

Overview of GBOM formation for product configuration through data mining in mass customization's product family architecture

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Abstract— Mass customisation deals with the production of variants of a particular product according to customers desires and requirements. These variants together constitute the product family and are represented by product family architecture. As the number of product variants increase, the recording of product data and product structure becomes a problem for two existing production/ inventory control information system. To resolve this problem, use of GBOM is made. The paper gives an overview of the process of preparing a GBOM with the help of data mining approach.

Index Terms—Component, formatting, style, styling, insert. (key words)

I.INTRODUCTION

Mass customisation is a manufacturing technique which provides the benefits of custom made and personalised products with low unit costs as associated with mass production. The process of mass customisation is solely dependent on the product configuration. Product configuration stands for the activity done to satisfy customer's demand by developing product from pre-developed components. Due to the increasing demand of individualised product in market, the importance of product configuration is increasing. The configuration is selection and arrangement of the parts to fit to the product and operational constraints. The constraints are formed on the basis of specifications required by the customer. Thus the core objective of configuration task is to select and arrange parts that satisfy the given specifications. If the product is configured properly the manufacturing process speeds up and vice versa.

II.PRODUCT FAMILY ARCHITECTURE

All the variants of the product form a product family and to describe this product family a concept of Product Family Architecture is used. In PFA, one of the ways of describing a product family is triple view representation scheme. The three views are the functional, the technical and structural view. The functional view is used to describe, typically the customer's functional requirements and the technical view is used to describe the design parameters in the physical domain. The structural view is used for performing the mapping between the functional and technical view as well as describing the rules of how a product may be configured. The three views are referred as FBS views. To materialise the structural view Generic Bill of Materials are used.

III.GENERIC BILL OF MATERIALS

The GBOM, introduced by Hegge and Wortmann (1991), is a special bill-of-material structure for all variants of a

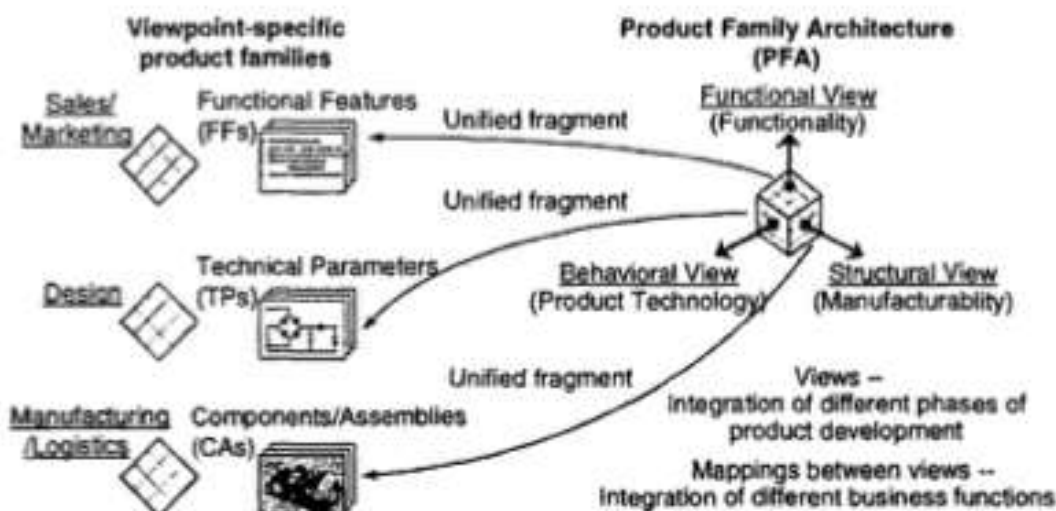


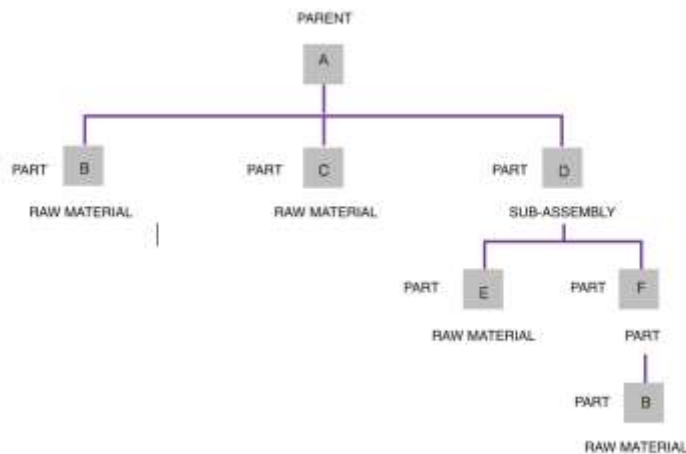
Figure 1:Representation of multiple views of product family in single context.[3]

product family. GBOM serves two purposes, firstly, it acts as a tool for configuring new product variants, i.e. as a Product configurator; secondly, it helps in search of similar parts in libraries, i.e. in reusing the existing designs. GBOM, like a bill of material carries all the necessary description for a product formation.

IV.DATA MINING

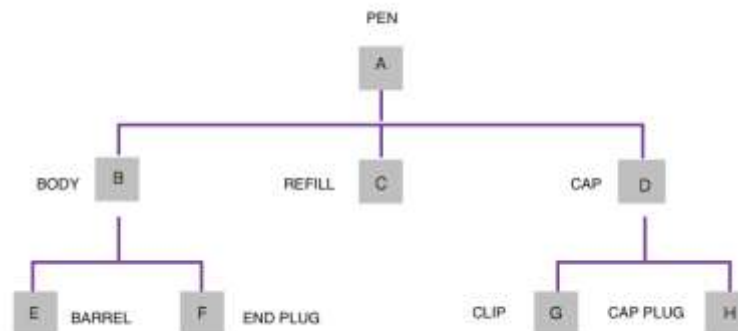
Data mining can also be called as knowledge discovery in databases (KDD). It is a process of analysing data from different perspectives and summarising it into useful information. In technical terms, it is the process of finding correlation and patterns between large sets of data. Data mining techniques include clustering, classification, text mining, association mining and graph based mining. Clustering or cluster analysis is a form data mining called unsupervised learning. It is a process of grouping unlabelled data records on the basis of similar attributes. It is the main task of data mining and a common technique for statistical data analysis. Whereas, Classification is called supervised learning as it is used to group labelled data records. Classification and clustering are commonly known data mining techniques.

Text mining or text data mining refers to analysis of input text in order to obtain quality information. Using master table of manufacturing resource planning (MRP) system, this technique can be used to codify parts. Association mining or market basket analysis is used for finding relationships between variables or attributes in large databases. In graph mining information is extracted from the structure of data sets.



V.DATA MINING APPROACH FOR GBOM FORMATION

For GBOM formation first step is the formation of bill of materials. Bill of materials is a list of parts or components required to build a product. List contains details like raw materials, parts, sub-assemblies and finished parts and the quantities of each required to manufacture an end product. BOM can be represented in form of rooted, unordered trees where the root represents finished or end product, nodes represent manufactured or assembled components and leaves represents purchased parts or raw materials. The BOM structure is shown in figure 2.



The BOM for variants of a single product are different. The BOM may differ in components or structure or in both components and structure. The difference in structure occurs due to change in the no. of intermediate parts, change in parent-child relationships etc. The difference in components occurs due to addition or deletion of one or more components in order to achieve desired characteristics in variants. The two BOM tree variants for a ballpoint pen can be seen in following figure.

When the BOM's have been formed the next step is to cluster the BOM's with similar content. The clustered BOM's are now unified to form one GBOM per cluster. The GBOM is formed by the union of BOM trees within the cluster. The tree with highest indenture level is taken as a starting point and all others cluster members are unified to it. Nodes in the GBOM are labelled according to the end items in BOM and part numbers. For the above mentioned variants of a ball pen GBOM is drawn as follows .

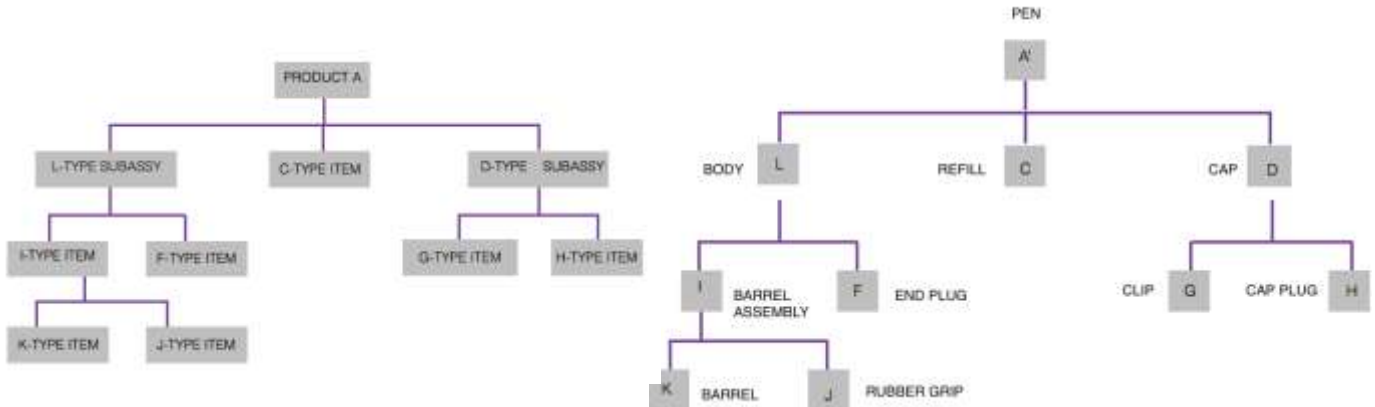
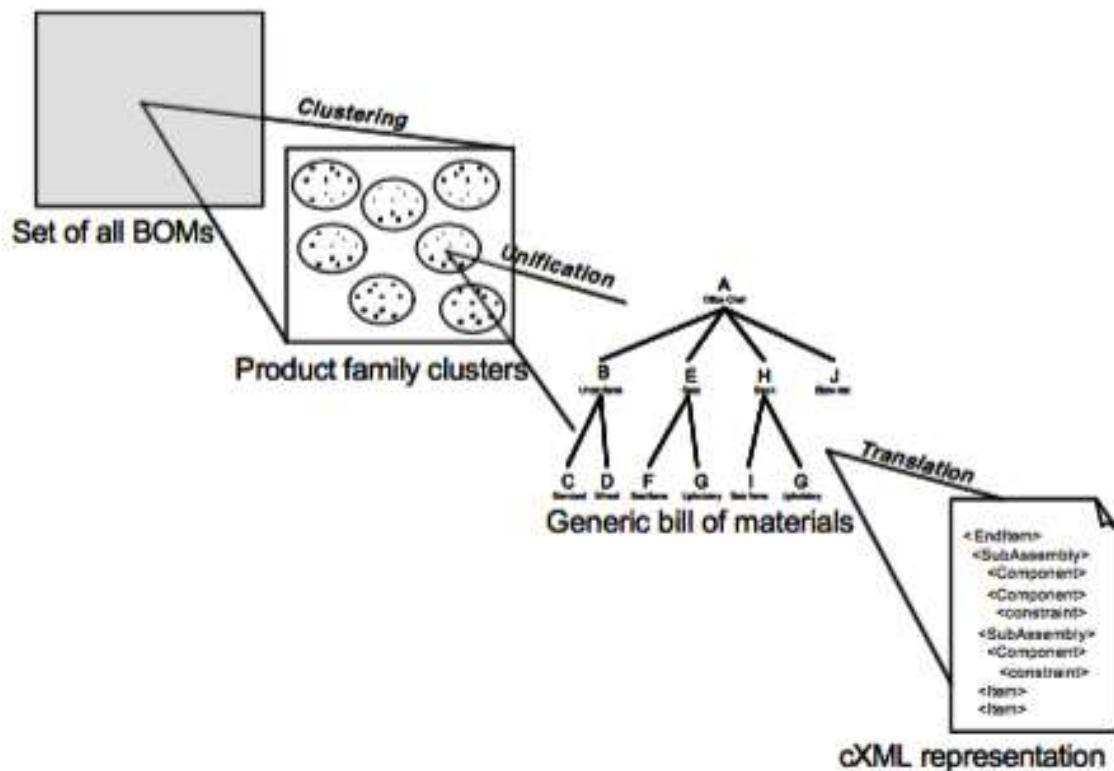


Figure 4: GBOM structure for given variants of ballpoint pen

The GBOM's so formed are represented as constrained XML files using the constraint capability to specify part numbers, processing informations and configurations, etc. This XML file contains node labels, attribute values and constraints for product formation.



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