E-RECRUITMENT PUBLIC SERVICES ONTOLOGICAL MODEL

Assoc. Prof. Dr. Roumiana Ilieva
Faculty of Management, Technical University of Sofia, Bulgaria, rilieva@tu-sofia.bg

Abstract: *Ontology is a broadly established tool for modelling of context information. Such researches have been carried out in many diverse areas for numerous purposes particularly in the e-Employment domain. A closer look on a current work of such domain of ontologies such as e-Recruitment is taken into account in this article. Ontology application for e-Recruitment is becoming an important task for matching job postings and applicants semantically in a Semantic web technology using ontology.*

This paper aims to optimize and enhance e-Recruitment processes in the domain of IT staffing services, and especially e-Recruitment processes that use Web platforms as means of sourcing candidates. The model is a response to a number of categories of requirements, ranging from the semantic to the performance of software at runtime. The successful starting point of a flourishing model must be an ontological analysis of the processes of e-Recruitment delivery, seen as a scientific problem-solving process. Through such approach a classification of types of e-Recruitment information is developed. Then a hierarchical ontology schema is examined, including domain ontology and set of application and task ontologies.

KEYWORDS: *ONTOLOGICAL MODEL, TAXONOMY, E-RECRUITMENT*

1. *e-Recruitment state-of-the-art*

e-Recruitment, also known as online recruitment, is the practice of using technology and in particular web-based resources for tasks involved with finding, attracting, assessing, interviewing and hiring new personnel [1]. The purpose of e-Recruitment is to make the processes involved more efficient and effective, as well as less expensive. Online recruitment can reach a larger pool of potential employees and facilitate the selection process.

Generally, "Job search services by labour offices" is categorized as one of the twelve e-Services provided for the citizens [2]. As such, most of the countries developed their own strategy for conducting it. The responsible departments are usually from the government. Furthermore, each of those countries exposes a separate web-site containing the necessary information, the available job openings as well as the terms that need to be followed.

France provides a devoted job search facility where both employees and employers are allowed to expose their CVs and opening positions respectively. (http://www.pole-emploi.fr/informations/plan-du-site-@/plan_du_site/). Furthermore, a summer job search portal is available as well. Its target group is mainly students and graduates. (http://www.jobs-ete.com/).

In Norway the responsible department is Ministry of Labour and Social Inclusion, Norwegian Labour and Welfare Service (NAV). The corresponding web site automatically updates the information and publishes the job offers. (http://www.nav.no/English). Those openings are available in the European Employment Services Job Mobility Portal.

In Slovenia the corresponding department is the Employment Service and Ministry of Public Administration. The available web sites are two – http://www.ess.gov.si/ and http://www.mddsz.gov.si/. They both provide the ability to search through a data base and to subscribe to a weekly feedback with the available job openings related to some predefined prerequisites and criteria. Both unemployed and employers are allowed to look through the database.

In Spain the corresponding National Employment System online portal (https://www.redtrabaja.es/es/redtrabaja/portal/homeTrabajo.do) gives the opportunity to unemployed to search on a list of job offers all over Spain. Furthermore, on a password basis, they are allowed to make more profound researches. On the other hand, each job-seeker is allowed to publish its own CV, portfolio and requirements. All of this is enabled by a clickable map that navigates each user to the appropriate regional employment service. Moreover, the portal provides links to the Europe-wide job mobility web site – EURES (http://ec.europa.eu/eures/) as well as to job openings in the armed forces and civil services.

Analysis and overview of the achievements in the e-Recruitment Service "Selection of suitable candidates for vacancies" shows that in terms of HRM, the Internet has radically changed the recruitment function from the organisational and job seekers' perspective. Conventional methods of recruitment processes are readily acknowledged as being time-consuming with high costs and limited geographic reach. However, recruitment through World Wide Web (www) provides global coverage and ease. Likewise, the speedy integration of the Internet into recruitment processes is primarily recognised due to the Internet's unrivalled communications capabilities, which enable recruiters for written communications through e-mails, blogs and job portals [3].

Thus the objective of this paper is derived to provide an ontological model for e-Recruitment services implementation procedure with researchers' recommendations and guidance for future research in handling the above issues.

2. *e-Recruitment Procedure "Selection of Suitable Candidates for Vacancies"*

The e-Recruitment Service "Selection of suitable candidates for vacancies" meets the necessity of the employer for appropriate and valuable personnel. Once a particular employer states his requirements and defines the work conditions and payments, the corresponding Directorate "Employment Bureau" – representing the government – undertakes its obligation to find and sort the candidates suitable for a particular job opening.

Basically, every employer has the possibility to define his need for employees and set his conditions. However, he does not have the right to choose the candidates on the basis of gender, age, nationality, health condition. Exceptions are made only if the nature of the work requires it. Once the employer fills the necessary documents for the available positions, their number, method for applying and necessary competences, the appropriate Directorate "Employment Bureau" starts gathering the appropriate candidates.

Every person that has submitted his documents for participation in the process and that responds to the required competences can be summoned for a meeting with the corresponding employer.

The process of employment is observed by the Employment Agency and needs to match the regulations defined in the "Law for Employment Promotion" and the "Regulation for Application of the Law for Employment Promotion" [8]. Furthermore, other government agents take part directly or indirectly in the process – Ministry Council, National Council for Employment Promotion, National Advisory Council for professional qualification of employees [6], [9].

Once the whole process is started and the available candidates are assessed and approved, the resultant documents are published [7] – List of filled and closed vacancies, List of hired employees, directed from the Directorate "Employment Bureau", List of unemployed who refused to accept the offered position, etc.

All of the above are gathered and verified. Lastly, the data is transferred to the National Institute of Statistics and the necessary information is analysed.

3. *Selection of Suitable Candidates for Vacancies – Ontology, Semantic Web and Taxonomy*

Each e-Service is created to meet the demand and satisfy citizen's needs. However, most of the time it depends on other services and there comes the necessity of organizing all the available ones, create connection in-between and structure them in a relatively consistent model. Here comes the necessity of semantically enhanced organization representing the concepts and relationships among those services.

To serve this need emerged ontology-based techniques. They cover different aspects of the services details (meta-data, necessary documents, people involved, individuals' responsibilities, etc.) [4]. Thus a consistent structure is created that helps improving the specific service and its interoperability and connection with other services in the same field.

3.1. e-Recruitment Ontologies for Semantic Search

Ontologies are becoming increasingly popular in practice, and the number of poor quality ontologies has made clear the need for a principled methodology for building them. Perhaps the most common problem we have seen in practice with ontologies is that, while they are expected to bring order and structure to information, their taxonomic structure is often poor and confusing. This is typically exemplified by the unrestrained use of subassumption to accomplish a variety of reasoning and representation tasks.

The first stage of the advanced design and/or modelling of any system or process is domain conceptualization. This activity comprises specifying of concepts, its commonly accepted definitions, synonyms, hierarchical and non-hierarchical relations between them, links with another related areas, translation in different languages, etc. Generally, this activity presently is implemented by domain ontology development.

It is well-known that application of ontologies in analytical modelling increases efficiency and quality of models with a view of its subsequent search, analysis and/or design. Moreover, without building ontology a lot of problems due to terminology inconsistency arise.

Having in mind that an ontological model of e-Recruitment is intended on the way to better understanding its matter, a holistic approach towards its domain for search, organizing, sharing and disseminating information about its services is provided.

The paper is structured in four main sections. The next section examines the ontology schema of the e-Recruitment model. The third section describes the process of creation of e-Recruitment domain ontology. In the first part of the fourth section application ontology is offered exploring the services provided of the Bulgarian National Employment Agency (NEA). In the second part task ontology of a procedure for accomplishment of a concrete service of the NEA is proposed as an illustration case study. At the end conclusions and intention for future work are represented.

The domain ontology of e-Recruitment is realized in OWL (Web Ontology Language) with Protégé 4.1 editor. The main reason of OWL choice is the fact that it is proposed to be the ontology language for the Semantic Web [5].

3.2. Meta-model

The purpose of the meta-model is to illustrate the basic guidelines for the future development of the service and keep it as consistent and straightforward as possible. The main idea is to connect the necessities of the citizen and the corresponding authority that takes care of them. Moreover, the meta-model has to pursue the goal of meeting the requirements for the development of any further public services.

The model in fig.1 demonstrates the basic organizational structure of the e-Recruitment Service "Selection of suitable candidates for vacancies". It displays the hierarchy of the required authorities as well as the corresponding inputs, outputs and the main goal of the process – hiring personnel.

3.3. Ontology template

Once the development of ontology is started, there comes the necessity of ensuring that all the terms and concepts used are accurate and approved. In order to meet that requirement, an ontology template is created. It demonstrates the possible relationships and ideas that can be used. Basically, such a template contains the following lines shown in table 1[1]:

Table 1: Ontology Template

Concept	***Description***
Service	*A means offered to the public for conducting business with the government*
Service Concept	*A citizen or enterprise that is a potential user of a service*
Organisation	*A governmental division that is responsible for defining and/or offering services to service consumers*
Service Implementation	*A concrete form of a service, offered by an organization and made available to service consumers*
Legislation	*Any type of official document or practice that regulates the operation of services*
Form	*An instrument through which a service consumer requests a service, typically by provision of field values and submission*
Document	*An official certificate issued by services*
Life-event	*An incident for a service consumer that necessitates the use of a number of services*

As in our case the subject to be examined is the e-Service "Selection of Suitable Candidates for Vacancies", the corresponding ontology template looks as shown in table 2:

Table 2: Ontology Template for e-Service: 'Selection of Suitable Candidates for Vacancies'

Concept	***Description***
Selection of Suitable Candidates for Vacancies	*A service supporting the process of hiring appropriate personnel.*
Service Concept	*Both the employees and the employers turn out to be the end users of the service.*
Organisation	*Employment agency – Directorate "Employment bureau".*
Service Implementation	*Selection of Suitable Candidates for Vacancies as an e-Service provided by the e-Government.*
Legislation	*Law of employment promotion and Regulation for the application of the Law of employment promotion.*
Form	*Request for vacancies. Letter-invitation for a registrant.*
Document	*An official certificate issued by services*
Life-event	*Unemployment*

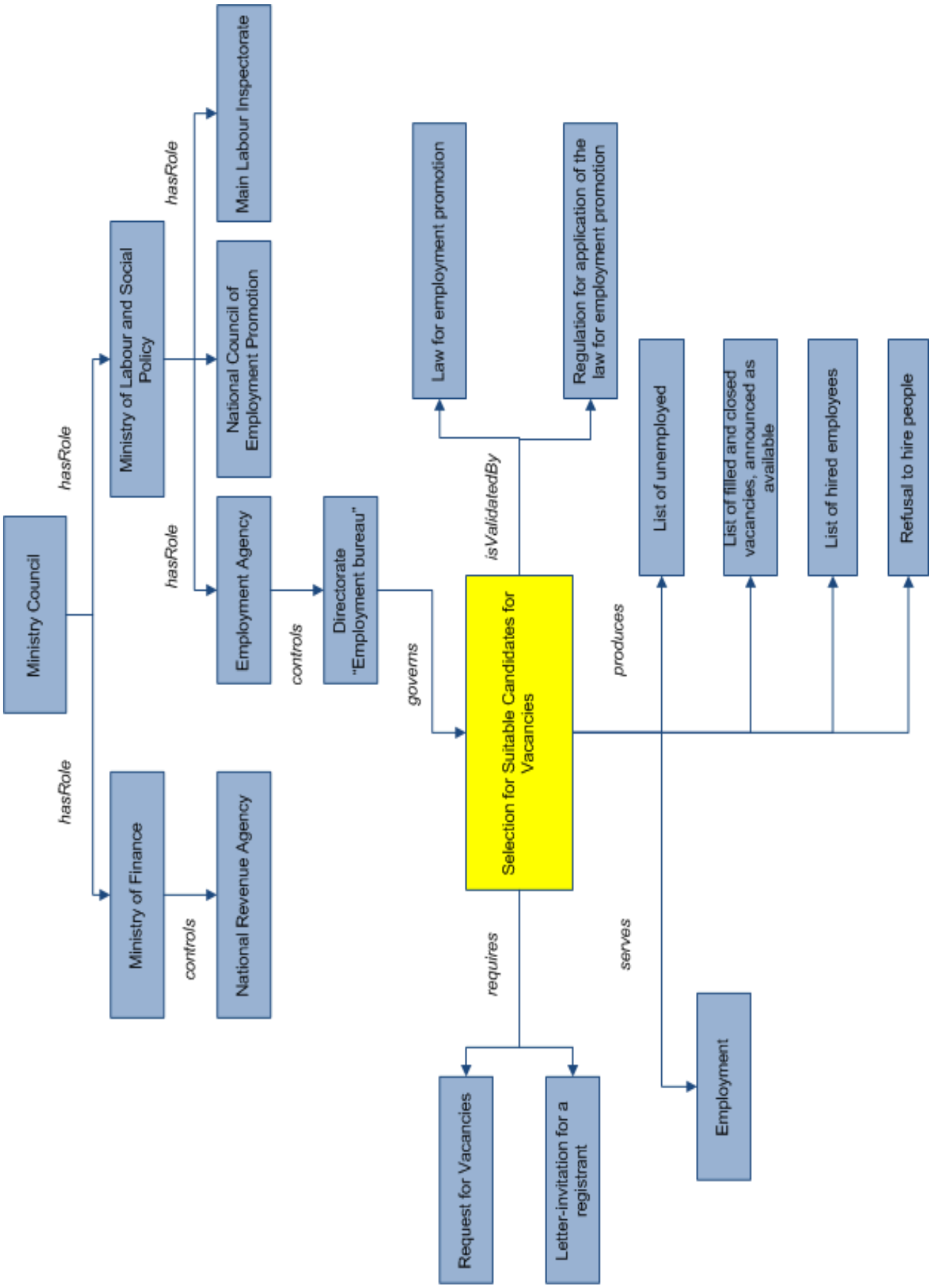

Figure 1: Meta - model

3.4. *Ontology population*

3.4.1. *Consistency Axiom*

Axiom is a statement that will always be true. It is used for verifying the consistency and accuracy of the ontology. In the context of currently investigated e-Service "Selection of Suitable Candidates for Vacancies", such an axiom may be as follows – an employer is allowed to publish a job offer if and only if he is able to provide such job position shown in table 3.

Table 3: Consistency axiom

Consistency Axiom
(Consistency between job offer and job opening)   ***(⇔ (is available – job position – job offer)***   ***(has job offer – job position)***

3.4.2. *Rules*

Rules are general two-part statements that indicate that if its firstly part is true, then most probably the second one is true as well. A basic rule in the government ontology for example is that "if a unit has a support-unit, then that unit is a subunit" [4]. In the context of the e-Service this particular rule may be presented in fig. 2 as follows:

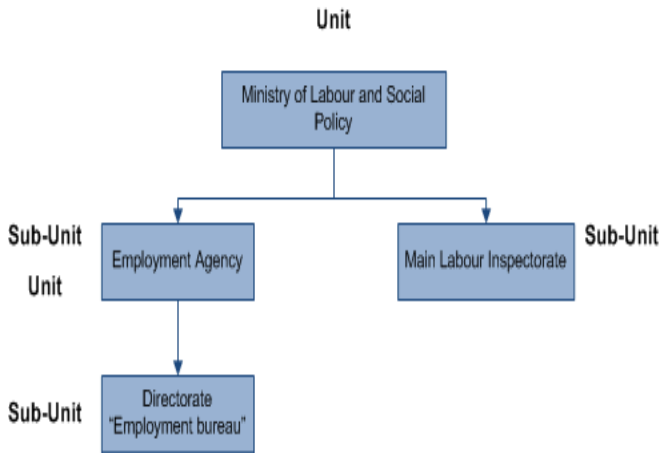

Figure 2: Rules

3.4.3. *Instances*

Instances present the final items – those that present concepts of the real world. Each class may have as many instances as required. In the current context a particular instance may be as follows in table 4:

Table 4: Instance

Maria Petrova (instance of Employee)	
First name	Maria
Last name	Petrova
Age	27
Sex	Female
Sector of interest	IT

3.5. *Taxonomy*

The taxonomy of the e-Service illustrates all the required parts of it and the connection between them. Using Protégé one can create the necessary structure. In this case the service can be separated into the following sub-categories:

- ✓ Government Department;
- ✓ JobPosition
- ✓ Person.

The corresponding tree-like diagram will be as follows in fig.3:

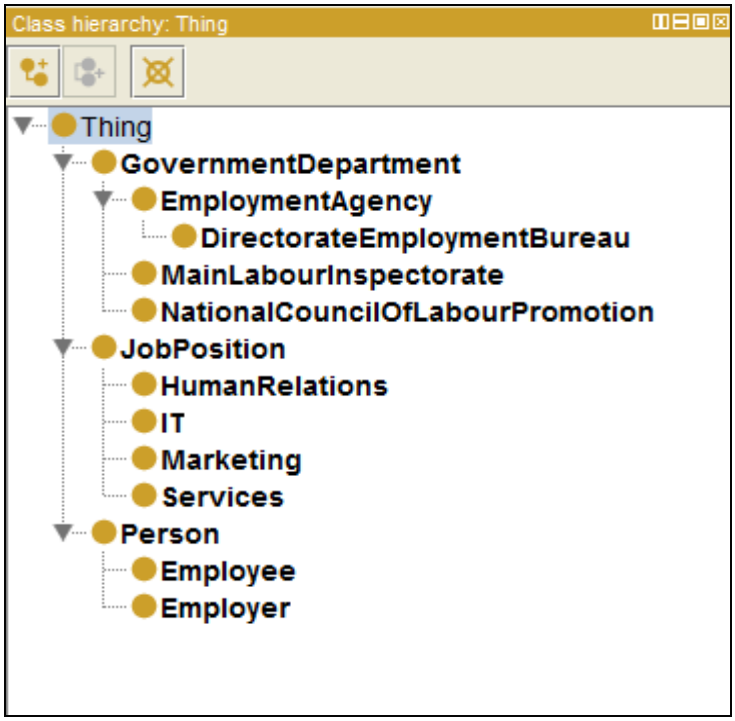

Figure 3: Class Hierarchy

An OntoGraph interpretation developed again with the help of Protégé is the following in fig.4:

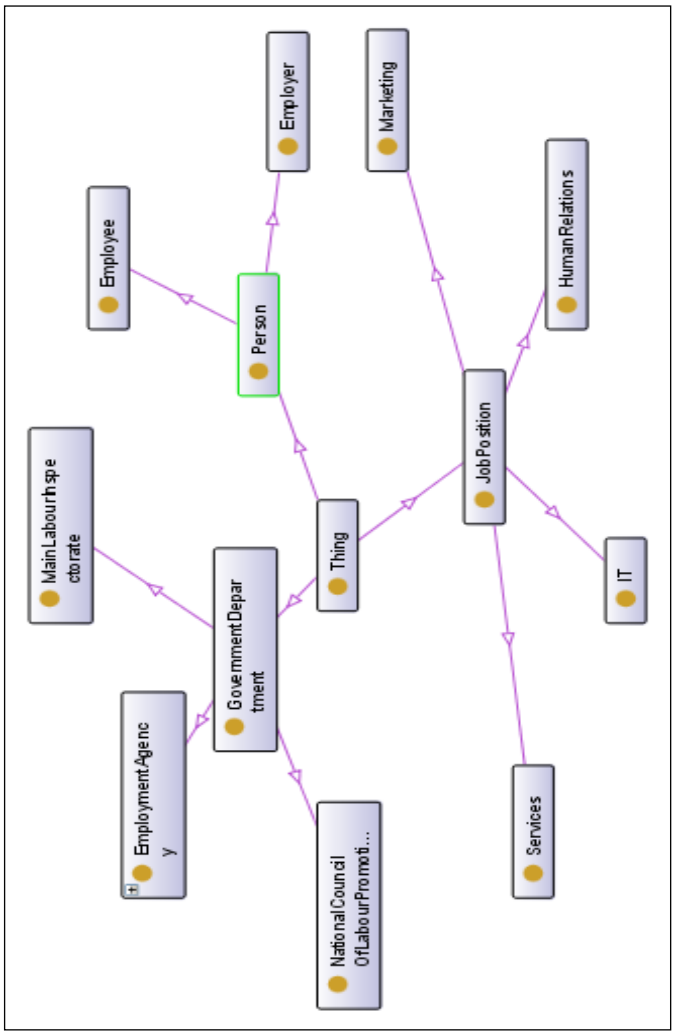

Figure 4: OntoGraph Class Hierarchy

In this case the main group of terms are shown in table 5:

Table 5: Main group of terms

Main group of terms
+ <term value="Government">
+ <term value="EmploymentBureau">
+ <term value="Employment">
+ <term value="Employer and Employee">
+ <term value="Job offer">
+ <term value="Vacancy">

Generally, this classifies the basic ontology concepts and their main purpose is to facilitate indexing and keywords searching.

3.6. Ontology

The ontology template is quite necessary for developing a proper and adequate semantic examination of the structure of the e-Service and its basic purpose. Each ontology contains main classes, each of which might have different subclasses. Each of those classes and consequently their instances can have one or more properties describing them and making the connection between each instance with an instance from another class.

In the current case, the main classes are shown in table 6:

Table 6: Main classes

Main classes
GovernmentDepartment
Person
Job position

Using Protégé programme we can easily create their implementation, configure their subclasses and configure the connection in-between the different classes. The class implementation is shown in fig.5:

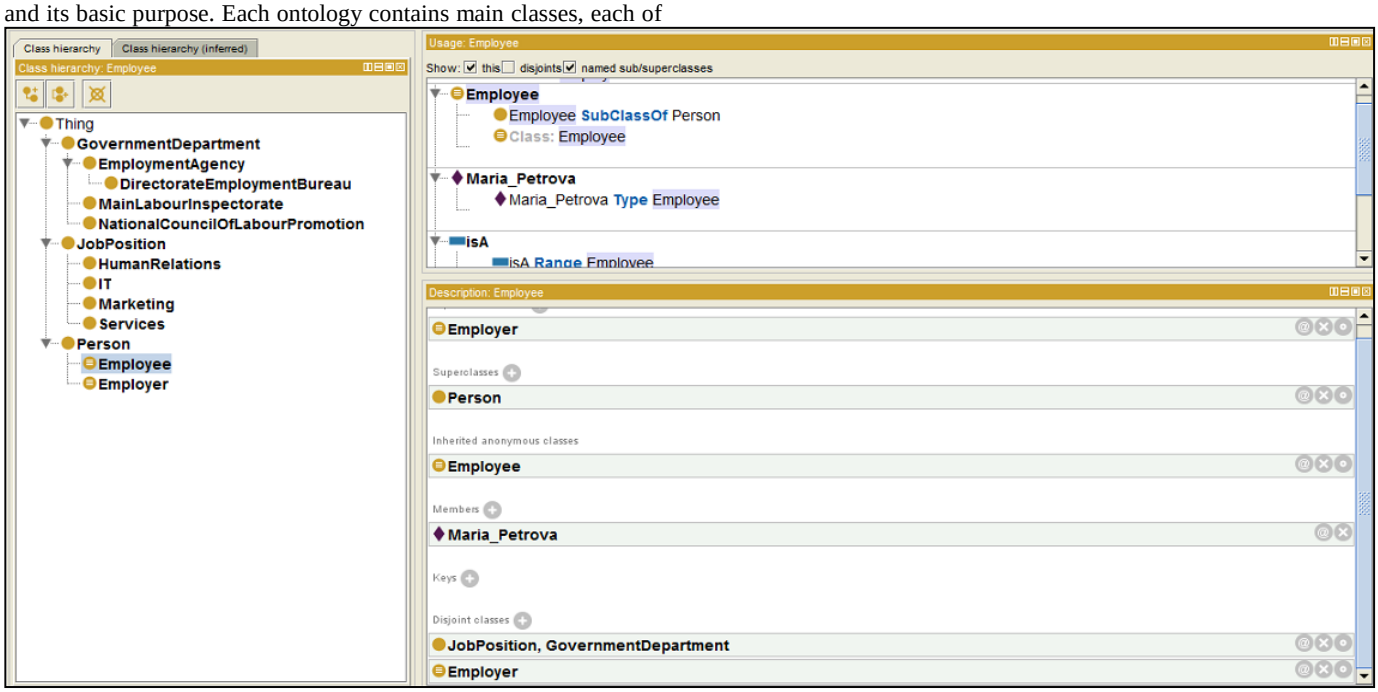

Figure 5: Class implementation

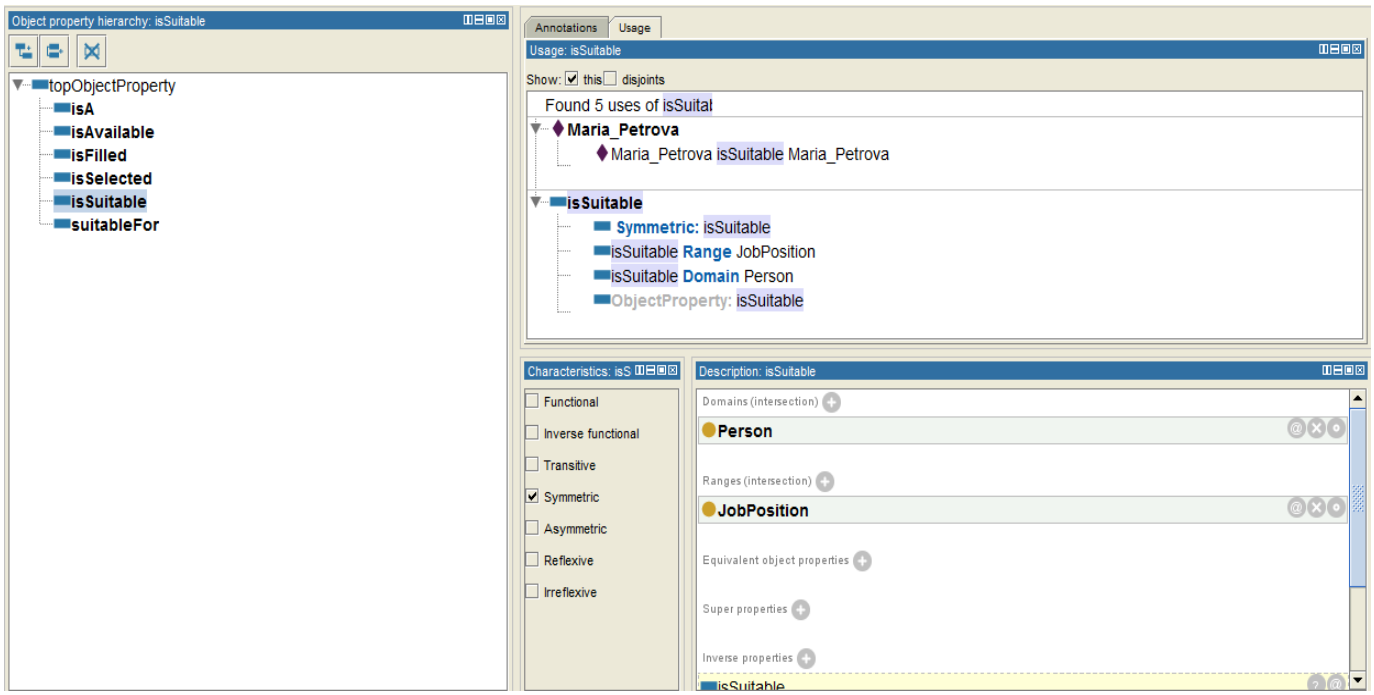

Figure 6: Object properties

Again with the help of Protégé we can define all the object properties as shown in fig.6.

4. Conclusions and Future Work

The basic steps of a methodology for ontology design founded on a formal ontology of properties built on a core set of meta properties, which exploits the basic notions of identity, rigidity, and dependence have been presented here. The backbone taxonomy is identified. It forces the analyst to make ontological commitments explicit, clarifying the intended meaning of the concepts used and producing therefore a more reusable ontology.

A Human Resource Ontology in e-Recruitment domain has been presented in this paper. It describes the human resource ontology used within ontology matching approach, which provides means for semantic matching approach to match job seekers and job advertisements in a recruitment domain. However, further research is needed to enhance methods of constructing human resource ontology, utilizing the matching techniques for local ontologies in order to match between an integrated set of ontologies composed to reach the best match between positions and candidates. Moreover, research about the usage of ontology matching techniques in different domains should be performed. Research intended at building sufficiently applicable matching techniques between local ontologies for this domain will improve ontology alignment processes. For finding an accurate ontology matching, exact and desirable similarity dimensions among source ontology elements and target ontology elements should be considered.

Acknowledgements:
Author expresses her deep gratitude to her students M. Zhecheva and Y. Andreev from e-Management Master Degree Program at ELFE, TU-Sofia for the hard modelling class work.

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