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Guest editorial preface: Software and system engineering: an ontological perspective

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1 Motivation

This is the second part of the special issue on ontological and epistemological aspects of software and system engineering. As briefly pointed out in the preface to the first part[1], the aim of the selected papers is to create a bridge between researches in Software and Knowledge Engineering through the notion of ontology as a way to build clear, not ambiguous and complete models of a domain. The final goal of this process is the design and implementation of high quality software.

The six papers presented here are mainly related to the Knowledge Engineering area: they cover both theoretical and practical topics, showing how Knowledge Engineering methodologies can be profitably exploited to build effective and efficient software systems to solve complex problems in a wide range of domains.

2 Contents of this issue

The paper titled *Ontological Modeling at a Domain Interface: Bridging Clinical and Biomolecular Knowledge*, by Gianluca Colombo, Daniele Merico, Zoltán Nagy, Flavio De Paoli, Marco Antoniotti and Giancarlo Mauri, discusses the challenges posed by the NEUROWEB project, as a case study of ontological modeling at a knowledge interface between neurovascular medicine and genomics. The aim of the project is the development of a support system for association studies. Authors identify the notion of clinical phenotypes, that is, the pathological condition of a patient, as the central construct of the knowledge model. Clinical phenotypes are assessed through the diagnostic activity, performed by clinical experts operating within communities of practice; the different communities operate according to specific procedures, but they also conform to the minimal requirements of international guidelines, displayed by the adoption of a common standard for the patient classification. A central model for the clinical phenotypes has been developed, able to reconcile the different methodologies into a common classificatory system. The general theory of biological function as the common ground between neurovascular medicine and genomics, therefore, authors decompose the clinical phenotypes into elementary phenotypes with a homogeneous physiological background, connecting them to the biological processes, that is, the elementary units of the genomic world.

In the second paper, *Sharing Architecture Knowledge Through Models: Quality and Cost*, Peng Liang, Anton Jansen and Paris Avgeriou analyze the paradigm shift from describing structural information, such as components and connectors, to documenting Architectural Knowledge (AK), such as design decisions and rationale. To this end, a series of industrial and academic domain models have been proposed for defining the concepts and their relationships in the field of AK. To a large extent, the merit of this new paradigm is to share and reuse AK across organizations,

[1] Micucci, D., Sartori, F. & Adorni, M. (eds): Software and system engineering: an ontological perspective. *Knowledge Engineering Review* **24**(1).

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especially in geographically distributed settings. However, the employment of different AK domain models by different parties makes effective AK sharing challenging, as it needs to be mapped from one domain model to another. In this paper, authors investigate two different approaches for sharing AK, based on either direct or indirect mapping between different AK domain models. They compare the cost and quality of these two approaches, with respect to the processing of large amounts of AK instances. To predict the quality and costs of this processing in advance, a prediction model is proposed and validated with a concrete AK sharing case. Based on the comparison results, stakeholders involved with AK sharing can select an appropriate approach by trading off quality and cost in their own context.

The paper titled *Semantic Templates for Case-Based Reasoning Systems*, by Juan A. Recio-García, Belén Díaz-Agudo and Pedro A. González-Calero, presents an approach to solve the drawbacks of manual composition of software components. The approach is applied within the *jcolibri* framework for building Case-Based Reasoning (CBR) applications. Authors propose a system design process based on reusing *templates* obtained from previously designed CBR systems. Templates store the control flow of the CBR applications and include semantic annotations conceptualizing its behavior and expertise. A CBR ontology is adopted to formalize syntactical, semantical and pragmatical aspects of the reusable components of the framework. The ontology vocabulary facilitates an annotation process of the components and allows to reason about their composition, facilitating the semi-automatic configuration of complex systems from their composing pieces.

In the fourth paper, *An Upper-level Functional Design Ontology to Support Knowledge Management in SMEs-based E-Manufacturing of Mechanical Products*, Alessandro Mosca, Matteo Palmonari and Fabio Sartori describe a conceptual and computational framework for supporting the development of knowledge management systems based on ontology design and implementation. This framework supports enterprises involved in the design and manufacturing of complex mechanical products: in particular, the attention is focused on a network of Small/Medium Italian Enterprises (SMEs) that collaborate in the production of a *supermotard bike*. Starting from some theoretical considerations about the role of ontologies in engineering design, the paper reflects on the difficulties arising when knowledge is distributed.

Dimitrios L. Settas, Sulayman K. Sowe and Ioannis G. Stamelos are the authors of the paper titled *Detecting Similarities in Antipattern Ontologies Using Semantic Social Networks. Implications for Software Project Management*. They introduce a three-layered antipattern semantic social network, which involves the social network, the antipattern ontology network and the concept network. Social Network Analysis (SNA) techniques can be used to assist software project managers in finding similar antipattern ontologies. For this purpose, SNA measures are extracted from one layer of the semantic social network to another and use this knowledge to infer new links between antipattern ontologies. The level of uncertainty associated with each new link is represented using Bayesian Networks (BNs). Furthermore, BNs address the issue of quantifying the uncertainty of the data collected regarding antipattern ontologies for the purposes of the conducted analysis. Finally, BNs are used to augment SNA by taking into account meta-information in their calculations. Hence, other knowledge not included in the social network can be used in order to search the social network for further inference. The benefits of using an antipattern semantic social network are illustrated using an example community of software project management antipattern ontologies.

The last paper, *Ontologies of Engineering Knowledge: General Structure and the Case of Software Engineering*, by Miguel-Angel Sicilia, Elena García-Barriocanal, Salvador Sánchez-Alonso and Daniel Rodríguez-García, focuses on Engineering knowledge, a specific kind of knowledge oriented to the production of particular classes of artifacts, that is typically related to disciplined design methods and takes place in tool intensive contexts. Representing engineering knowledge requires the elaboration of complex models that combine functional and structural representations of the resulting artifacts with process and methodological knowledge. The different categories used in the engineering domain vary in their status and in the way they should be manipulated when building applications that support engineering processes. These categories include artifacts,

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activities, methods and models. This paper surveys existing models of engineering knowledge and discusses an upper ontology that abstracts the categories that crosscut different engineering domains. Such upper model can be reused for particular engineering disciplines. The process of creating such elaborations is reported on the particular case study of Software Engineering as a concrete application example.

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