Building Ontologies for Information Systems: What we have, what we need

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ABSTRACT
In this research, we investigate how we can build ontologies that are suitable to Information Systems design. We analyzed methodologies for *building ontologies from scratch*. Preliminary results show that the process of building ontologies for Information Systems should address issues of metamodels, procedural knowledge, temporal relations and knowledge acquisition.

Categories and Subject Descriptors
I.2.4 [**Knowledge Representation Formalism and Methods**]: Representations, Semantic Networks. I.2.6 [**Learning**]: Concept Learning, Knowledge Acquisition.

General Terms
Management, Documentation, Design, Theory

Keywords
Building Ontology, Information Systems Design, Methodologies

1. INTRODUCTION
The first step in the conceptual modeling activities of Information Systems (IS) is the transformation of the perceived real-world into a model of the world it intends to represent. As ontology is used to represent the real-world, "our descriptions [of the world] will only be as good as our ontologies" [1, p.xii], and because information systems are models of real-world systems, "our information systems will only be as good as our ontologies" [1, p.xii].

We are interested in ontologies in the context of Ontology-Driven Information Systems (ODIS), where they can be used at development time and at run time [2, 3]. At development time, an ontology can be used in the conceptual modeling phase of IS, representing the knowledge of a given domain and supporting the creation of IS components, such as information resources, applications programs, and user interfaces. At run time, an ontology can be used as another part of the information system driving all of its aspects and components.

Building ontologies for Information Systems is not an easy task, and requires a great set of skills from the Ontology Engineer. There has been a proliferation of conceptual modeling methods that use ontology as an artifact in Information Systems Analysis and Design (ISAD). Despite almost three decades of research and a shared understanding that ontology plays a central role in Information Systems [2, 4, 5, 6], researchers have not yet produced a standard set of methodological guidelines for building ontologies to be used in ISAD.

A survey [7] shows that 60% of the participants did not use any methodology to build their ontologies (Figure 1).

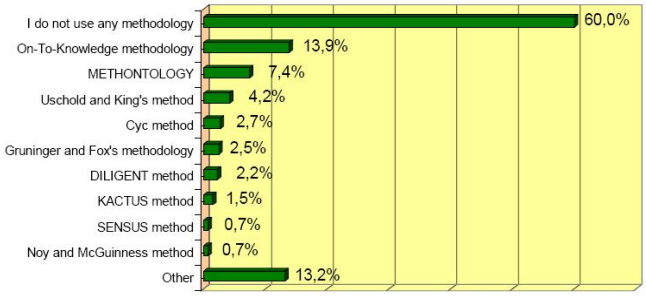

Figure 1: Methodologies used to develop ontologies [7].

The goal of this research is to identify guidelines for the process of building ontologies that are suitable to IS design. We studied existing methodologies and we identified four main issues that need to be considered when designing ontologies to be used in ISAD.

2. RESEARCH
For our sampling, we selected methodologies that fall into the category of *building ontologies from scratch* [8]. In this category, we envision ontologies that are built from ground up by designers who are acquiring knowledge about a domain through interactions with stakeholders and observations of their daily activities.

Our initial investigation revealed important issues that should be taken into consideration in the process of building ontologies for ISAD. These issues are related to:

- *Metamodels*: guide the construction of domain ontologies and increases the semantic for understanding the domain.

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- *Procedural knowledge*: describes a set of tasks for achieving goals.
- *Temporal relations*: represent the chronological arrangement of the tasks
- *Knowledge acquisition*: relates to a systematic approach for capturing domain knowledge

A thorough analysis of existing methodologies for building ontologies should uncover important lessons learned and practical approaches that can support the process of building ontologies for the purpose of modeling and designing Information Systems. It should also provide a list of issues that still need to be addressed to allow that to happen.

We used the issues above and some other criteria that we developed to frame the analysis of the methodologies, as follows:

- *Knowledge Acquisition*: we are looking for techniques that can help acquiring knowledge about a domain.
- *Identify Concepts*: we want to know how the methodologies support the identification of domain concepts, including their related attributes and relationships.
- *Identify Tasks*: this criterion covers how the methodologies identify and represent the procedural knowledge needed to achieve goals.
- *Identify Temporal Relations*: we are looking for particular ways to identify and to represent the chronology and dependences of the tasks within the ontology.
- *Identify Axioms*: an important feature of ontology is the possibility of representing relevant constraints of the domain. This criterion gives us valuable information on how the methodologies propose the identification and description of theses constraints as well as what logic approaches are used to describe the constraints (e.g., descriptive logic).
- *Ontology Levels*: developing ontologies with the help of a metamodel ontology can provide additional knowledge about the domain. This criterion focuses on the methodologies that are using different levels of ontology.
- *Identify Constructs*: if a methodology has adopted different levels of ontologies, we want to know if they propose guidelines for identifying the constructs of the higher-level ontologies as well as if they suggest a method for mapping the levels.
- *Domain Specific*: we want to know if the methodology was developed to accommodate a specific domain or if it is flexible to be applied to other domains, especially the Information Systems domain.

Motivated by Guarino's caveat about the lack of principled methodologies to build ontologies [9], we are also paying careful attention to the issues identified by each methodology as well as the approaches used to overcome the issues. In particular, we want to track the influences behind the methodologies by identifying (1) if a methodology has included parts from other methodologies within its own approach, (2) which methodologies have been analyzed to identify open issues, and (3) what specific theories have been adopted to support the methodology.

3. CONCLUSION AND FUTURE WORK

This work reports the preliminary results of our analysis of methodologies for building ontologies. Suggesting guidelines for building ontologies either by reusing existing approaches or by proposing new ones constitutes a significant contribution to IS researchers and practitioners.

As the use of ontology for representing knowledge increases and crosses different domains, we see the need for simplified approaches for people to build ontologies about their domains. In this case, we envision methodologies that will allow end-users (i.e., non-ontologists) to build their own ontologies without the burden of learning the underpinnings of ontology engineering, and in a way that is similar to how they think and communicate. Also, people should be able to quickly identify important conceptual and procedural knowledge from the domain, and map them to the proper constructs of computational ontologies.

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