

Manufacturing Data Modelling and Cost Analysis of Printed Circuit Board Industry

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Abstract

Printed Circuit Board (PCB) is an important platform that provides fundamental interconnected function for all virtually electronic components. A current business reality in PCB industry is that the original design companies outsource PCB production to qualified original equipment manufacturers (OEMs). That is, design and fabrication activities of PCBs is usually separated and distributed in different geographic locations. Therefore, PCB design engineers are hard to acquire manufacturing process knowledge to make good decisions concerning product manufacturability. This reveals the importance and necessity of an inter-organizational PCB design information exchange system for manufacturability analysis. Meanwhile, original design companies are looking for OEM suppliers that can provide quick response on quotation according desired configurations. The information is valuable, because design engineers can modify the design accordingly based on what-if cost analysis.

In order to promote PCB manufacturability analysis, researches contribute several information models based on standard for the exchange of product (STEP) and written in EXPRESS. To systematically evaluate the quotation of PCBs, several researches are conducted. They proposed some activity-based cost (ABC) models for predicting the manufacturing cost of PCB product in order to analysis the quotation of PCBs. Although described researches are trying to provide solutions for PCB manufacturability and quote

analysis, some major problems have been identified. First, those manufacturability models is designated to operated in an isolated organization, but not for inter-organizational collaboration. They are all short of providing integration methodology for design and manufacturing information in an on-line environment. Second, the quote analysis such as ABC would take a long time to analyze each individual activity so that it is hard to be utilized in on-line inter-organization.

To address these issues, this paper presents an on-line inter-organizational PCB manufacturability evaluation and quotation system (PCB-MEQS). The system consists of three modules: manufacturability evaluation module, neural network based quotation module and user interface. Manufacturability evaluation module, based on EXPRESS object-oriented modeling, is able to captures design specifications and manufacturing process restriction under an inter-organizational environment. A rule-based mechanism is embedded in the module to check the validity of a PCB design. To provide precise and rapid quote response, we develop a neural network based quotation module. The network, trained by historical data, stores every possible quote instance in its connection weights so that it can response instantly to a new request. Our experiment shows that proposed neural network quote method performs much faster than ABC method with less than 5 % error rate. Finally, a web-based user interface is constructed to integrate the two modules. Through this interface PCB design engineers can assess their design specifications by acknowledging its manufacturability and quotation. It is believed that proposed PCB-MEQS system can be efficient and effective to the inter-organizational cooperation of PCB industry.

Keywords: Printed Circuit Board, Manufacturability Analysis, Quotation, STEP, EXPRESS, Object-Oriented Modeling, Neural Network, Inter-Organizational Collaboration.

