Semantic Enrichment of Models to Assist Knowledge Management in a PLM Environment

Yongxin Liao[1,2], Mario Lezoche[1,2], Eduardo Loures[3], Hervé Panetto[1,2], and Nacer Boudjlida[4,5]

[1] Université de Lorraine, CRAN, UMR 7039, Boulevard des Aiguillettes B.P.70239, 54506Vandoeuvre-lès-Nancy, France
[2] CNRS, CRAN, UMR 7039, France
[3] Industrial and Systems Engineering, Pontifical Catholic University of Parana., ImaculadaConceicao 1155, Curitiba, Brazil
[4] Université de Lorraine, LORIA, UMR 7503, Boulevard des Aiguillettes B.P. 70239, 54506Vandoeuvre-lés-Nancy, France
[5] CNRS, INRIA, LORIA, UMR 7503, France
{yongxin.liao,mario.lezoche,herve.panetto}@univ-lorraine.fr, eduardo.loures@pucpr.br, nacer.boujlida@loria.fr

Abstract. Product Lifecycle Management (PLM) has been considered as an essential concept for improving the product competitive ability in manufacturing enterprises. The PLM solution aims at providing a shared platform for facilitating the management of the knowledge related to any product development process in or across enterprises. However, facing with different standards, enterprise systems and stakeholders, enterprises still need to deal with interoperability issues between those collaborative information systems, encompassing their capability to find the right information during the whole Product Life Cycle (PLC). The objective of this paper is to cope with the major issue of semantic interoperability, by proposing a formalization of semantic annotations and a prototype for facilitating a coherent, complete and contextualized interoperability of knowledge between all enterprise systems and related stakeholders. An example of the instantiation of our method within a real application scenario in manufacturing domain is presented to demonstrate its applicability and use, both at the engineering and the exploitation phases.

Keywords: Semantic Interoperability, Semantic Annotation, BPMN, PLM, Knowledge Management.

1 Introduction

Nowadays, the need for interoperability in a Product Lifecycle Management (PLM) environment has become increasingly imperative. A PLM solution aims to bring together different enterprise systems that deal with the product-related knowledge at each stage and intend to facilitate the communications among all stakeholders [1]. However most of the enterprises have implemented only a few of these systems

R. Meersman et al. (Eds.): OTM 2013, LNCS 8185, pp. 267–274, 2013.

without coping with any coherent integration of the entire information system. This has resulted in a kind of "tower of Babel", where each application is considered as an island in the middle of the ocean of information. Of course, all of these stakeholders have their own background, unique knowledge, particular needs and specific practices. This "cloud of knowledge" is then over increasing the issue of interoperability, not only in the collaborations among the enterprise systems but also by the mutual understanding of the product-related knowledge between these stakeholders.

The objective of this paper is to cope with the issue of interoperability, especially the semantic interoperability, by proposing a formalization of semantic annotations and a prototype for facilitating a coherent, complete and contextualized interoperability of knowledge between all enterprise systems and related stakeholders. The remainder of this paper is organized as follows. Section 2 presents an overview of the background and identifies the semantic interoperability issues to limit the research scope and discusses the related works that made use of semantic annotations to meet particular needs. Section 3 illustrates eight formal definitions of semantic annotations, a conflict detection policy and a semantic annotation framework. A case study is presented in section 4 to demonstrate the applicability and the use of our solution. Section 5 concludes this paper and highlights future research directions.

2 Problems Statement and Related Works

The concept of the Product Life Cycle (PLC) has been introduced since the 1950s, it describes every phase a product of interest goes through, from the first initial requirement until it is retired and disposed [2]. In the early 1980s the problems of locating the required data and losing control of change process associated with these data became increasingly intense [3]. During the 1990s, the concept of Product Lifecycle Management (PLM) is proposed, which aims at providing a shared platform for facilitating the process of capturing, representing, organizing, retrieving and reusing the knowledge concerning the related product in or across enterprises. It should provide the integration strategies and technological supports to bring together all existing enterprise systems that deal with the product [4]. Therefore, product-related knowledge becomes one of the critical concepts in the PLM.

In the so-called DIKW Pyramid [5], referring to a hierarchical model for representing the structural relationships between Data, Information, Knowledge and Wisdom, knowledge is considered as the awareness of things that brings to its owner the capability of grasping the meaning from the information [6]. Knowledge is obtained through certain learning behaviors, in which, the external information from the real world is sublimated and becomes the awareness. In our research, we consider knowledge as a kind of invisible thing, which can only be captured by expressing it into multifarious forms of representations. In some of the literature about knowledge, researchers categorized it into two kinds: (1) tacit knowledge, which is highly personal, difficult to articulate and to formalize; (2) explicit knowledge which is easier to be expressed formally and systematically [7]. According to the main theses that Polany used to define the concept of knowledge, all knowledge is rooted in tacit knowledge