OntoM4IS+: Ontology Reuse Method for Information Science

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ONTOM4IS+: ONTOLOGY REUSE METHOD FOR INFORMATION SCIENCE[1]

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ABSTRACT

Ontologies are a kind of knowledge organisation system (KOS) and it is widely used in many contexts and for different purposes. When the decision of development of a new ontology is taken, the very first decision that is suggested by knowledge specialists, is the possibility of adaptation of existing ontologies. Our intention, with this article, is to propose a new method called OntoM4IS+ (Ontology Reuse Method for Information Science). The main idea is to reuse the content of ontologies or other vocabularies, from multi-sources, as a contribution to the Information Science community in knowledge organisation tasks. We will adopt a hybrid approach, combining the best features of each methodology. The Design Science Research (DSR) will be the support for the whole process. We will use also qualitative research techniques, such as interviews and focus groups to validate our proposal. Moreover, as a research strategy we will follow the bibliographic research technique of published materials. This is a work in progress, and as results is expected a real contribution (the OntoM4IS+ method) to knowledge specialists, as a way to solve the issues arised in the knowledge organisation process.

Keywords*:*OntoM4IS+. Ontology Reuse. Knowledge Organisation. Science. Knowledge Organisation System. Design Science Research.

RESUMO

Ontologias são um tipo de sistema de organização do conhecimento (SOC) e é amplamente utilizado em muitos contextos e para diferentes propósitos. Quando a decisão de desenvolvimento de uma nova ontologia é tomada, a primeira decisão que é sugerida pelos especialistas em conhecimento é a possibilidade de adaptação das ontologias existentes. Pretende-se com este artigo, propor um novo método chamado *OntoM4IS+* (Método de Reúso de Ontologias para a Ciência da Informação). Assim, a ideia principal é reutilizar o conteúdo de ontologias ou de outros vocabulários, a partir de múltiplas fontes, como uma contribuição para a comunidade da Ciência da Informação, nas tarefas de organização do conhecimento. O artigo adota uma abordagem híbrida, combinando as melhores características de cada metodologia. A *Design Science Research* (DSR) dará o suporte para todo o processo. Usa também técnicas de pesquisa qualitativa, como entrevistas e grupo focal para validação da proposta. Além disso, como estratégia de pesquisa, segue-se a técnica de pesquisa bibliográfica de materiais publicados. Este é um trabalho em andamento, e como resultado espera-se uma contribuição real (o método

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OntoM4IS+) para especialistas em conhecimento, como forma de solucionar problemas que possam surgir no processo de organização do conhecimento.

Palavras-chave:*OntoM4IS+*. Reúso de Ontologias. Organização do Conhecimento. Sistema de Organização do Conhecimento. *Design Science Research.*

1 INTRODUÇÃO

Ontologies are commonly classified as a kind of knowledge organization system (KOS) such as classification schemes, subject heading lists, taxonomies, folksonomies, and other similar types of controlled vocabularies. Ontologies are wide adopted as a KOS due his features to express knowledge (reality perceived by humans), promoting interoperability between human and machine agents.

Ontology is originally associated to Philosophy, but is widely used in other scientific areas as Computer science (CS) and Information Science (IS). CS and IS taked as loan the term ontology in the recent years, especially with the exponencial growth of Web, as a mean to model the reality and further representation in a format (e.g. OWL – Web Ontology Language*)*. Ontology has its roots in Aristotle, but in our field the booster came with the emergence of semantic Web, where, some objectives are: promote interoperability, sharing (and reuse) knowledge between agents.

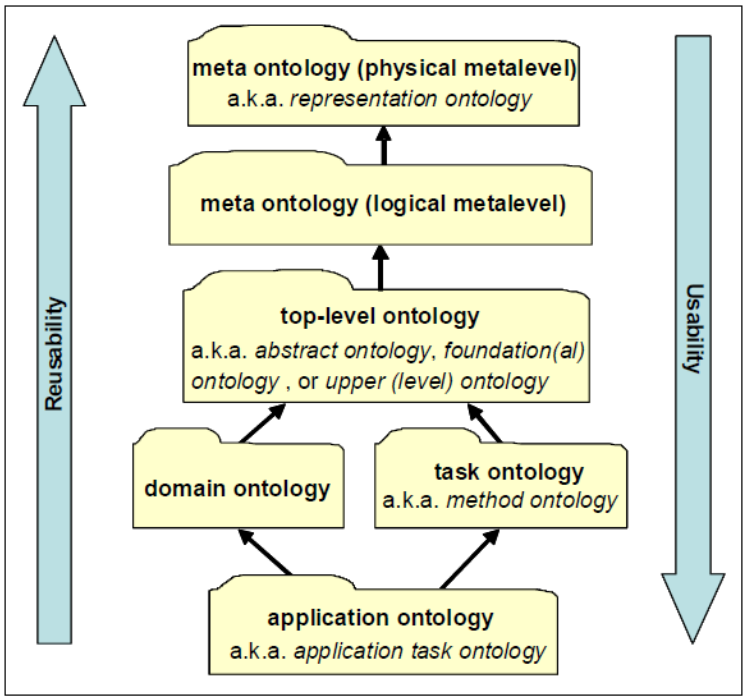
The term 'ontology' (or *ontologia*) was coined in 1613, independently, by two philosophers, Rudolf Göckel (*Goclenius*), in his *Lexicon philosophicum* and Jacob Lorhard (*Lorhardus*), in his *Theatrumphilosophicum*. Its first occurrence in English as recorded by the OED (Oxford English Dictionary) appears in Bailey's dictionary of 1721, which defines ontology as 'an Account of being in the Abstract' (SMITH, 2003).

In this paper we address a important ontology design principle that is the reuse of contents from multi-sources (ontological and non ontological resources). According OCHS et al. (2017) reusing content (e.g., classes and properties) of reliable quality can save an ontology author significant time and effort. The same authors state that the reuse of content allows for a consistent representation of a domain among all ontologies that reuse the same content. Support for reusing ontology content is included as part of the Web Ontology Language (OWL) specification (i.e., using *owl:imports* axioms).

It is commonly accepted that reuse is important not only for the mentioned aspects but as a way of giving importance to work and effort of others, the so called credibility.

The authors Scherp et al. (2011), state: "When designing an ontology, it is desirable to use a solid and sound modeling basis". Thus, our method recommend the use of a foundational ontology (also known as upper level ontology) such as DOLCE (Descriptive *Ontology* for Linguistic and Cognitive Engineering), GFO (General Formal *Ontology)*, BFO (Basic Formal *Ontology*). The suggestion of a upper level ontology, is sustained by the Extended classification framework (see figure 1), where is balanced by the degree of usability and reusability of the respective ontology types. Depending of the context, complexity and ontology types the knowledge specialist can balance this two dimensions. For instance, the usability increases with the ontology type's degree of specialization, whereas its reusability decreases (MARQUARDT et al., 2010).

Figure 1: Extended classification framework



Source: MARQUARDT et al. (2010).

Foundational ontologies provide a high-level, abstract vocabulary of concepts and relations that are likely to be used in current and future application domains (SCHERP et al., 2011).

2 PROBLEM

The organization of knowledge is a crucial task and the use of ontologies is fundamental to ful fill this purpose. The literature review suggest a lack of methods for construction of ontologies in the Information Science field. However some efforts were identified, such as the *Onto For Info Science* (MENDONÇA, 2015), a methodological approach with concurrent support of three methods: *Ne On, Method 101* and *Methontology*. This methodology addresses an aspect that is so important but notably unexplored, the reuse. Our object of analysis is to investigate the reuse of contents of ontologies, focusing in classes and properties.

3 OBJECTIVES

The aim soft his paper is to present a section of our the sisproject, the*OntoM4IS+*. The acronym OntoM4IS+, stands for Ontology Reuse Method for Information Science. The main idea isto reuse the content of multi-sources vocabularies. Moreover, it is seen as a contribution to Information Science field, namely in the organization of knowledge, providing a method to help

the researchers in matter sofknowledge representation with the support of well-established methodologies from Information Science and concurrent support of Semantic Web technologies.

4 METHODOLOGY

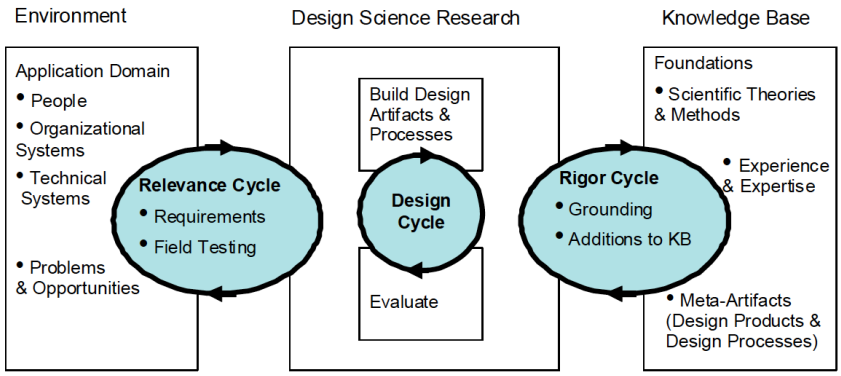
We will adopt a mixed approach, combining the best features of qualitative and quantitative methodologies. The Design Science Research (DSR) will be the support for the process (HEVNER, 2007). As a philosophical assumption, the DSR is based on the pragmatic view. Pragmatism is a real-world, problem-centered philosophical view. We will use also qualitative research techniques, such as focus groups to validate some aspects of our proposal. Furthermore, as a research strategy, it will be followed the bibliographic research technique of published materials.

The Design Science Research process, according to Hevner (2007), has three cycles (see figure 2): *Relevance Cycle*, *Design Cycle* and *Rigor Cycle*.

These three cycles occur in three Spaces:

- *Environment*– This space is the context of the research, providing the requirements for the development of artifacts[2]**.**
- *Design Science Research* – This is the core space, where occur the intersection of the three cycles. This Design cycle is responsible for the development of artifacts where the researcher, builds and evaluate the design artifacts and processes of the research.
- *Knowledge Base*– It is seen as a support for the Rigor cycle, providing the scientific foundations, experience, and expertise that supports the research.

Figure 1: Design Science Methodology Cycles

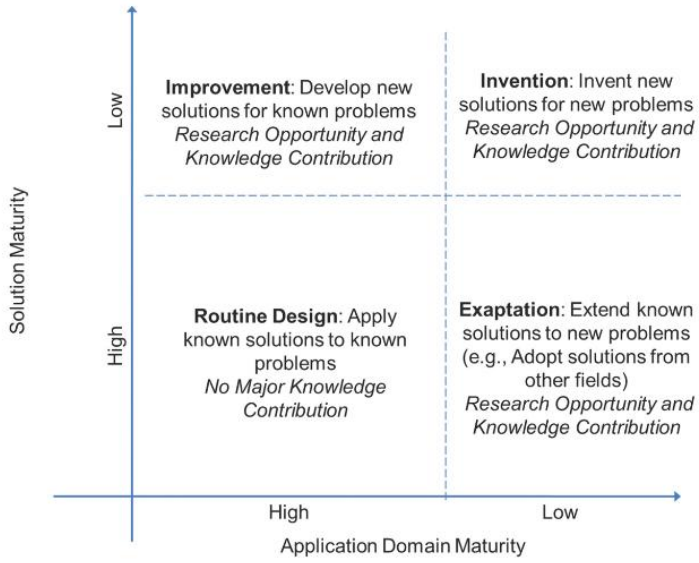


Source: HEVNER (2007)

[2]The term *artifact* is used to refer to a thing that has, or can be transformed into, a material existence as an artificially made object (e.g., model, instantiation) or process (e.g., method, software). (Gregor & Hevner 2013, p. 341).

Gregor; Hevner (2013) proposed a framework to characterize and position DSR projects regarding the contribution of knowledge (see figure 3).

Figure 2: DSR Knowledge Contribution Framework



Source: GREGOR;HEVNER(2013)

A project can be evaluated according to the maturity of the problem and the maturity of the solution. The authors define two axes and four quadrants. The maturity of the problem lies on the x-axis (abscissa), and the maturity of the solution lies on the y-axis (ordinate). As for the quadrants we have the follows: *Routine Design*, *Improvement*, *Exaptation* and *Inventions*.

High maturity quadrant in both measurements (lower left corner): it is a question of applying known solutions to known problems. Gregor; Hevner (2013) call this quadrant *Routine Design*. This quadrant makes no contribution to the knowledge base and does not in fact present any research opportunity since it is existing knowledge that applies to routine situations (MALTA, 2014).

Gregor; Hevner (2013) call the next quadrant, the *Improvement* quadrant. Quadrant of high maturity in knowledge of the problem and low maturity in the knowledge of the solution: it is about developing new solutions to old problems. This quadrant is an opportunity for research and brings possible contributions to the knowledge base (MALTA, 2014).

The Quadrant of low maturity in knowledge of the problem and high maturity in the knowledge of the solution: it is a question of extending known solutions to new problems. The authors call this quadrant, the *Exaptation* quadrant. This quadrant is an opportunity for research and brings possible contributions to the knowledge base (MALTA, 2014).

Finally in the upper right corner we have the quadrant of low maturity in both dimensions: it is to invent new solutions to new problems. The authors call this quadrant, the *Inventions* quadrant. This quadrant is a research opportunity and brings contributions to the knowledge base. It is a quadrant where there is a real start from nowhere; however, inventions are rare and inventors even rarer (MALTA, 2014).

Our method (OntoM4IS+), in terms of Knowledge Contribution, can be positioned in the Improvement quadrant. OntoM4IS+ is based on contributions from Information Science and contributions from Semantic Web technologies (e.g. Ontology development methodologies), which translates into an attempt to improve a known problem, with the developing of a new solution.

5 RELATED WORK

The state of the art has shown that the proposed methods for the construction of ontologies are still incipient in the IS's area. Some works, has caught our attention. In the information science sphere we identify the *Onto For Info Science* methodology, which is inspired by the upper level (and formal) ontology, BFO (Basic Formal Ontology). *Onto For Info Science* is an ontology construction methodology based on three methodologies, *Ne On*, *Methontology* and *Method 101*. Reuse is a task that is emphasized and highly recommended in this proposal. *Onto For Info Science* has already been used and applied in the creation of two domain ontologies, *Hemonto* in the field of Biomedicine and *Ontolegis* in the Law area.

Many works have put the emphasis on reuse. Some authors argue that a reusable ontology is not a static model, but evolves over time according to prevailing conditions and requirements. An ontology must anticipate the possibility of later changes and support their realization (MARQUARDT et al., 2010).

In fact, "Ontologies can be reused in several ways: they sometimes result in the creation of an independent ontology from the concepts of others (which can be extended and adapted), and in other situations they preserve the original ontologies" (CAMPOS et al., 2013).

6 EXPECTED RESULTS

This article will present a work in progress comprised of the whole process starting on the literature review and further contributions, embodied in a method for ontology reuse in the Information Science field.

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