Journal of Industrial Information Integration 000 (2017) 1–11

Contents lists available at ScienceDirect

Journal of Industrial Information Integration

journal homepage: www.elsevier.com/locate/jii

The reference view for semantic interoperability in Integrated Product Development Process: The conceptual structure for injecting thin walled plastic products

Athon Francisco Curi de Moura Leite[a], Matheus Beltrame Canciglieri[a], Anderson Luis Szejka[b], Osiris Canciglieri Junior[b,*]

[a] Industrial Engineering Department, Polytechnic School, Pontifical Catholic University of Paraná, Curitiba, Brazil
[b] Industrial and Systems Engineering Graduate Program, Polytechnic School, Pontifical Catholic University of Paraná (PPGEPS/PUCPR), Curitiba, Brazil

ARTICLE INFO

Article history:
Received 29 November 2016
Revised 5 May 2017
Accepted 14 June 2017
Available online xxx

Keywords:
Integrated Product Development Process
Semantic Interoperability
Ontology
Reference View

ABSTRACT

The ongoing sophistication in costumer's needs have increased the complexity in the Integrated Product Development Process (IPDP). This remarkable growth demands that systems offer support to many different stages of IPDP, going across early planning and practical development phases. Concurrently, the level of detail and quantity of information are exponentially growing in this applications. However, there was also an increase in the number of semantic obstacles to sharing information across systems. These semantic obstacles are mainly related to the heterogenic nature of the information, which has its captured meaning interpreted in a divergent way, increasing the project costs and development time. In this context, this article contributes to the development of the core ontologies from the Reference View, to aid the semantic interoperability in the Product Design stage, further improving the exchange of information during different phases of the IPDP. The core ontologies research is focused on supporting the development of a plastic injected product, gathering and sharing information across the domains of part and mould design, mould manufacture and materials selection. The experimental system has demonstrated the potential to aid the exchange of information and inconsistency analysis in the Integrated Product Development Process.

© 2017 Published by Elsevier Inc.

1. Introduction

Currently, the demand for more elaborated products has increased the complexity in the Integrated Product Development Process (IPDP), due to the necessity of goods being developed in less time and with higher quality, associated with the continuous improvement of technology. Therefore, there's a need for computational systems that offer support to the many different stages of the product development and that can also share the knowledge produced between these stages and the products manufacture [1].

There has been a considerable increase in the quantity and level of detailing of the knowledge from the product development in past decades, but along with that came an augmentation in the number of semantic obstacles for sharing this knowledge efficiently. These semantic obstacles are mainly related to the heterogenic nature of the knowledge, which has its meaning captured and interpreted in a divergent way by the many different departments charged with the IPDP, increasing the costs and development time [2,3].

A mutual understanding of the semantics inside the shared and exchanged knowledge representations is the cornerstone in the quest for semantic interoperability [4]. This paper supports the creation of a path towards providing this mutual understanding. In that sense, contributing to the growing recognition for the need of reference ontologies that stay in between generic foundation ontologies and highly specific domain ontologies [2]. This article focuses on the adoption of an approach where the meaning, in computational form, associated to core feature-based concepts is established. This method uses formal heavyweight ontological structures to define the meaning behind the information [5,6], such as standard features, machining process execution, geometrical and dimensional tolerances and product material knowledge, in the context of injection moulded product design.

In this context, this research proposes the structuring of Reference Core Ontologies, from which new ontology based models can be specialized to suit specific application domains. In combination, these ontologies will serve as the semantic schema for a knowledge base, in order to aid product development and ensuring that

* Corresponding author.
E-mail address: osiris.canciglieri@pucpr.br (O. Canciglieri Junior).

http://dx.doi.org/10.1016/j.jii.2017.06.002
2452-414X/© 2017 Published by Elsevier Inc.

Please cite this article as: A.F. Curi de Moura Leite et al., The reference view for semantic interoperability in Integrated Product Development Process: The conceptual structure for injecting thin walled plastic products, Journal of Industrial Information Integration (2017), http://dx.doi.org/10.1016/j.jii.2017.06.002

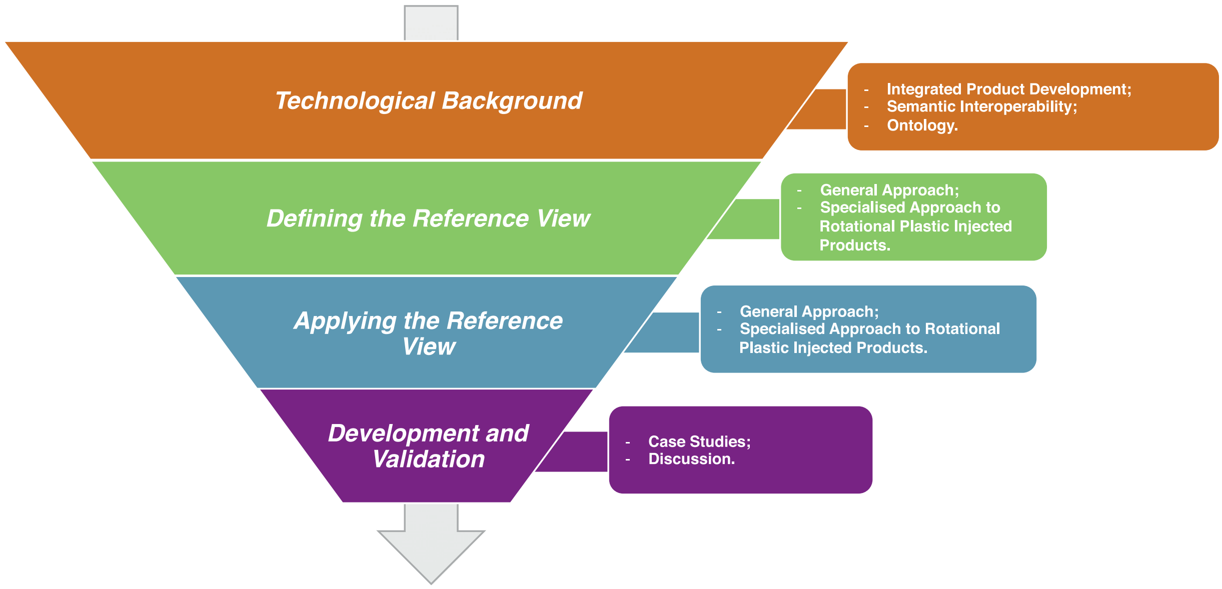

Fig. 1. Technical procedures adopted for the research.

knowledge created in one domain of the product development process will be shared and understood in other related domains without information heterogeneity.

The first stage of this research is dedicated to review the main concepts on IPDP, interoperability and ontology engineering. The second stage is dedicated to the concept exploration on the creation of core ontologies (also referred as reference ontologies). The final stage regards the creation of the core ontologies, which will serve as basis for further development of the system and work as knowledge base for the entire concept. This will allow an analysis on the consistency and information sharing, considering other elements of the Product Design and Manufacture in future stages.

The paper adopts the following structure: Section 1 presents the methodology for the development of this research. shows the research's literature review and its relevant topics. Section 3 describes the concept of the reference view and the creation of its ontologies and how they will enable an interoperable product development process. In Section 4 the reference model is applied to a real case, allowing the evaluation of the interoperable environment that is created by it. Finally, in the conclusion section, the main outcomes, knowledge gathered and research perspectives are presented.

2. Research methodology

This research is considered applied science since it aims to understand, explain and produce knowledge, which can be implemented to solve interoperability issues in manufacturing industries, based on existing theories. It has a qualitative approach, as qualitative studies seek to gain an in-depth understanding of a specific phenomenon through descriptions and exploratory interpretations to provide greater familiarity about a specific problem [7]. The emergent nature of the concepts analysed classifies the scientific objective as exploratory. The technical procedures were further explored in a scheme that shows the logical steps taken in the research development, to improve and simplify its comprehension, as shown in Fig. 1.

Firstly, a technological background is proposed in order to explore concepts such as Integrated Product Development, Semantic Interoperability and Ontologies. Secondly, an experimental application will be developed, starting by “Defining the Reference View” and “Applying the Reference View”, based on information gathered in the previous stage. Later, an application of the concept is proposed through a case (Development and Validation) based on information from a product, subsequently, its results will be analysed.

3. Technological background

This literature review explores the concepts of Integrated Product Development Process (IPDP), interoperability and ontologies. The review establishes concepts, relevant topics and an overview on each theme, as well as their connections.

3.1. Integrated Product Development Process

The Integrated Product Development Process (IPDP) is defined as a set of multidisciplinary activities coordinated for the creation of a product, taking in consideration technological viability, customers' needs and market opportunities, according to Rozenfeld et al. [8]. Along with this information, innovation plays a key role on the development process [9]. In this context, a categorisation of projects was presented by Pereira and Canciglieri [10] considering three categories: improvement projects (which improve an existing project), platform projects (develops a next generation based on an existing product) and radical projects (completely new products).

There are different Product Development Models in order to structure the activities in IPDP. They have several applications, where each one has a similar structure but different aims and glossary as shown in [11] and [12]. However, one of the main problems in IPDP is dealing with different knowledge domains, which result mostly in creation of data misinterpretation, ambiguity, semantic inconsistencies and mistakes, remarkably in design and manufacturing planning stages [13], which represent the largest portion of impact in later costs [14].

3.2. Semantic interoperability

Semantic interoperability, as defined by Chen [15], is an improvement in communication between two heterogeneous systems, as a way of optimizing their joint operations and resources

متن کامل مقاله

دریافت فوری

ISIArticles
مرجع مقالات تخصصی ایران

- ✓ امکان دانلود نسخه تمام متن مقالات انگلیسی
- ✓ امکان دانلود نسخه ترجمه شده مقالات
- ✓ پذیرش سفارش ترجمه تخصصی
- ✓ امکان جستجو در آرشیو جامعی از صدها موضوع و هزاران مقاله
- ✓ امکان دانلود رایگان ۲ صفحه اول هر مقاله
- ✓ امکان پرداخت اینترنتی با کلیه کارت های عضو شتاب
- ✓ دانلود فوری مقاله پس از پرداخت آنلاین
- ✓ پشتیبانی کامل خرید با بهره مندی از سیستم هوشمند رهگیری سفارشات