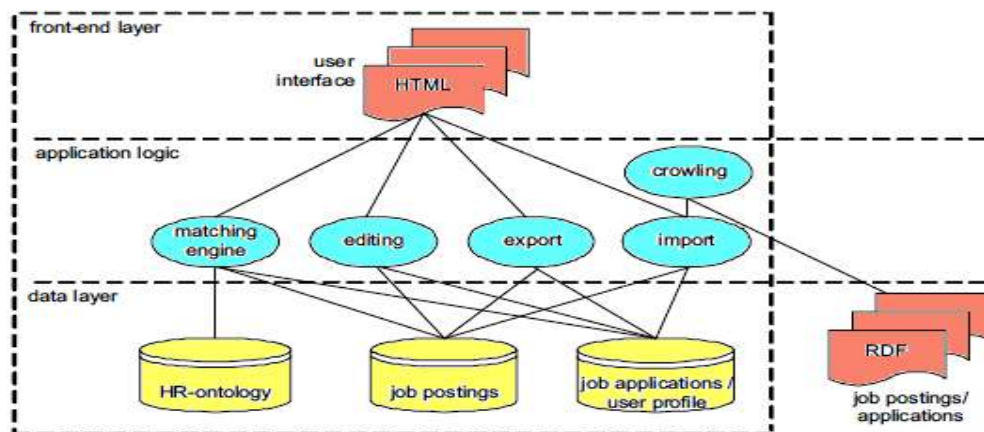


Fig. 2. Architecture of the Evaluation System

RDF-repositories located at the data layer store the human resource ontology and all collected descriptions of job postings and user profiles. The application logic provides services for querying the database and editing its content. Moreover, at this layer the semantic matching of job postings and applications is performed. On top of the architecture, the front-end layer offers a browser-based user interface which accepts input from and presents ranked query results to the user, and another interface providing services for import and export of RDF-encoded job postings and applications.

## 6. Conclusion

In this paper, we proposed an application of Semantic Web technologies in the recruitment domain. We described the human resource ontology used within our approach, which provides us means for semantic annotation of job postings and job applications. Using controlled vocabularies, in contrast to free text descriptions, results in a better machine processability, data interoperability and integration.

Moreover, having job postings and user profiles semantically annotated, enables us to perform semantic matching which significantly improves query results and delivers a ranked list of best matching candidates for a given job position. Finally, we described the system architecture of the recruitment portal based on Semantic Web technologies. In the next step of our research, we plan to implement the recruitment portal founded on the ideas presented in this paper.

## References

1. Billig, A., Sandkuhl, K., (2002), *Match-making based on semantic nets: The xml-based approach of baseweb*, In: Tolksdorf, R., Eckstein, R., (Hrsg.), "Proceedings of the 1<sup>st</sup> workshop on XML-Technologien für das Semantic Web", S. 39–51
2. Zhong, J., Zhu, H., Li, J., und Yu, Y., (2002), *Conceptual Graph Matching for Semantic Search*, ICCS 2002 - The 2002 International Conference on Computational Science, Amsterdam, The Netherlands
3. Internetökonomie, Internetökonomie, (2004), <http://www.internetoeconomie.net>
4. InterVal-Berlin Research Center for the Internet Economy, Interval-internet and value chains, (2004), <http://interval.hu-berlin.de>
5. W3C: *OWL Web Ontology Language—Reference*, (2004), <http://www.w3.org/TR/owlref>
6. <http://www.arbeitsagentur.de/>
7. <http://www.ams.se>

8. <http://www.hr-xml.org>
9. <http://www.destatis.de/allg/d/klassif/wz2003.htm>
10. <http://www.census.gov/epcd/www/naics.html>
11. <http://www.itmtimis.ro/html/cor.htm>
12. [http://www.arbeitsamt.de/hst/markt/news/BKZ\\_alpha.txt](http://www.arbeitsamt.de/hst/markt/news/BKZ_alpha.txt)
13. <http://www.bls.gov/soc/>