

GENERIC EDUCATIONAL NOMENCLATURE FOR INTERNATIONAL UNIVERSITY STRUCTURES– ONTOLOGY GENIUS-ONTOLOGY

THIAGO SOUZA ARAUJO

*DSc. in Knowledge Engineering and Management, Federal University of
Santa Catarina
Federal Institute of Santa Catarina (IFC), Professor of Business
Management
araujo.thiago.souza@gmail.com
ORCID orcid.org/0000-0002-5944-1041*

MARCIO CLEMES

*MSc. in Production Engineering, Federal University of Santa Catarina
Federal University of Santa Catarina, Superintendence of Electronic
Governance and ICT
marcio.clemes@gmail.com*

RENATO JORGE PRIM

*BSc. in Mathematics, University of the Region of Joinville
Empresa Brasileira de Telecomunicações S.A., SC Operations Management
reprim@gmail.com*

JOSÉ LEOMAR TODESCO

*DSc. in Production Engineering, Federal University of Santa Catarina
Federal University of Santa Catarina, Professor in the Department of
Knowledge Engineering
tite@egc.ufsc.br
ORCID orcid.org/0000-0003-4934-9820*

VINICIUS BARRETO KLEIN

*MSc. in Knowledge Engineering and Management, Federal University of
Santa Catarina
Instituto Federal Catarinense (IFC), Professor
vinibk@gmail.com / vinicius.klein@ifc.edu.br*

ABSTRACT

Purpose: This paper aims to present the results of the research and development of a generic ontology with terms nomenclature that would be applied to different educational organizations.

Design/Methodology/Approach: the research approach is qualitative, an applied research based on research and development. As methodological type, it has a component of exploratory and documentary research, had as field Research interviews with domain expert.

As techniques and tools, it was used Internet for online research on universities organizational charts, open and unstructured interviews in the field research. In the development stage, it was used two main software tools: OntoKEM e Protégé ontology editor. The ontology development was applied to a real case - the Federal University of Santa Catarina in Brazil – with a knowledge elicitation process by extensive interviews with a domain expert.

Results: Although universities use different names the roles in academic organizations of high education do not differ significantly. In fact, the work of find common terms for the same role demanded a lot of discussion and, therefore, a lot of time. However, the feasibility of direct application is very high.

Originality/value: As result, differently from what was available as domain ontology till then, now there is available online an ontology that may be used directly for virtually any University organization.

Keywords: Ontology. Educational institution structure ontology. Owl. Generic university domain ontology.

ONTOLOGIA GENÉRICA PARA NOMENCLATURA INTERNACIONAL EM ESTRUTURAS ORGANIZACIONAIS UNIVERSITÁRIAS – ONTOLOGIA GENIUS-ONTOLOGY

RESUMO

Objetivo: Este trabalho pretende apresentar os resultados do desenvolvimento de uma ontologia genérica com indicações de termos que seriam aplicadas a diferentes organizações educacionais.

Design/Methodologia/Abordagem: A abordagem de pesquisa é qualitativa, sendo pesquisa aplicada baseada em pesquisa e desenvolvimento. Como procedimento metodológico, foi realizada uma pesquisa exploratória e documental, que teve como pesquisa de campo entrevistas com um especialista de domínio.

Resultados: Embora as universidades usem nomes diferentes, os papéis em organizações acadêmicas de ensino superior não diferem significativamente. Na verdade, o trabalho de encontrar nomenclatura comum para o mesmo papel exigiu muita discussão e, portanto, muito tempo. No entanto, a viabilidade da aplicação direta é muito alta.

Originalidade/valor: Diferentemente do que estava disponível como ontologia de domínio até então, agora existe uma ontologia online que pode ser usada diretamente em praticamente qualquer organização universitária.

Palavras-chave: Ontologia. Ontologia de estrutura de instituição educacional. Owl. Ontologia de domínio universitário genérico.

I INTRODUCTION

This paper aims at presenting a domain and generic ontology for universities. It is not expected to create the ultimate silver bullet but to develop a generic ontology to provide some degree of universal understanding of the concepts and maybe a computational standard to absorb the differences among most of countries that adopt the concept of university. So, the focus is not on university organizational structures, rather its target is to create a set of equivalences for common understanding of the roles played and terms used to respect the differences among countries. From this point of view an ontology may help not only automated software for knowledge-based tasks but also helps University members to understand different terminology for similar roles played in different countries. We expect that this approach may be very useful for the academic context.

Starting from an exploratory research in university domain ontologies we selected some examples to be reused, improved and validated in international multi-context use. The challenge was to create common understanding for different careers structures that exist in universities around the world. This means that the biggest difference the reader will find in GENIUS ontology is the possibility to use the domain ontology in any University in the world.

In the domain ontology, we reused the HERO (Higher Education Reference Ontology). Starting from HERO ontology and FOAF (Friend of a Friend Ontology) we developed the "Generic Educational Nomenclature for Internationals University Structures – Ontology", that was abbreviated to GENIUS Ontology.

We believe that HERO Ontology is a good starting point but it is still too context dependent. In section two we present the theoretical foundations and some definitions of the expressions used in this paper in order to have a common understanding of the concepts. In section three we present the methodology used in this work. In section four the first stages of the research: the documentary research; analyses of university organizational structures available online; interview with domain experts for knowledge elicitation. Then, the Development of the ontology is detailed in its operational aspects: the OntoKEM methodological approach of the use of "competence questions", the outline of terms, the hierarchy of classes, object properties, data type, languages and the visualization of the ontology. Then the authors write the final remarks regarding the results and the overall value of this work.

2 THEORETICAL FOUNDATIONS

In this section some concepts are presented for common understanding and also the actual stage of Ontology development is presented. In table 1 are shown the basic concepts:

Table 1 - Standardized Understanding of Concepts

Word or Expression	Standardized Understanding of Concepts	Authors/Reference
Data	It is understood as a sign or conjunct of signs plus a syntax to express a magnitude or relation, possible to be registered in a database. The quantities, characters, or symbols on which operations are performed by a computer. Uninterpreted Signals.	Oxford Dictionary (2013); Schreiber et al. (2000).
Information	It is Data equipped with meaning.	Schreiber et al. (2000).
Knowledge	Knowledge is the whole body of data and information that people bring to bear to practical use in action, in order to carry out tasks and create new information. Know how. It is context dependent. The Knowledge is understood as a production factor Schreiber et al (2000, p. 4)	Schreiber et al. (2000).
Linked Data	It is to spreadsheets and databases what the Web of hypertext documents is to word processor files. Linked data is a technology that associate words and expressions in order to make them available and usable by humans or system agents. It is the base of semantic web.	W3C (2012).
Semantic Web	The Semantic Web is a use of the WWW for a web of data.	W3C (2012).
Tacit knowledge	It is a knowledge that someone barely is able to articulate, almost can not explain but knows how to do (procedural knowledge). The tacit knowledge may be observed in a human action and can be obtained in the analysis of a process, it remains in the artifacts in a process (systems).	Shadbolt (1999); Brown e Duguid (1998).
Explicit knowledge	Formalized and codified knowledge that can be found in: databases, memos, notes, or other types of documents, systems and artifacts.	Brown e Duguid (1998); Cook e Brown (1999); Botha et al. (2008).
Embedded Knowledge	The (most tacit) knowledge that remains in the artifacts, like systems. The organizational culture, the way things are done in the organization.	Horvath (2000); Gamble e Blackwell (2001).
Knowledge engineering	Knowledge engineering provides methods to obtain a thorough understanding of the structures and processes used by knowledge workers; Knowledge system engineering requires the analysis of the building and maintenance process itself and the development of appropriate methods, languages, and tools specialized for developing Knowledge Systems.	Scheriber et al. (2000); Studer, Benjamins e Fensel (1998).
Knowledge engineer	It may be understood as Knowledge analyst	Schreiber et al. (2000).
Knowledge model	It explicates in detail the types and structures of the knowledge used in performing a task	Schreiber et al. (2000).
Communication model	It shows the transactions between the agents involved	Schreiber et al. (2000).
Domain	It is an area of interest. E.g. Medicine; automotive engineering; biotechnology.	Schreiber et al. (2000).

Word or Expression	Standardized Understanding of Concepts	Authors/Reference
Task	It is a piece of work that need to be done by an agent	Schreiber et al. (2000).
Agent	It is any human or software system able to execute a task in a certain domain.	Schreiber et al. (2000).
Process Roles	A human may play different roles in a process.	Schreiber et al. (2000).
Tools	A piece of software that carries out a particular function, typically creating or modifying another program. May means a set of software or specific techniques	Oxford Dictionary (2013).
Application	An Application is the context provided by the combination of a domain and a task carried out by one or more agents.	Schreiber et al. (2000).
Framework	A basic structure underlying a system, concept, or text;	Oxford Dictionary (2013).
Method	A particular procedure for accomplishing or approaching something, especially a systematic or established one.	Oxford Dictionary (2013).
Common KADS Design Model	The CommonKads models together can be seen as constituting the requirements specification for the knowledge system. The design model gives the technical system specification in terms of architecture, implementation platform, representational constructs and computational mechanisms needed to implement the functions laid down in the knowledge and communication models.	Schreiber et al. (2000).
Communication model	It shows the transactions between the agents involved	Schreiber et al. (2000).

Source: Authors (2016).

The World Wide Web Consortium (2013), as the main international standards organization for the World Wide Web, stands that the semantic Web is a common framework that allows data to be shared and reused across application, enterprise, and community boundaries.

An ontology consists of a formal and explicit specification of a shared conceptualization (BENJAMINS; STUDER; FENSEL; 1998), that was based on Gruber (1993) and also in Borst (1997).

The ontology concept is related to linked data as well as to the semantic web, which means the common understanding of terms defined in data sets made available online. So, the ontology - these relationships among words - becomes available for agents (both human and automated software). They carry the concepts with definitions and their contexts; they are categorized in an explicit and formal conceptualization that can be shared. At this way software agents are able to perform different kinds of inferences and distinguish, for example, a car door from a house door depending on the specified domain.

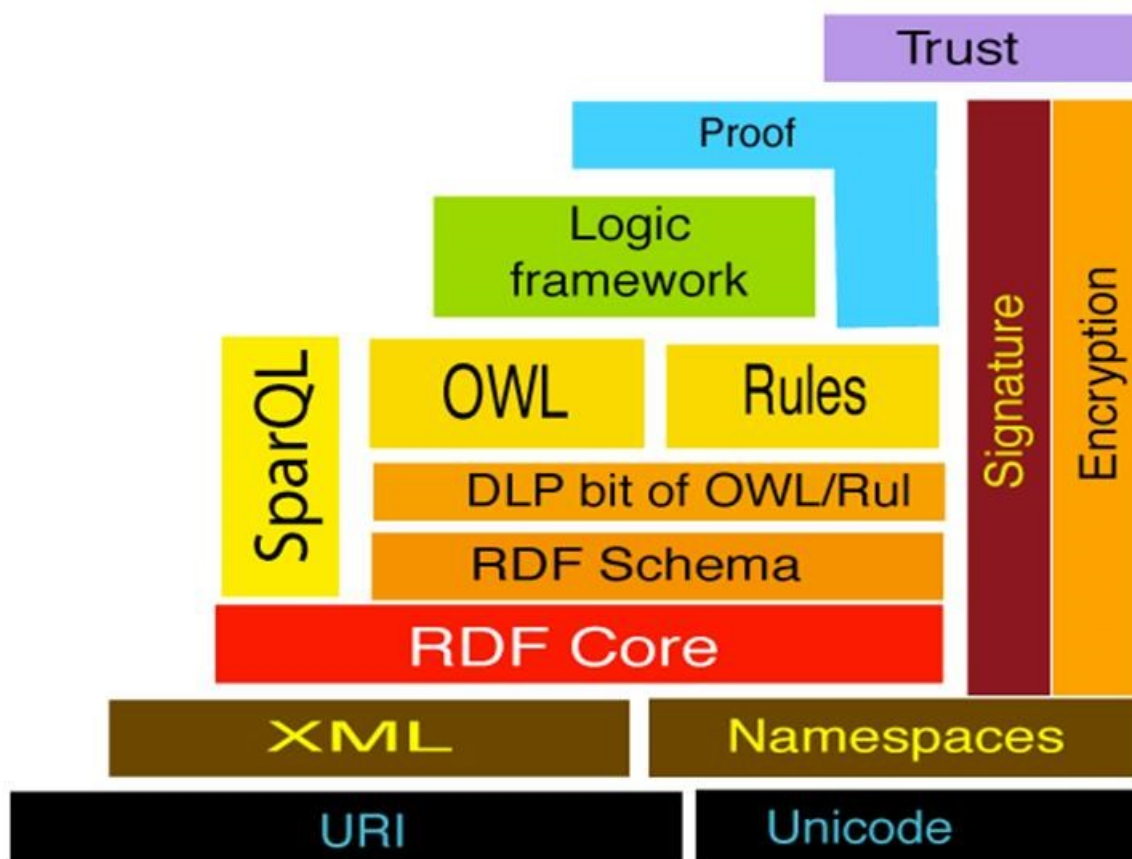
Interoperability means the possibility to change data among different systems, by agreed protocols and databases configurations. The term electronic integration (E-integration) – is also

applied by some authors, like Kaylor (2005), to designate interoperability. Lam (2005) states that to set patterns for interoperability is the key to overcome the barriers in information interchange. Guijarro (2007) presents interoperability as referencing basic technical specifications that all the relevant agencies should adopt.

Accordingly, to the Linked data organization (2014), Linked Data is about using the Web to connect related data that wasn't previously linked, or using the Web to lower the barriers to linking data currently linked using other methods.

As the leader of the W3C, Bernes Lee (2001), conducted the organization of specifications and standardization of web semantics, called Web Semantic Stack. The Unicode, XML, and namespaces are fully standardized and consolidated. Other layers are in process of consolidation like RDF Schema and OWL. The higher layers are still on discussion. The figure 1 shows the W3C conception of semantic web stack, presented by Bratt (2005).

Figure 1 - Semantic Web stack



Source: Bratt (2005).

Due to the fact this is a research and development paper, and most of the work is described step by step having a codified ontology as result, it is assumed that the theoretical references above are enough to the comprehension of this work.

3 RESEARCH METHODOLOGY

The research problem appeared when an ontology for “university department” was requested. Several ontologies were found, but none was fully reusable or would minimally fit the University’s structure. All the ontologies found had too many specificities. Then the authors realized that there was a demand for a generic domain ontology regarding universities organizational structures. Thus, the authors carried out further research and development that resulted in the GENIUS-Ontology.

The research type is analytical and applied with a domain ontology as a product. The research strategy was empirical, and knowledge based. It has several components like documentary research, open interview with experts in the area, and a knowledge elicitation strategy as defined by Schreiber et al. (2000) is used. In the development phase, we used two main tools: OntoKEM and Protégé ontology editor.

The Knowledge field is multidisciplinary being composed mainly by Knowledge engineering, Administration, Information Technology, Computer Science and more specifically the theme of ontologies.

The research approach is qualitative, based on research and development. In the first phase it was exploratory, researching for existent University ontologies or other potentially reusable ontology to meet the established purpose. Then it was developed a documentary research in universities organizational charts available online. Based on the organizational charts, the HERO, and Friend of a Friend Ontologies, the “alfa version” of GENIUS-Ontology was developed. Subsequently a domain expert was interviewed in several rounds in what we may call a process of knowledge elicitation to ontology development. The Interviews were open and unstructured and the questions were implemented as doubts raised along the development of the ontology. It was also used two main tools: OntoKEM and Protégé ontology editor to develop the ontology.

Thus, the research was structured in four stages: 1. Documentary research; 2. organizational structures online; 3. Interview with an expert in the area of knowledge; 4. Ontology development.

4 FIRST STAGES OF RESEARCH

The documentary research had two steps: first the search for existent university ontologies, second the search for different university structures, careers and roles.

4.1 UNIVERSITY ONTOLOGIES

A set of ontologies was researched in the online repositories of ontology reuse. This specific stage of research had two main objectives: to confirm or not the hypothesis that there was not available a Generic Domain University organizational ontology, that motivated its development by the authors. The second objective was to analyze each ontology for possible re-usability. It means that, if none would fit the objective of generic domain ontology capable to be easily applied to any University, the ontologies found could at least to bring some definitions and relations to be reused and expanded in its development to reach this objective. So, this stage of research was developed as presented in table 02, in which are registered the repositories searched, the ontology analyzed, the self-description of the ontology, and our analysis regarding its suitability for reuse:

Table 2 - Search for ontologies

Repositories	Ontology	Description	Analysis
Protege Ontology Library	FOAF Ontology	An ontology that describes people, the links between them and the things they create and do.	It has a lot of useful definitions of agents in organizations. It was chosen to be reused.
Protege Ontology Library	HERO ONTOLOGY	HERO stands for Higher Education Reference Ontology which provides consensual knowledge model of university domain.	The most embracing University Domain ontology found in the repositories. Other positive aspect is the organizational approach. It was also chosen to be reused.
Protege Ontology Library	Institutional ontology	Institutional Ontology is a model of a University/ Institute	It was a border line ontology. Although the name suggests an institutional ontology, it was more an operational ontology than a Organizational Domain ontology, therefore it was discarded. Since the more operational, more specific the ontology tends to be, the authors preferred to develop some concepts from the research than have it already defined.
DAML Ontology Library	Academic Positions	Ontology describing a *fictional* employment hierarchy based on many of the positions available at the Robotics Institute, CMU.	Too specific, focused in engineering faculties.
DAML Ontology Library	academic department	An ontology for describing universities and the activities that occur at them.	Also too specific for a generic Domain ontology since it focus on operational aspects.

DAML Ontology Library	Indian University Courses	Computer Courses taught in the Department of Computer Science, Tezpur University (India), similar to most of the computer Science courses taught in India.	Very specific for a generic Domain ontology.
http://watson.kmi.ox.ac.uk/WatsonWUI/	University/ Departments/ computer/statistic/mathematics departments	Set of Owls files without description.	Each file was opened in Protégé ontology editor and analyzed. All of them was focused on departments or was too specific for the context in which they was created.
Swoogle	-	No significantly results were found.	Swoogle is an online search tool with option to search for ontologies. In the research made, nothing besides the already known ontologies was found.

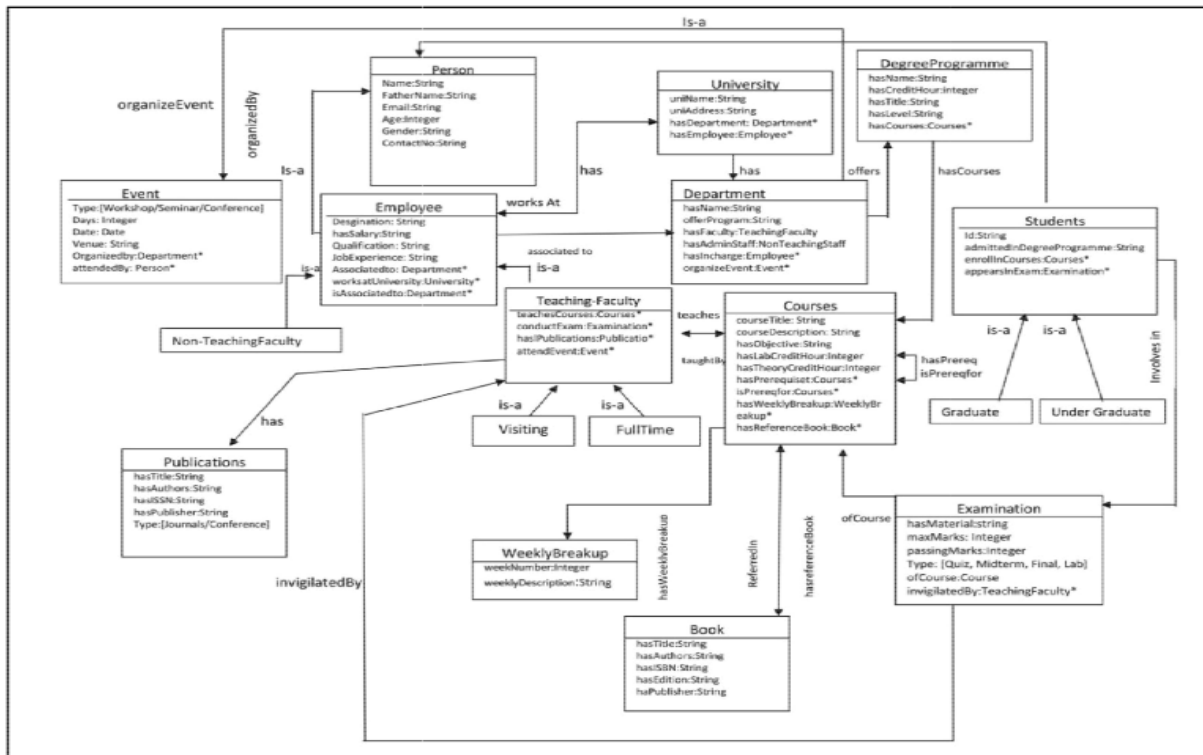
Source: Authors (2016).

To ensure that, it was realized another documentary research, now looking for scientific papers about the topic. Bawany and Nouman (2013) presented an Education Domain ontology. While their focus was in the educational process, ours is in the University organizational structure and roles. It is worth to mention that they may complement each other or have some small overlaps. The work of Bawany and Nouman (2013), specially the “General Layout of University Ontology”, is presented in figure 2.

Another ontology reused was the Friend of a Friend (FOAF), since this library already provided some semantic definitions. The authors considered FOAF ontology useful as a pattern that would make it easier to use due to the broad adoption of this ontology.

We were careful to keep their main settings. However, a number of adaptations to the reality of various organizations in different countries were necessary. In the use of ontologies - specially in HERO ontology - the addition of new terms was necessary to perform some equivalences of terms used in a set of universities researched.

Figure 2 - General Layout of University Ontology



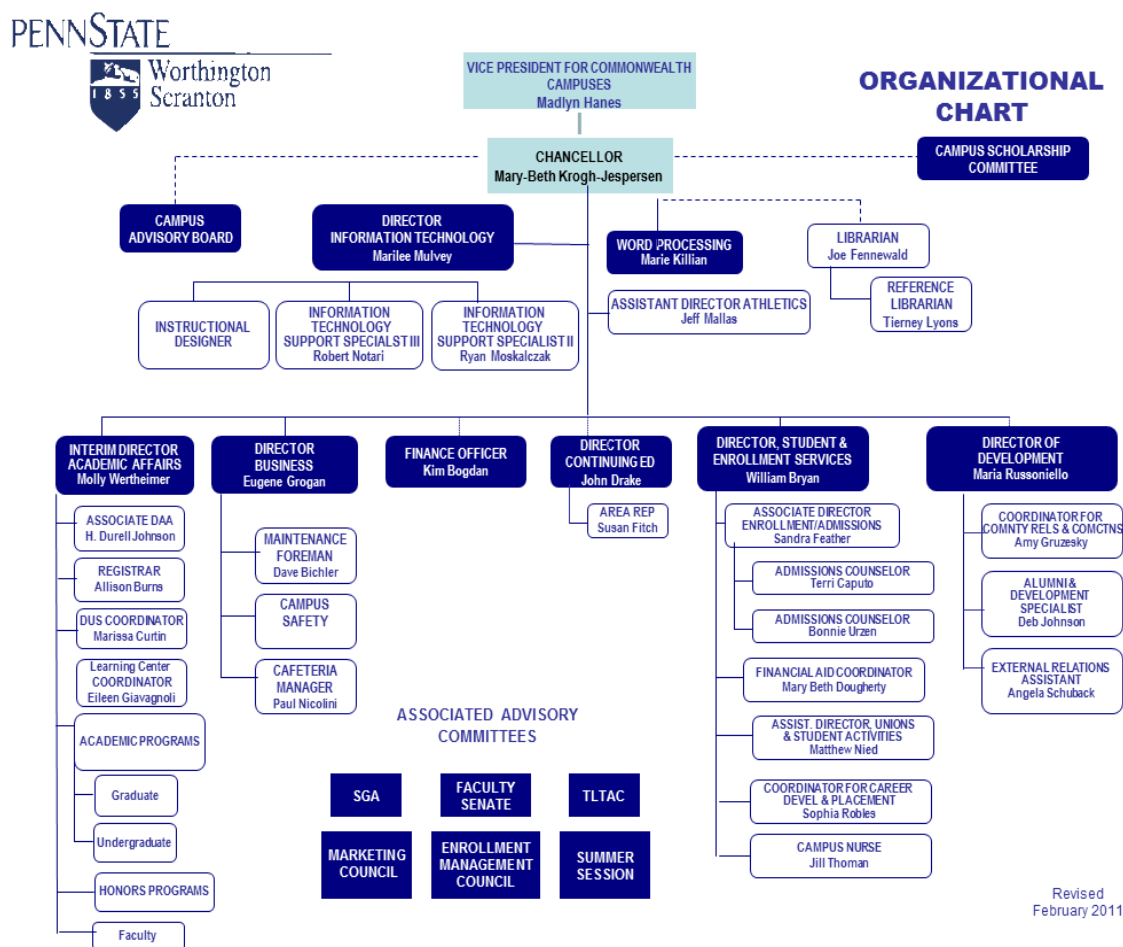
Source: Bawany and Nouman (2013).

4.2 UNIVERSITIES ORGANIZATIONAL STRUCTURES - ONLINE RESEARCH

We searched in several universities websites around the world the differences, similarities, and categorization styles around the main topics, which are: organizational model (departments, colleges, faculties, employee roles and so on), teaching career, as well as student and technical staff among other elements.

The online research was performed all along stages three and four. We consulted several Universities such as private, community, and public in different countries but mainly in Brazil, United States of America, United Kingdom, and Germany, although much other countries appeared during the research. It was realized two major branches: the first search branch was about “organizational/faculty hierarchy”; the second search was related to “University Organizational Chart”. The figure 3 shows some examples of organizational Chart analyzed.

Figure 3 - PennState University organizational chart



Revised February 2011

Source: PennState University

These procedures were carried out simultaneously with the interviews with experts that will be described in the next section.

4.3 EXPERT DOMAIN INTERVIEWS

The purpose of this step was the knowledge elicitation process. Interviews with the domain expert took place in a five months time frame, four hours per week. These data were important to analyse the equivalences of concepts. The interviews were open and unstructured, conducted personally by the authors.

As in Schreiber et al. (2000), the expert interviewed was a very experienced technician, a university employee that has worked with several organizational units and lived as different institutional roles (technical staff, graduate student and some teaching, community member). Since he had to develop most of the university information systems by himself, he already knew

the limitations of the organizational model. Because of his contacts with another software developers in different universities, few doubts were solved by telephone. The knowledge elicitation was conducted in rounds. The researchers spent some time searching for Universities organizational structures. Then some structures with similarities and differences were selected to be discussed with the domain expert on how to deal with these issues. These selections of cases and the conducted discussions happened in rounds with the expert domain. So, we developed the most generic ontology possible to embrace the necessary concepts in a reusable manner.

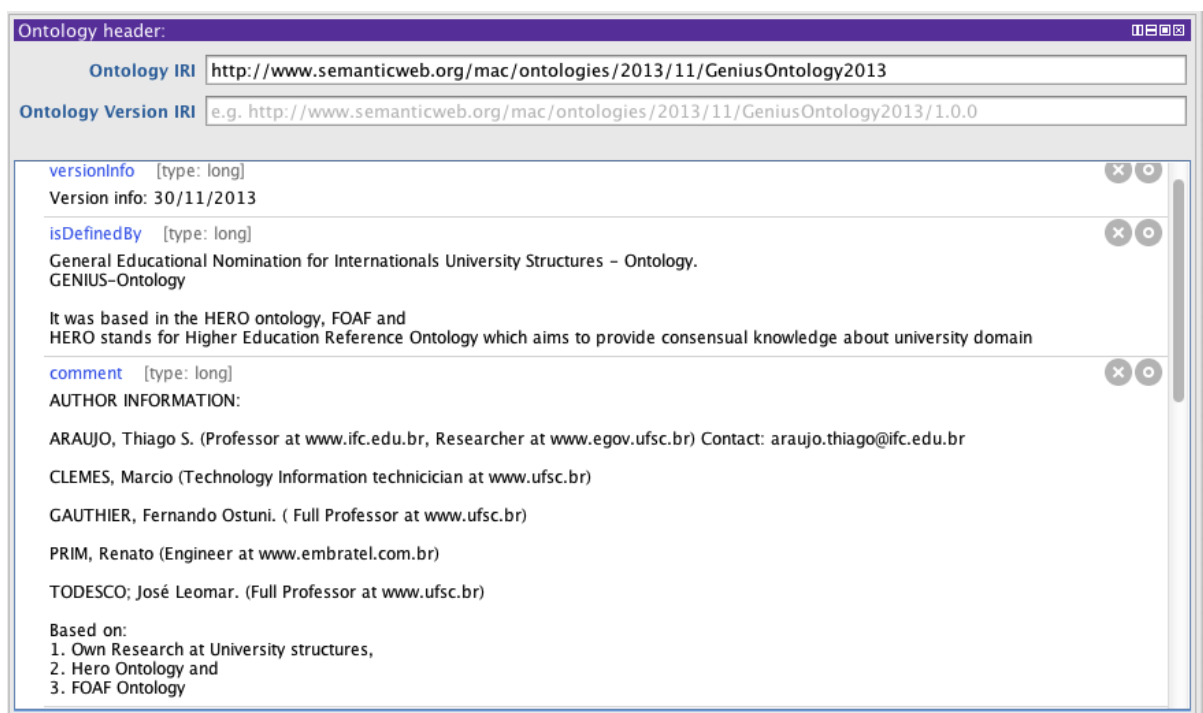
4.4 ONTOLOGY DEVELOPMENT

This effort is a research and development work. The ontology emerged as a direct product of the previous stages of research, and was performed all along stages two and three, and it is detailed in section 5.

5 DEVELOPMENT OF THE GENIUS-ONTOLOGY

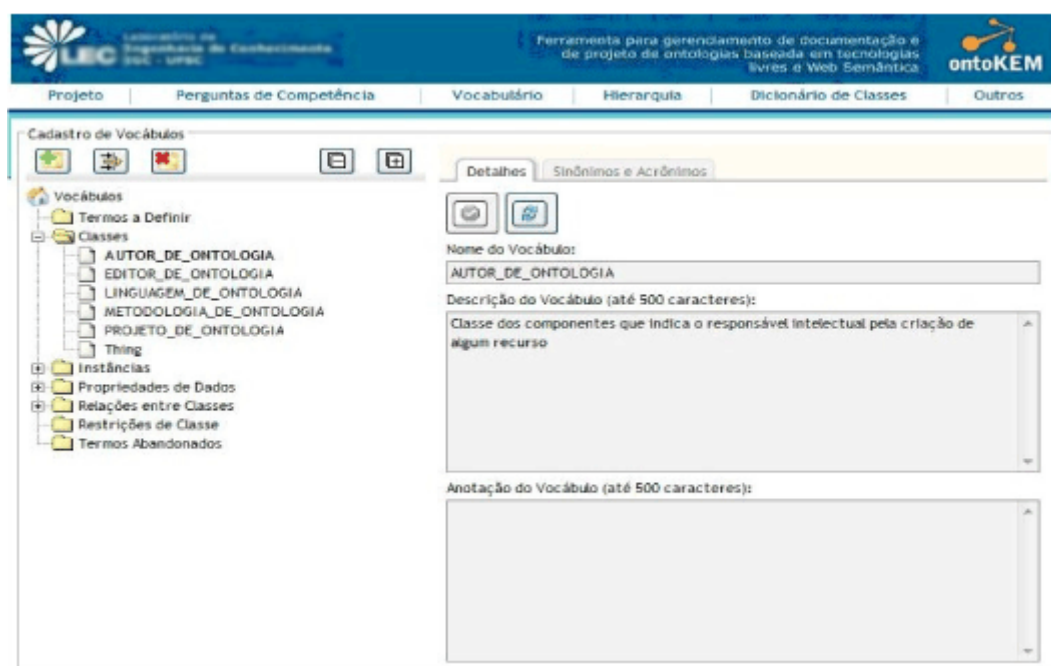
In the Ontology Header presented below it is registered the basic information about the GENIUS Ontology.

Figure 4 - Ontology header



Source: Authors (2016).

Figure 5 - OntoKEM interface



Source: OntoKEM website (2016).

To the purpose of this work it was understood that the best software available for the GENIUS-Ontology development were the OntoKem and Protégé.

The OntoKEM (2009), is a tool for ontology construction based on the methodologies 101 (NOY; MCGUINNESS, 2008), On-to-Knowledge (FENSEL; HERMELEN, 2008) and advance architecture (GOMEZ-PEREZ et al., 2004). Its interface is shown in figure 5:

The OntoKEM methodology comprises the creation of “competency questions”, which will work as a base for the creation of terms.

In this sense, the OntoKEM is a tool to document management and ontology projects based on free and semantic web technologies. This tool adopts the methodology that assists ontology development. The steps consisted in: elaborate the questions of competence, define hierarchy and then outline the taxonomy. The terms were listed using OntoKEM and then defined in this tool.

Later, it was used the Protégé tool. This software guides the process of creation of classes and instances. The combination of methodologies becomes interesting through a process of ontology construction.

5.1 QUESTIONS OF COMPETENCE

Following the OntoKEM methodology it was developed the questions of competence with the objective to identify the structures existent in the Brazilian Universities, since there is already a big variation of organizational structure in Brazil. These competence questions will be shown in figure 6. Later the questions were rewritten thinking in universities in other countries.

In a third stage, the HERO ontology was considered, the terms were compared and consulting the expert and researching universities structures the terms were refined and standardized in a generic domain ontology to meet the needs of most universities by find equivalent terms for similar relative positions in a university organization. Thus, the taxonomy was completed.

So, in this first stage the outputs from the competence questions were just a draft. The competence questions rise a series of other questions about organizational structure that leads to discussion and knowledge elicitation in sessions with the expert. A great functionality of OntoKEM is the possibility to work online collaboratively, since it is web based. With some accounts authorized to work on the same project it was useful to collaborate online in the OntoKEM using Skype, for example. These first insights of terms were exported from OntoKEM and imported into the Protégé tool.

5.2 INITIAL OUTLINE OF TERMS

The initial list of terms was constructed based on the competence questions using the OntoKEM tool, based on the competence questions (figure 6). It was just a first raw set of terms that arose to be the most common in universities.

Figure 6 - Competence questions, suggested terms and suggested relations

Question of competence	Suggested terms:	Suggested relation:
How do the Academy organizes itself about time academic periods?	AcademicTerm	
	AcademicYear	
How it is organized the hierarchies of the departments?	AdministrativeDepartment;	Has minimum of 1 employee
	Boss	
	ProRector	
How post graduate is organized?	GraduateCourses	HasMember Students enrolled
What are the components of the campus	SpatialThing	
	Location	
	Campus	
	Building	
	CampusDinningHall	
	CampusHall	
	Dormitory	
	Laboratory	Has minimum of 1 ResearchGroup
	UniversityHospital	
	UniversityLibrary	HasStaff
What kind of agents are related to the University community?	CommunityCenter	
	FosteringAgencies	ProvidesFinancialAidTo research, students; teacher
	Foundations	ProvidesFinancialAidTo research, students; teacher
	PrivatePartnerRDFinancialSupporter	ProvidesFinancialAidTo research, students; teacher
	PublicSectorGovernment	
What are the activities of teaching, what are the levels of education existent in universities?	BasicEducationalStage	IsEducationCenter
	DoctorateCourse	IsEducationCenter
	Undergraduate	IsEducationCenter
	Master	IsEducationCenter
	Specialization	IsEducationCenter
What are the extension activities in Universities?	AcademicCommunity	
	ExtensionCourse	Has Students

Source: Authors (2016).

A lot of these terms were discarded and others were included in later stages of the ontology development.

5.3 HIERARCHY OF CLASSES / TAXONOMY

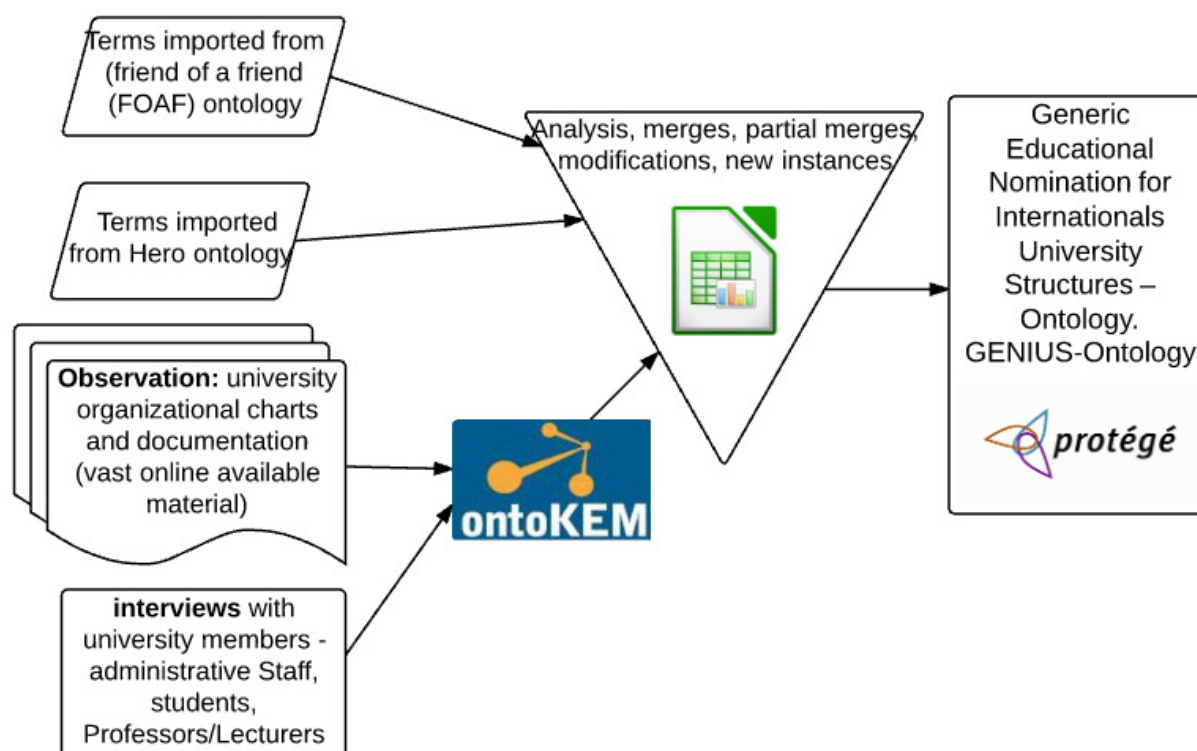
The development of the Hierarchy of classes (taxonomy) was accomplished by a top down approach and a spiral methodology. First it was structured using the OntoKEM tool, then it was

adjusted in a spreadsheet and finally it was developed a final version using the Protégé Ontology editor. The first Cycle of the spiral development was deployed using the OntoKEM tool as presented below at figure 7.

Then it was developed a worksheet to compare between universities in different countries and traditions. The different nomenclature for similar structures such as the denomination of faculty, Course, School, college and so on was identified. At this way authors intended to generalize terms to create a set of universal concepts that would fit for most of University organizational structures.

The follow worksheet was elaborated (in portuguese) based on the OntoKEM classes and Other classes from other ontologies to structure the equivalences among terms.

Figure 7 - Adjustments Worksheet



Source: Authors (2016).

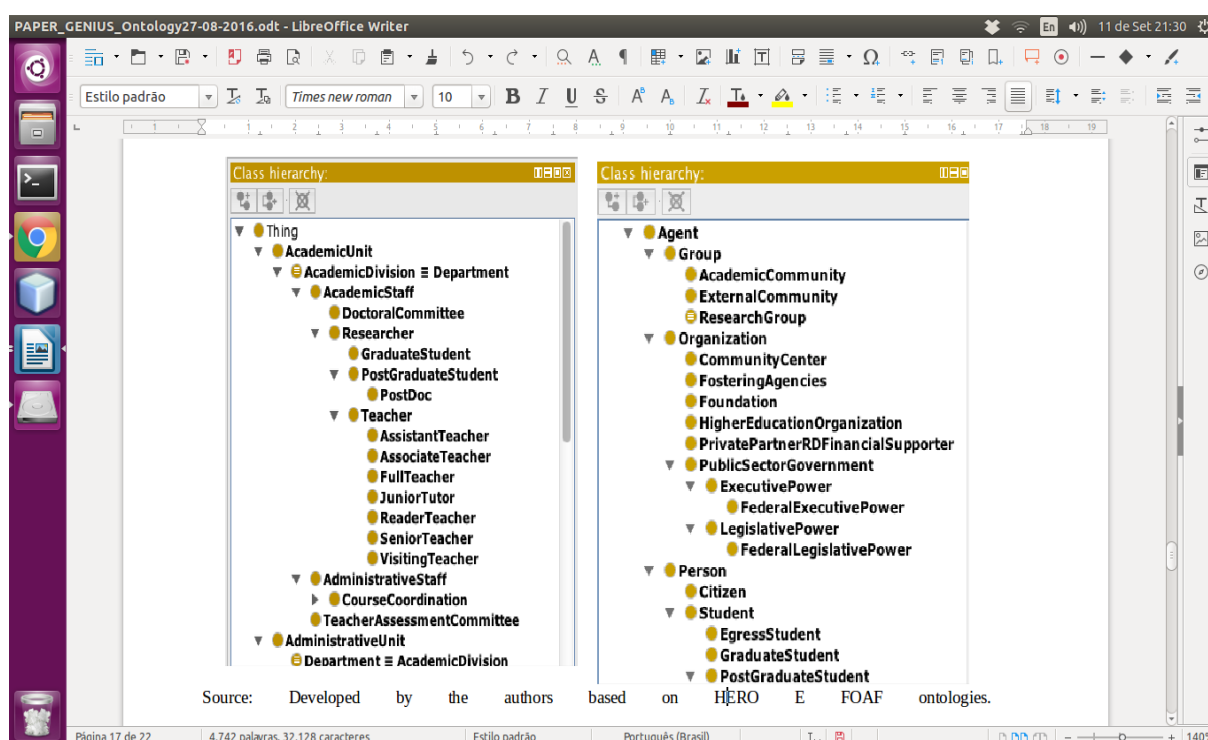
Therefore, based on the research of the ontologies and organizational structures, the questions of competence were created in the OntoKEM tool and adjusted in the worksheet as shown in figure 6. The strategy of Ontology development applied and encouraged was to, in some cases, permit the creation of classes with no subclasses. This was done to try to keep always

a more generic domain model, to promote a future expansion and create more flexibility possibilities.

After the elaboration of the Taxonomy in the OntoKEM, all the taxonomies and terms were adjusted in the Worksheet and then inserted in the Protégé Ontology editor. Hence, this is the highest contribution of the Ontology: the taxonomy and all the terms developed with wider definitions for each necessary terms, with a large set of equivalences possibilities.

Although many terms were reused or redefined from the HERO Ontology, the contribution of the GENIUS-Ontology is the Generalization of most of the terms, and creation of new ones with extensive definitions, making possible to use this ontology in almost any University organization around the world. It is a generic domain ontology for the university organizations. In this way the structure of classes was set as shown below:

Figure 8 - Class Structure



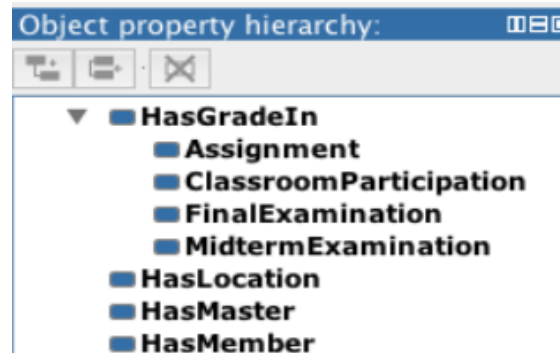
Source: Authors (2016).

5.4 OBJECT PROPERTIES

Some of the terms raised in the beginning of the study were later identified as object properties. These Object properties and some other identified properties were then put together

with the HERO and FOAF object properties to fulfill the GENIUS-Ontology using the Protégé Ontology editor.

Figure 9 - Object properties



Source: Authors (2016).

The Object properties were developed allowing domains with wider and more generic Ranges. This flexibility was developed with the objective to elaborate an ontology that would be able to be compatible with several University Organizations in different contexts, including different countries. An example of this strategy is the use of the Class “AcademicUnit” (figure 10). The AcademicUnit class allows to embrace a large set of terms used in different universities in their organizational models. Anyway, there will always exist some kind of “Academic Unit” that may be a faculty, a college or similar designation for an organizational unit to execute this role. This strategy makes easy the direct use of the GENIUS-Ontology to any University Organization.

Figure 10 - Ontology development strategy example

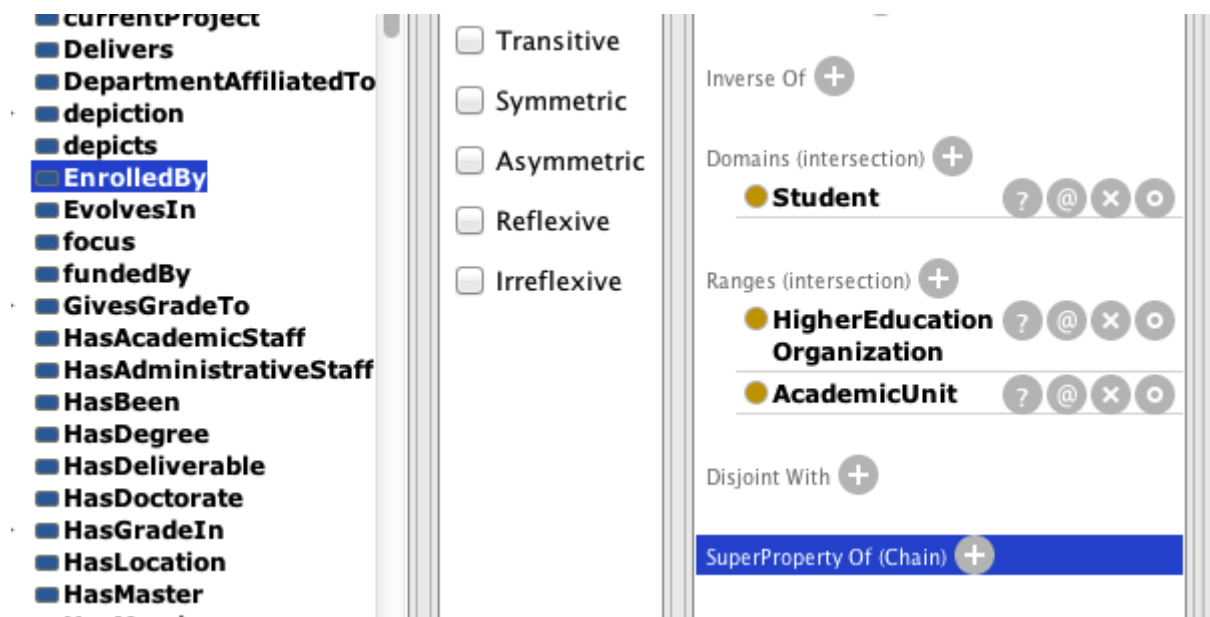


Source: Authors (2016).

Similarly, it was developed a generic subclass “AcademicDivision” and indicated the equivalence with the department term, already existent in HERO Ontology. So, it was possible to reuse some properties and relations of this class. Because of that it was possible to also reuse some properties as well as relations of the class.

Yet it was done several improvements. For example, the Student domain was considered subscribed only in one “HigherEducationOrganization” (Range). To satisfy different realities identified in the research this range was enlarged to the AcademicUnit class, and consequently to the “AcademicDivision” (subclass) which was set equivalent to Department, as one can see the ObjectProperties on figure 11:

Figure 11 - Wide range ontology development strategy example



Source: Authors (2016).

This is a typical example of the preference for flexibility in the ontology developed. Other example is what was considered "deliverables" of University organization (figures 12 and 13). The class “Delivers” in HERO ontology only had as domain “Department” for the range degree. In GENIUS-Ontology it was added as Domain for that class, the entire “AcademicUnit” and as Range the Class “Deliverable” as follows:

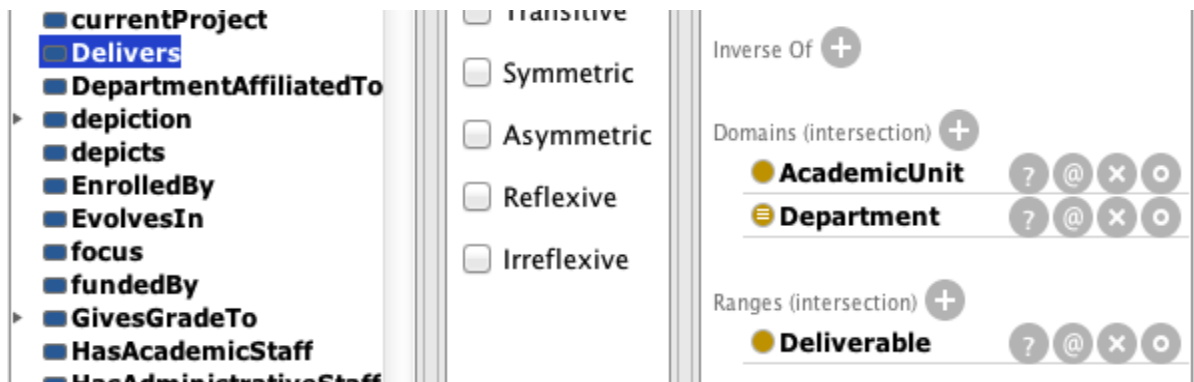
Figure 12 - Wide range ontology development strategy example 2



Source: Authors (2016).

Therefore, the Domain becomes more adaptive to different university organizations structures, as the range becomes wider. This approach increases the possibility of GENIUS-Ontology reuse directly without modifications, although some adjustments may be convenient to specific contexts.

Figure 13 - Domain specification example



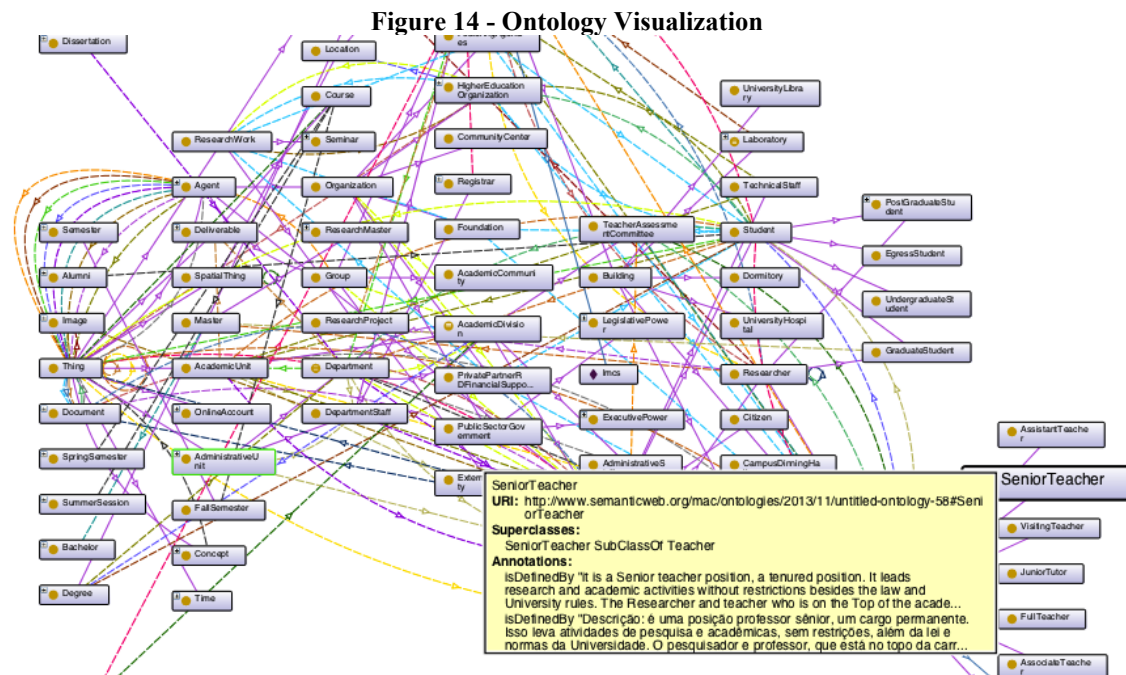
Source: Authors (2016).

5.5 DATA TYPE

Finally, it was added some data properties in the GENIUS-Ontology in the Protégé Editor completing the OWL file.

5.6 ONTOLOGY VISUALIZATION

Bellow there is the visualization of the ontology generated by the OntoGraph Plugin:



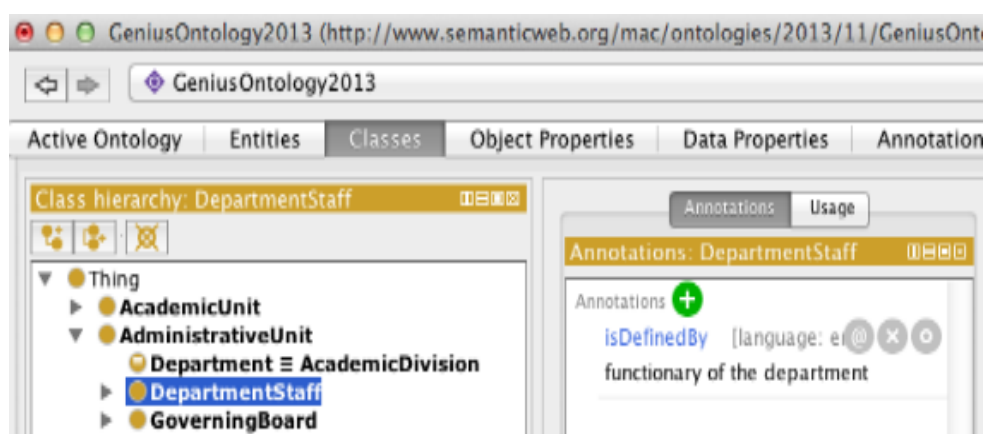
Source: Authors (2016).

5.7 LANGUAGES

First the ontology was developed in English, the most used language in the academic world. Afterward, from the generic and flexible definitions in English it was translated into Portuguese, by adding a new language in the Protégé Ontology editor. It is an easy procedure and may be done fast with a small team – like 3 persons - of experienced teachers and university staffs in around 12 hours of work. The procedure is indicated here:

1. Select the term that will be translated into in a new language (e.g. DepartmentStaff)
2. Add “Annotations” (the plus signal detached in green)
3. Next go to “Annotations” and add a “isDefinedBy”. This will open a field to type the new language translation keeping the already existent untouched. In this case it was added the Portuguese translation keeping the English definition. This procedure of translation to Portuguese was done to all terms and object properties existent in the ontology.

Figure 15 - Languages



Source: Authors (2016).

5.8 FINAL REMARKS

The research and development work was carried out in four stages: 1.Documentary research, 2.organizational structures searched online; 3. Interviews with experts in the domain knowledge, 4. Ontology development. Then, the Generic Educational Nomenclature for International University Structures Ontology, the GENIUS-Ontology was developed. Due to the goal of being a domain ontology for universities, it needed breadth and flexibility to enable wider application. Therefore, most of the possible restrictions in ranges were withdrawn. With the same objective, specific terms were taken and new equivalent and generic terms were added on the mentioned re-used ontologies.

Thus, it allows the Universities examine in their specific case what restrictions should apply. In the development of the ontology this means that in the description "Disjoint with" property was applied very rarely, when the occurrence really should not be plausible in any case. In the case of the Federal University of Santa Catarina in Brazil, the authors consulted the domain expert and concluded that virtually all roles (citizen, teacher, student, employee, etc.) can be played by the same individual simultaneously. A junior teacher may be a PhD student in another department or even in the same department in rare cases, but they exist. This same person is a citizen, a community member, a computer user, an employee, may live in the campus, and so on. Although some universities will not allow some of those combinations, others may allow. So, to maintain the Generic use characteristics, by default the restrictions were set on the lowest level.

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