Semana de Engenharia 2010
Guimarães, 11 a 15 de Outubro

COMPARISION OF PRODUCT INFORMATION MODELS

João P. Gomes
Department of Production and Systems, School of Engineering of University of Minho
jpgomes@dps.uminho.pt

KEYWORDS
Bill of materials, diversity management, generic referencing

ABSTRACT

Production systems are changing to meet customers' increasingly demand for customised products and lower delivery times. Mass customization is a production paradigm used in organizations that aim at satisfying these customers. In these new high product diversity and customization environments, Production Information Systems must be able to deal with a large number of product variants in an efficient way. Generic referencing models aim to answer this objective in the representation of product information for production planning and control systems. Three generic referencing models are characterised according to part identification and bill of materials (BOM) representation. The application of generic referencing in a baby clothes industry is presented and compared with direct referencing models.

INTRODUCTION

In mass production, customers had low expectations as to the selection of product characteristics and were usually satisfied by standard models. New production paradigms, such as mass customization (Gilmore and Pine, 1997; Pine, 1993), aim to satisfy the specific needs of each customer while keeping the benefits of mass production (Du et al., 2006; Pine, 1993).

This contributes to an increase in the diversity of products with which an industrial organization has to deal. This diversity causes deep implications on the shop floor and in production planning and control (PPC) information systems. Whereas implications at the shop floor level can be supported by flexible and reconfigurable production systems, PPC information systems lack satisfactory methods to specify and manage all possible variants of products (Olsen et al., 1997).

The management of information about parts, production operations, bill of materials (BOM) and bill of operations (BOO) has become a problem for PPC information systems (Hegge and Wortmann, 1991) due to the large amount of information that it must maintain. One basic cause for this shortcoming is related with the traditional representation models used to manage product information. In these conventional models, each part has an identification number, a BOM and a BOO (Du et al., 2005; Sousa et al., 2009). Several authors have presented different approaches of more generic ways to represent product information, looking for a decrease of the complexity and effort in product variant management.

The main objective of this work is to present a comparison of product information representation models for PPC information systems. A case study in an industrial company of baby clothes is described.

PRODUCT INFORMATION

PPC systems have management processes that are based on information about product, production processes and resources. This work is centred on representation models of parts and BOM, sometimes referred in this work as product information models. These models can be classified into two main categories (Scheer, 1994; Wob, 1997):

- Category 1: direct referencing models. Models in which each part is identified and treated independently and where for each there is a BOM and BOO.
- Category 2: generic referencing models. Models in which groups of parts are identified and treated as one generic reference or family. In these models, the representation of BOM and BOO relate generic references to other generic references.

Direct Referencing Models

In conventional models, parts are represented by predefined attributes. Nevertheless, there is an attribute that plays a special role: part number. This is used to identify each of the parts unambiguously.

In this type of model, if a set of similar parts are differentiated by colour (5 alternative values), length (10), width (10) and shape (20) it is necessary to specify 10.000 (5*10*10*20) variants (Olsen et al., 1997) independently. This number could easily double if, e.g., a customer is allowed to choose between two different raw materials. The representation of each BOM and BOO for each variant makes the use of this type of conventional representation highly dependent on available time.

A BOM for a parent part represents both the link to a set of components which are necessary for the production of that parent part and the required components' quantities to make one unit of that parent part.

Generic Referencing Models

In this type of models, groups of parts or products are identified and treated as one generic reference or family. The following generic referencing models, represented by an abbreviation, are characterised according to part and BOM representation: HEGG model (Hegge, 1992; Hegge and Wortmann, 1991); OLSN model (Olsen and Saetre, 1998; Olsen et al., 1997); JIAO model (Jiao et al., 2000).

As regards the identification and characterization of parts, different authors use different terms to represent similar concepts.

The parts belonging to a generic BOM must have identical structures, and this BOM of a generic product is specified only once (Hegge and Wortmann, 1991).

INDUSTRIAL CASE STUDY

A case study in an industrial company of baby clothes (Gomes et al., 2010) will be described to show the application of the concepts presented in the conventional and generic models.

This company has experienced a large increase in the amount of data to be entered and maintained on the database due to the increase of models for baby clothes with individual variants to be marketed.

One indicator that can be used to measure the effort of PPC system users to record data in direct and generic referencing is the number of records on the database (Gomes et al., 2009). The following criteria will be used: number of information records needed to identify parts and number of information records needed to represent BOMs (Gomes et al., 2009).

Despite the effort being much lessened with the use of generic referencing models, there are still some shortcomings associated with this type of models that are described in this work.

CONCLUSION AND FUTURE WORK

Product information representation models were characterized as to part identification and representation of BOMs. Three different generic referencing models were analysed from the point of view of part identification and BOM representation.

The number of records of these two types of models, direct and generic referencing, were taken for an example from an industrial company. The decrease in effort with the use of models with generic references and generic BOMs is evident. Nevertheless, a set of described limitations should be taken into consideration for these types of models.

A deeper study on the use of generic referencing in industrial environment should consider and explore the relationships between component parameters and parent parameters as well as take different PPC systems into consideration. Different types of relationships and effort management should also be considered. Furthermore, the generic BOO is also an issue that should be addressed with industrial cases. Finally, requirements and implications of different decisions regarding generic referencing design should be studied.

ACKNOWLEDGES

This work was supported by Fundação para a Ciência e a Tecnologia (SFRH/BD/38196/2007).

REFERENCES

Du, J., Jiao, Y.-Y. and Jiao, J., 2005. Integrated BOM and Routing Generator for Variety Synchronization in Assembly-to-Order Production. Journal of Manufacturing Techonology Management, 16(2).

Du, X., Jiao, J. and Tseng, M.M., 2006. Understanding customer satisfaction in product customization. Int J Adv Manuf Technol, 31: 396–406.

Gilmore, J.H. and Pine, B.J., 1997. The Four Faces of Mass Customization. Harvard Business Review, 75(1): 91.

Gomes, J.P., Lima, R. and Martins, P., 2010. Bill of materials structuring in high product diversity and customization environments (accepted for publication), 17th International Annual EurOMA Conference (EurOMA2010), Porto.

Gomes, J.P., Lima, R.M. and Martins, P.J., 2009. Analysis of Generic Product Information Representation Models (accepted for publication), IEEE International Conference on Industrial Engineering and Engineering Management (IEEM 2009) (H. SUN, R. JIAO & M. XIE), Hong Kong, pp. 194-198.

Hegge, H.M.H., 1992. A generic bill-of-material processor using indirect identification of products. Production Planning & Control, 3(3): 336-342.

Hegge, H.M.H. and Wortmann, J.C., 1991. Generic bill-of-material: a new product model. International Journal of Production Economics, 23(1-3): 117-128.

Jiao, J., Tseng, M.M., Ma, Q. and Zou, Y., 2000. Generic Bill-of-Materials-and-Operations for High-Variety Production Management. Concurrent Engineering: Research and Applications, 8(4): 297-322.

Olsen, K.A. and Saetre, P., 1998. Describing products as executable programs: Variant specification in a customer-oriented environment. International Journal of Production Economics, 56-57: 495-502.

Olsen, K.A., Saetre, P. and Thorstenson, A., 1997. A procedure-oriented generic bill of materials. Computers & Industrial Engineering, 32(1): 29-45.

Pine, B.J., 1993. Mass Customization: The New Frontier in Business Competition, Boston.

Scheer, A.-W., 1994. Business Process Engineering: Reference Models for Industrial Enterprises. Springer-Verlag.

Sousa, R.M., Martins, P.J. and Lima, R.M., 2009. Formal Grammars for Product Data Management on Distributed Manufacturing Systems (accepted for publication), PRO-VE'09 - 10th IFIP Working Conference on Virtual Enterprises, Thessaloniki, Greece.

Wob, W., 1997. A Rule-driven Generator for Variant Parts and Variant Bills of Material. 556-561.