INFORMATION MODELLING OF FOUNDRY PRODUCTS AND PROCESS

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ABSTRACT

In present market conditions it is necessary to integrate the stages of products and technologies planning. The most important problem to be solved is creating models of project information. Authors present the concepts of ontology that can be used for information modelling in integrated product and process planning. The ontology is based on XML technology.

Keywords: castings classification, XLM

1. INTRODUCTION

Production program – in terms of its quantity and quality – is the basis of rational foundry design. The design process consist of [7]:
- the choice of casting technology,
- the choice of production and transport equipment,
- the choice of manufacturing layout,
- the choice of organizational structure.

The exact description of production program is a very difficult task due to technological considerations and dynamic changes in market demands. The proper description of production program has a great influence to all the enterprise activities,

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among them the marketing and the planning ones. Coding products and services according to standardized classification systems are useful for speeding up commerce among companies. In addition, the development of e-commerce solution has rapidly increased the requirement of machine-readable product names that assist marketing and sales functions to find customers and provide better customer and distribution channel services.

2. TRADITIONAL METHOD OF CASTINGS CLASSIFICATION

The task of products classification is to assign each product to a product group corresponding to common attributes.

The castings are classified taking into account the following criteria [4]:

- casting material,
- casting weight,
- casting dimensions,
- batch size or demand per year,
- thickness of a casting wall,
- acceptance specifications,
- indices of a form.

This traditional, linear description of production program is inflexible and inadequate for information needs of foundry designers; moreover, its application to computer-aided design is limited.

Traditional product data base involves [5]:

- great efforts (time, costs) to keep data base up-to-date,
- poor quality of the data,
- lack of common product description and exchange formats (manufacturers, wholesalers and customers handle the same product data in different formats),
- inefficient searching structures in the database.

3. THE FORMAL DESCRIPTION OF FOUNDRY PRODUCTION PROGRAM

A useful product classification scheme should be hierarchical, so that individual commodities represent unique instances of larger classes and families. Hierarchical organization allows a given company to focus on a level of specificity that best suits its purposes, market situation and technology. In addition to maintain a hierarchical taxonomy, a classification scheme must be constantly revised (to add new products and modify existing structures to adapt to changing market offers), it must be responsive to industry, and code assignments to products and services must be impartial (to prevent unfairly promoting one company’s products at the expense of others) [1].

The formal description of products is necessary if they are to be offered in eMarketplaces. The use of Internet in commercial activities has resulted in solving numerous problems connected with automatic exchange and search of information [2].
We can meet similar problems in aiding other forms of activity such as collaborative researches or designs.

The knowledge for support of information exchange in a design process has to be coherent. The formal presentation of coherent and well-ordered knowledge is one of the main tasks of computer intelligent systems. The knowledge conceptualization consists in definition objects, ideas and relations. This knowledge model forms ontology for the area being considered.

As it was shown in [6] the description of products for eMarketplaces is insufficient for production program description in foundry as it does not take into account the technological considerations. However, it is possible to use that approach for a production program description.

The most often used solution in networks for ontology presentation is metalanguage XML which let users design their own customized markup languages for limitless different types of documents. The XML ability for creating structured content is crucial from the practical applications point. Contemporary XML tools allow to operate on documents saved according to XML schema definitions in a similar way as SQL operates on databases. Still, there is no guarantee that the XML concept itself will enable to solve problems of data integrity, usefulness for advanced search, etc. namely these which solve relational or object schema sufficiently.

The works promoting XML application in steel industry have been conducted from several years. The American Iron and Steel Institute (AISI) XML Workgroup sponsors a 'Steel Industry XML Project' focused upon the design of XML-based specifications for business transactions in the steel industry. The primary objective of the AISI XML Workgroup is to develop standardized XML terminology to be used throughout steel related transactions documents. Phase One project activities include [3]:

- a data requirements review and element mapping for the Shipping Notice, Material Release, Inventory Advice, Material Receipt, Test Report, Customer Purchase Order, Service Order, and Vendor Order transactions,
- construction of an XML steel industry glossary of terms for document usage,
- construction of Document Type Definition (DTD) for reviewed transactions.

This process will simultaneously create a Steel XML Glossary, which can then be used throughout the industry and by developers of internet based applications for the industry. The glossary will be posted to the website as it is developed.

For the same reasons a developing standardized XML for foundry industry is necessary. Some introductory works are conducted, e.g. an example of casting formal description in XLM language was presented in [6].
4. THE IDEA OF PRODUCTION PROGRAM DATA MODEL

The authors assume that the complexity of relations between castings properties and technological parameters motivates for entity relationship diagram (ERD) application as the modelling tool. This approach does not exclude another automatic system of production program description as ERD model transformation into UML class-diagram or DDS schema is possible. ERD diagram for the description of a foundry production program is presented in Figure 2.

It was assumed that all the castings properties could be included in a single ProductDescription entity. Properties entity contains the definitions of castings properties e.g. weight, thickness, consistency, tensile strength or batch size. The properties are grouped into the types (e.g. size, mechanical properties) which are defined in PropertyType entity. Castings classes are defined in the same way. Presented model is very flexible so different production programs can be described irrespective of production types, technology and terms of sale. Moreover, the information exchange with classifier systems and computer aided design systems is possible.
5. CONCLUSIONS

The research aimed for create universal classification of castings are very important for development of methods and techniques applied in foundry design. The proposed method forms the rational structure for design process and enables researchers and engineers to exchange the information.

Advantages in general are:
- coherent and well-ordered knowledge,
- no redundancy of work,
- reduction of the sources for errors,
- a uniform and better search method.
While the results of our research have confirmed the value of XLM language for building castings classifier system, it is also evident that further research in this area is necessary. The future work will concentrate on application of machine learning, evolutionary algorithms and artificial neural networks to automatic castings classification.

REFERENCES


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INFORMACYJNE MODELOWANIE PROCESU I PRODUKTÓW ODLEWCZYCH

STRESZCZENIE

Integracja procesów planowania produktów i technologii jest koniecznością w obecnych warunkach rynkowych. W tym przypadku najważniejszym problemem do rozwiązania jest stworzenie modeli informacji projektowej. W pracy zaprezentowano koncepcję ontologii, która może być zastosowana do modelowania informacji w procesie planowania odlewni. Ontologia bazuje na języku XLM.

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