Study on Quality Prediction Technology of Manufacturing Supply Chain

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ABSTRACT

Supply chain quality is the assurance of product quality in its full life-cycle. Although supply chain quality control is a hot topic among researchers, supply chain quality prediction is actually an important but unsolved problem in manufacturing industry. In this paper, an approach of manufacturing supply chain quality prediction based on quality satisfaction degree is proposed to control supply chain better, in order to help ensure product quality. Supply chain quality prediction 3D model and model based on customer satisfaction and process control are established firstly. And then technologies used in quality prediction are studied, including quality prediction index system established on Expert scoring -AHP and prediction workflow built on ABPM. Finally an example is given to illustrate this approach. The customer satisfaction prediction result of supply chain quality can help supply chain management, and the quality prediction software system can make it easier, which provides a new direction for the product quality control technology research.

Keywords: ABPM, Manufacturing Supply Chain, Process Control, Quality Prediction, Quality Satisfaction Degree

INTRODUCTION

21st century is the quality century, in which the traditional "vertical integration" single enterprise quality control mode has changed into "horizontal integration" supply chain quality management mode in manufacturing industry (Feigenbaum, 1983; Mettler et al., 2012). Modern manufacturing supply chain is a complex system, with human resources, capital, materials, energy and information as input, and the tangible products and intangible services as output (Huang, 2003; Carmen & Manoj, 2005; Kart et al., 2010), any link in the chain with a problem can affect the whole supply chain's quality and finally the products quality (Zhang et al., 2011). Although supply chain quality control is a hot topic among researchers (Kuei et

al., 2001; Thomas, 2008), supply chain quality prediction is actually an important but unsolved problem in manufacturing industry.

In 1995, CENTRIM of Brighton University finished the project "Total quality management in the supply chain" with Bath University as a beginning of supply chain quality prediction. Beamon and Ware (1998) worked out a process quality model for the analysis improvement and system control of supply chain. Duan and Tong (1999) studied on quality assurance system and quality prediction methodologies of supply chain. Also Zhang and Huang (2003) studied on supply chain quality prevention decision problem under asymmetric information. Furthermore, Zhou (2005) and Xu (2008) researched on quality management of supply chain in their maters' theses within supply chain quality prediction technology.

Nowadays, there are more and more researches on supply chain quality prediction (Tsai & Wang, 2004), some of which are applied in manufacturing industry (Hans et al., 2000; Tang, 2004). However, there are still many problems need to be solved, mainly as follows:

- Key quality characteristics extraction of the product realization process under supply chain environment;
- Index data acquisition of dynamic supply chain quality prediction;
- Nonlinear problem in mathematical modeling of supply chain quality prediction.

To overcome the shortcomings, an approach of predicting the quality satisfaction degree of manufacturing supply chain in the next time period is proposed in this paper. Quality prediction models based on customer satisfaction and process control are built, and technologies used in quality prediction are studied. While firstly the prediction index system is established, then the adaptive variable step back propagation method (ABPM) is used in quality prediction, and finally an example is given to illustrate the approach, which provides a new direction for the quality prediction technology research.

MODELING OF MANUFACTURING SUPPLY CHAIN QUALITY PREDICTION

The 3D Model

Supply chain quality prediction should not only focus on the quality of "interface" (customer satisfaction), but should also attach great importance to the quality of "process" (process control). Customer satisfaction should be combined well together with process quality control in supply chain quality prediction (Min & Zhou, 2002; Goknur & Turan, 2010). According to the characteristics of supply chain quality prediction, based on systematically thinking, the 3D model of supply chain quality prediction is built up with three parts—quality prediction related parties, quality prediction contents and quality prediction technologies, as shown in Figure 1.

Model Based on Customer Satisfaction and Process Control

Product life cycle is the core of the manufacturing enterprise production and operation, which includes all the links in product realization process: marketing research, demand analysis, functional plan, design and development, manufacturing, assembly debugging, storage, delivery, site service, recovery and disposal. Manufacturing supply chain quality prediction intends to predict the quality (forecast the supply chain quality satisfaction degree) throughout realization process under supply chain environment based on customer satisfaction, in order to guarantee and improve supply chain quality effectively, to win customer satisfaction, and to promote supply chain competitiveness comprehensively. Supply chain quality prediction based on customer satisfaction and process control is an important content of quality prevention, diagnosis and control, which plays the most intuitive fundamental role in ensuring and improving the quality of supply chain.

Referring to the process division model and the labor's functional division model in general manufacturing product realization process,

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