

Towards an Ontology for Health Complaints Management

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Abstract: The dissatisfaction of healthcare institutions users has increased in Portugal in the recent years. This fact can be seen through the increase of complaints that the entity responsible in this country has been receiving lately. More and more technical efforts has been done to understand and analyse this tendency. In this paper the authors are proposing an ontology about the whole process of complaints management from healthcare institutions. All the work was developed after analysing the entire process and the data collected by the entity responsible with this matter in Portugal. The ontology developed can show the main concepts involved in the process and the relationship between them. As main ontology entities are person, document, measure and status.

1 INTRODUCTION

Nowadays the entity which is responsible for complaints management in healthcare area in Portugal collects a large volume of data every day. A very large part of the data collected states real problems being most of them associated to services provided to the healthcare institutions users. This fact results in a growing necessity of developing analysis in this area by discovering an adequate answer to the complaints in order to solve the problems and improve the quality and efficiency of services provided in healthcare units.

This article aims to explore and develop an ontology focused on the health complaints management area as a way to specify and organize all the knowledge involved. In this study a formal representation of all knowledge by structuring a framework based in concepts and informational classes involved in the management process and through the semantic relationships between them are proposed.

The development of this study is the first phase of a project having as goal to develop real-time models able to make automatically classification and recommendations in the complaints management system by exploring date and text mining techniques.

In this way in this phase an ontology about complaints management that can be integrated in the project previously referred was developed. This ontology is capable of making an exactly translation of the whole management process and at the same time can be reutilized in similar projects.

The work were performed with the help of the Portuguese Complaints management institution. The ontology developed in now being implemented.

In order to fully understand the information in this article, initially in Section 2 it is an analysis of the state of the art which will be briefly spoken about the institution that enabled the proper development of ontology providing information about all the complaints. In this section it is explained the process and the various entities and concepts involved in the process. This section also describes the ontology and complaints concepts. Here some information about where users can submit their complaints as a constitutional right and why it is so important to realize studies and analysis about complaints are provided. To finalize this section the motivations that lead experts to analyze complaints and the contributions which they provide to the scientific community are also discussed.

In the third section of this article a description of the ontology is performed. This section starts with an exact designation of the whole process involved in the

complaints management in healthcare units. As the section name indicates the ontology is presented specifically through the respective diagram, relying on a description of all classes, concepts and properties involved.

The fourth section is dedicated to discuss the work and respective results. In this section is discussed the relevance of the effort employed in this project as a contribution to the scientific community and the usefulness of the project in a real context domain.

After the discussion there is a conclusion section where the last ideas about the work and the next steps of this project are presented.

2 STATE OF THE ART

2.1 Complaints Management Entity

The entity involved in this project is a Portuguese entity of public nature having the mission of regulate all the activity developed by health care provider's establishments (Lobo, 2004).

This institution has the skills to cover the national network of the health care public and private services. Primarily concerned with the protection of user rights and basic principles of public service, namely the universality and equality of service access, safety and quality of care (Simões, 2004).

In recent years, as part of its functions, this organization has targeted the exercise of mainly regulation in two dimensions: economic, to fix prices, control the production in health establishments, and on a social dimension, humanizing services and monitoring the compliance of users rights (*Relatório sobre "A carta dos Direitos dos Utentes"*, 2011).

2.2 Complaints

According to the current legislation in Portugal, all health care institutions users have the constitutional right to pursue and formally complain about the services provided, when they are not adequately treated (*Relatório sobre "A carta dos Direitos dos Utentes"*, 2011). This system also can be used to make a *louvor*. The complaints has not only the goal to present the negative aspects but also can be used to expose the most positive aspects.

All citizens as users of health care facilities have the constitutional right to complain (negative or positive) about the service or the way of they had been treated. Effectively this right gives a clear and perceptible response in health matter. It is one of the majors concerns of the regulator entity. It is very

important to have a proper processing of all complaints and expositions of displeasure by the users. The main goal is allowing a better assessment of the weak points of the national health system and identify areas requiring further intervention.

In 2009, the regulator entity received a total of 7848 complaints related to health services, and most of them were related to waiting times and quality of administrative assistance and health care. Thus, the claims are a good indicator of the response that the people expects receive in health care facilities. The complaints handling process, should reflect the needs and expectation of users as well shall be in accordance with the objectives of organizations (Firmino, 2011). A correct management of complaints clearly affects the sense of justice and satisfaction of users, strengthening the bonds of loyalty of users to the institution concerned. An effective and efficient management of complaints could result in organizational success on a highly competitive market of direct competition, as is observable in the health sector.

2.3 Ontologies

In recent years an increase use of ontologies was observed, migrating from artificial intelligence (AI) laboratories for the personal computers of experts in the field (Gruber, 1993; Noy and McGuinness, 2001).

The concept of ontology has a Greek origin and it was originally formulated by Aristotle being described in philosophical Oxford dictionary as "[...] term derived from the Greek word meaning "to be", but used since the seventeenth century to denote the branch of metaphysics that means of what exists" (Almeida and Bax, 2003; Blackburn and Marcondes, 1997; Guarino, Oberle, and Staab, 2009). Since then the concept has generated a lot of controversy and several authors have set out differing views on the concept depending of the context in which it occurs.

Today ontology is treated as the "science of being" and this definition also may lead to different interpretations (Pisanelli, 2004). The Webster's dictionary defines ontology in two perspectives:

- The branch of metaphysics related to nature and the relations of being;
- A particular theory of nature of be and all his types of existence (Pisanelli, 2004);

In 20th century, the area of artificial intelligence decided adopt the theme and plot their own perspective and it is interpreted as a "specification of a conceptualization" in the context of sharing knowledge through data (Gruber, 1993; Pisanelli, 2004; Yao, Orne, and Eitzkorn, 2005). It is possible to

verify that ontologies are constantly used in the field of computer science, and in some ways they are seen as a very particular and special type of informational object or computational artefact (Guarino et al., 2009). In that view, an ontology can be defined as a formal and explicit specification of a shared conceptualization, where formal specification refers to something that computers are capable to read and to explicit the concepts, ideas, terms, properties, relationships, functions, constraints and axioms explicitly defined. Conceptualization is an abstract model of some phenomenon of the real world and for sharing it we can understand an idea of consensual knowledge (Borst, 1997; Morais and Ambrósio, 2007).

This is a technique characterized by defining a common vocabulary for researchers who need to share their knowledge and their discoveries in a certain scientific field. Here it is included a definition of a context interpretable by computers able to characterize the core concepts of a field of study and the relationships between them (Noy and McGuinness, 2001).

Several authors claim that the reason for the development of ontologies is directly related to the sharing and reuse of knowledge by sharing the understanding of the information structure used and worked among software and people. However ontologies also facilitates communication by enabling humans and machines to make assumptions about an explicit domain.

In practical terms ontologies define a language, like a set of terms and concepts that will be used to formulate queries or research information. The ontology in this view could define the combination of rules between terms and their relationships. These relations are established by experts after intensive study of the project area. Ontology users carry out informational queries through specified concepts and terms (Almeida and Bax, 2003; Morais and Ambrósio, 2007; Obitko, Snásel, and Smid, 2004).

Increasingly, the branch of ontologies has been proving its merit in the scientific community asserting itself as an effective way for modelling data collections within the user's context. They can be seen as a powerful and useful tool for presenting overviews of a particular theme of study related to a specific scientific area, formulating a rapid and appropriate means for navigation and search of data and information. In order to summarize the model of concepts and relationships provided by ontologies, a high level of abstraction is used. They provide to humans a rich semantic level with the formality level required to develop a processing and mechanical

reasoning through computers (Golemati, Katifori, Vassilakis, Lepouras, and Halatsis, 2007).

The development of an ontology requires the use of a specific vocabulary in order to describe a reality as well as a collection of logical axioms to give semantics to the intended meaning by the words of a vocabulary. On the development of an ontology we always need to use the following objects (Martins, 2002; Pickler, 2007):

- Entities, that describes concepts and are responsible to give the logical representation;
- Attributes, that are responsible for describing the properties of the entities involved;
- Relationships, that are responsible for describing the connections exists between objects of a model;

On the development of an ontology, Aldo Gangemi (Gangemi and Presutti, 2009) defends the existence of two kinds of ontologies, being the first designed Coverage-oriented ontologies covering the terminology, metadata or folksonomies respecting to a specific domain and being the second kind designed as Task-oriented ontologies. This type is able to structure a knowledge base that can be used to answer competency questions.

In the study of a specific scientific area must be defined a perspective to use in a way to capture knowledge or to identify the principles concepts that will be used in the ontology and the relationships between them. For that purpose there are three approaches that can be used and integrated into the knowledge capture activity being them the Top-Down approach, the Bottom-Up approach and the last the Middle-Out approach.

Currently more and more ontologies have been developed for many different areas. One of the areas where ontologies have been more prominent is medicine, where it is focused on the representation and organization of medical terminologies. Several applications based on ontologies and their perspectives have been developed in the health care sector, and their benefits have been proved at the level of development of information systems dedicated to health. These systems are systematically more powerful than before and they are more capable of interoperability. At the level of medical patient data the application of ontologies helped to improve the transmission, reutilization and sharing process of information, and also provided contributions in statistics for many different purposes in healthcare sector (Pisanelli, 2004).

Nowadays there are ontologies dedicated to the specific area of customer management and for managing the relation with them having as a

fundamental factor their level of satisfaction. Several ontologies are actually focused on detection of health problems and diseases for doctors, but there is not yet a single ontology that can be capable of deal directly with the area of complaints management in health care units.

This type of complaints has a complete different characteristic. The complaints are obtained from simple commercial establishments of direct transaction and distribution of products to the final consumer. One of the main distinguishing characteristics of complaints obtained from health care providers units is the fact that in a simple complaint the protestant can claim about several aspects related to the attendance, to the service and the infrastructure, as the waiting time and could be also of medical aspects involving several different areas of study.

3 ONTOLOGY DESCRIPTION

3.1 Problem Contextualization

As above stated, this ontology focuses its intervention on the field of complaints management in healthcare units. It was developed relying on the information collected from the Portuguese institution responsible for the regulation of complaints (*Relatório sobre "A carta dos Direitos dos Utentes"*, 2011).

Therefore and taking into account the concepts and rules assimilated from many different articles and studies focused in the field of ontologies, it was extremely necessary during the development process take into account two main perspectives: the first perspective is related to the embodiment of this work in developing an analysis system for complaints, from the perspective of who provides data for the informational ontology chain (protestant, complaints respondent and the regulatory institution) and the prospect of future utilization of this ontology by experts from the scientific community on similar projects.

The users of a health care services unit have constitutional right to make a complaint (positive or negative) of the service that was rendered them always they feel the need to do so. For this valid reason in all establishments (public or private) there are always a requirement to submit the book of complaints and it is mandatory to provide it to customers freely whenever this book is requested.

The book in question is dedicated solely to receive complaints, and has a unique structure being exactly

equal for all establishments in the Portuguese health network. In this way when a client begin to formulate a complaint on this book, this can be seen as the first stage of the entire complaints management process. The user of a health care unit who produces a complaint in the book, is referred to this stage as the Protestant and initiate the stage by the formulation of the informative fields concerning with personal information identifying the person who claims by name, civil identification number, address and telephone number. Then and still filling the complaint, there is a supply of information relating to the person or institution who suffers the complaint and the Respondent. Finalizing the formulation he writes information relying with the claim itself i.e. writing the subject of the complaint choosing a category or type to designate the document and finally the writing of the text which the reason of dissatisfaction / satisfaction of the Protestant that lead to the formulation of the claim itself is explained. In conclusion of this first stage it remains to say that filling the complaints book is not the only way for the Protestant presenting and sharing his claims about a service, this action also can be done by writing the complaint directly on the web portal (formulary is equal to the book) of the institution that regulates health care complaints in Portugal.

Posteriorly all the complaints are collected and they are sent for analysis by the responsible institution. The analysis process is conducted by a detached agent of the institution, which oversees and reviews all the information of the complaint He determines whether it is well categorized. Then he processes it into the institution system using the Protestant and the Respondent personal information and writing an informative synthesis of all complaint subject.

After the complaints processing stage be completed there is an analysis phase which the central issue of the document is the complaint study. In this phase a corrective measure to solve the problem identified is created. It is communicated and shared to the respondent of the complaint in order to solve the problem.

If the measure outlined by the institution is well applied by the Respondent the problem is solved and the case is finalized. Then the complaint in matter is officially archived. When the measure drawn is not capable to solve the identified problem or do not return the expected result, there is a communication between the regulatory institution and the Respondent of the complaint to study the reasons of why the problem was not primarily solved or why the measure was not adequate initially to the problem.

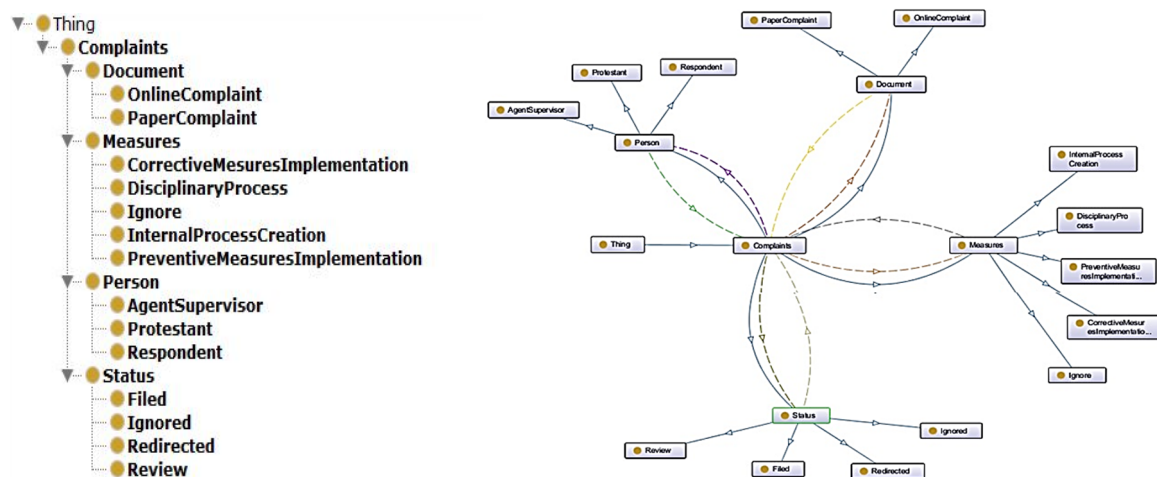


Figure 1: Taxonomy and Diagram of Major classes of complaints ontology.

Remains to be said that as soon as it starts the processing and analysis phase of complaints is assigned to every single one complaint a state related with the conclusions of the preliminary analysis of the document attributed by the detached supervisor agent by the institution.

In figure 1 can be observed all the major classes involved in the process of complaints management in health care establishments and its relationships previously described in this section of the article.

3.2 The Ontology

The ontology is basically a transcription of all knowledge acquired in a particular field of interest, i.e. it is a data model that aggregates several concepts, terms and the properties which defines and determine the exploration theme and specifies the various existing relationships between them.

For the development of this ontology a Top-Down approach was followed. First the most general and abstract concepts were defined. Subsequently the degree of specialization was increased.

This ontology reflects all knowledge acquired over the area of complaints management in health care establishments, and so on the main concept of the whole study is the complaint. As can be seen in the figure 2 this is the principal class of the ontology and all other classes created are effectively subclasses of this superclass complaints.

After this, we can see the existence of two level of classes, the first is structured by the class document, the class measures, the class status and finally the class person. In the second level of classes the reader can denote an increase of the degree of specialization of the ontology related to the presentation of more and

more specialized classes restricting even more the number of individuals involved in the problem.

This ontology diagram (figure 2) is composed by classes, object properties and data type properties in order to represent exactly the flux of data and the principal terms identified in the process of complaints management in health care institutions.

As previously referred ontology is the complaints superclass. This superclass should have four subclasses namely the class Document, the class Person, the class Measures and the class Status.

The class Document was created with the objective to reflect the first stage of the process of complaints management. In other words this is the phase where a person makes formally a complaint and the properties that make up this class are related to the categorization of the document, the description of the complaint and the subject involved.

In the process of creation of a complaint the Protestant has to decide the way that he is going to present his claim and he has two ways: paper or electronically. It was the reason to create two subclasses of document, the class PaperComplaint and the class OnlineComplaint.

The class Person was created by the fact that in this ontology there are three classes that feature both human resources in the process chain and simultaneously they have similar data properties. In this way the class person has as informational data properties the name and the address of the person involved in the process of complaints management.

On the second level of this class the ontology has the class AgentSupervisor who is the person detached by regulator institution for the analysis developed about a complaint. This class has as properties the activity developed by the agent and information about his position inside the company.

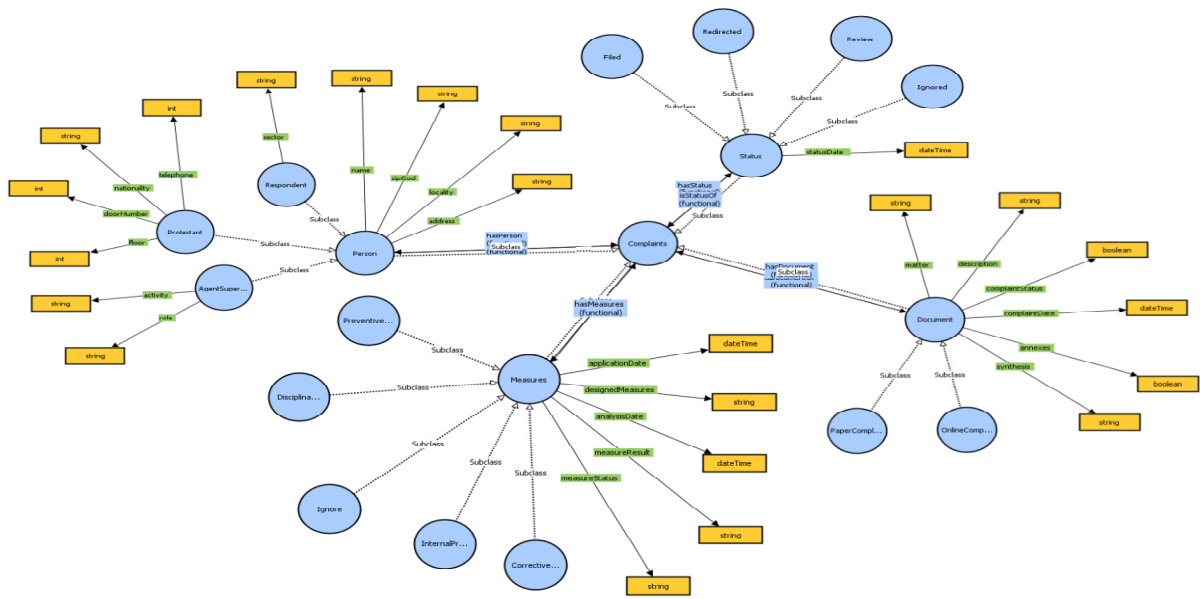


Figure 2: Complaints ontology diagram.

Another subclass of person is the class Respondent, concerning with the person or entity which the complaint is formed and focuses.

The last subclass of person is the class Protestant. This class refers to the person whose felt dissatisfied with the service provided or wants to thank to someone or some care. This class has informational properties of data as the telephone number of the protestant or his nationality.

The next class presented is the Measure class (figure 3). It is directly linked to the solution proposed for resolving the problem found in complaint provided by the regulator company. This class has subclasses designed and related with the principle and more commons measures.

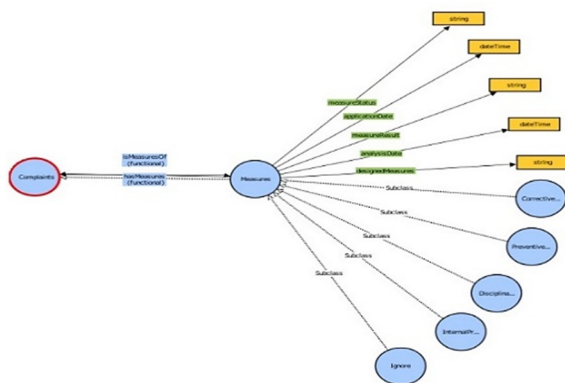


Figure 3: Design of the Class Measures.

In this order of ideas the subclasses Measures is composed by Internal Process Creation, Disciplinary

Process, Preventive Measures Implementation, Corrective Measures Implementation and Ignore.

The properties of Measures class are related to the adequacy of corrective measures outlined by the agent who supervised the complaint and if it had the desired effect or not and what state of the measure is. In this particular case it is possible to observe that the measures class is defined with the property analysis date being this property of date time format. It is the date that the measure was analysed.

Measure status as the name indicates refers to the state that actually it is the measure, i.e. if the drawn measure was effectively applied, if it was approved or if it was rejected.

The following property is designed as measures results. It is concerned with the result that the measure have obtained after their application. This class also have properties as application date relating to the day of application of measure.

Finally the last property measure is description where it is detailed the resolution to the problem identified in the complaint.

The last class is status (figure 4). This is a class dedicated to the analysis of the complaint state. It is characterized by four subclasses which all represents a particular state that the complaint can have being them the subclass Review, Filed, Redirect and Ignored.

The main property of the class Status is called StatusDate referring the date on which the regulator agent classified the complaint status being this property of type date time.

4 DISCUSSION

This ontology was designed in real context being all the information necessary for developing it work collected on the field. Therefore it reflects the main concepts of the area of complaints management in health care institution.

The development of this ontology fulfils all the work goals. It provides an understanding of the whole process of management and regulation of health complaints and its interpretation is easily understandable for experts in the field of ontologies. It can be read by common people and for machine interpretation fulfilling the purpose related to the reuse of knowledge.

By the way this work was made with the help of the entity responsible for the complaints management in Portugal the ontology was designed in order to be global and to represent what exactly happens during the process. This ontology can be easily adopted by any country and can be used for example by any service / department provided by a hospital. Taking as example the Centro Hospitalar do Porto, this ontology can be adopted to make complaints in maternity care (Abelha, et al., 2015), emergency (Portela, et al., 2010) intensive care units (Portela F., Vilas-Boas, Santos, and Rua, 2012) (Portela, et al., 2014)(Portela et al., 2014), dermatology (Duarte, Portela, Abelha, Machado, and Santos, 2011) and others) and for many reasons: patient discharge (Portela, et al., 2014), readmissions (Braga, Portela, & Santos, 2014), nosocomial infections (Silva, et al., 2015), triage (Cabral, et al., 2011), among others.

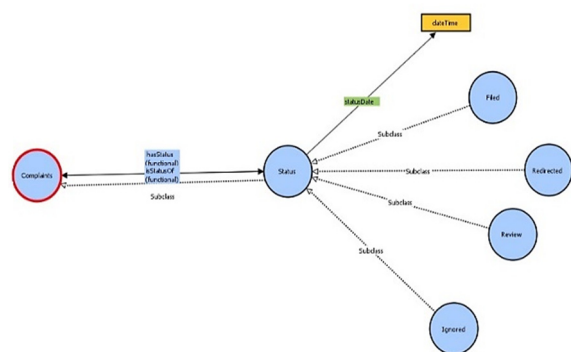


Figure 4: Design of the Class Status.

5 CONCLUSION AND FUTURE WORK

This article presents an ontology applied to the field of management complaints in health care units based

in real facts. For the development of this work it was needed an intensive search and analysis of the development of ontologies which was combined with a study of the complaints management process with the entity that regulate this issue in Portugal. For this reason this paper demonstrates a very interesting contribution to the scientific community because all the work has real data daily collected.

In the developed ontology, a conceptual layout of the entire knowledge in the complaints management process was designed. It is easily to observe that the most important concepts in this activity are structured through classes also being evidenced the relationship between them. This conceptual layout demonstrates an easy understanding of the existing information flow in the area for both experts and researchers in the field of ontologies as for ordinary people.

One of the main advantages that focused the development of all work is the ability to use and reuse the implicit knowledge in ontologies on similar projects. The absolute objective that motivate the development of work and the effort dedicated to the project it is the use of information and the possibility of using the information provided by ontology in data and text mining project in order to study the possibility of developing a system able to automatically classifies and recommend a categorization for the management of complaints.

In this sense the developed ontology is being implemented in real context and its impact will be studied. The integration of the ontology will be studied an evaluated by ensuring their viability and their contributions to both scientific community as well as to the entity that regulates complaints from health care establishments, which helped the project from the start.

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