



Review

A review of data mining applications for quality improvement in manufacturing industry

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ABSTRACT

Many quality improvement (QI) programs including six sigma, design for six sigma, and kaizen require collection and analysis of data to solve quality problems. Due to advances in data collection systems and analysis tools, data mining (DM) has widely been applied for QI in manufacturing. Although a few review papers have recently been published to discuss DM applications in manufacturing, these only cover a small portion of the applications for specific QI problems (quality tasks). In this study, an extensive review covering the literature from 1997 to 2007 and several analyses on selected quality tasks are provided on DM applications in the manufacturing industry. The quality tasks considered are: product/process quality description, predicting quality, classification of quality, and parameter optimisation. The review provides a comprehensive analysis of the literature from various points of view: data handling practices, DM applications for each quality task and for each manufacturing industry, patterns in the use of DM methods, application results, and software used in the applications are analysed. Several summary tables and figures are also provided along with the discussion of the analyses and results. Finally, conclusions and future research directions are presented.

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1. Introduction

Quality improvement (QI) of industrial products and processes requires collection and analyses of data to solve quality related manufacturing problems. While QI programs such as six sigma (6σ), design for six sigma (DFSS), and kaizen keep encouraging collection of data to attack quality problems, with advances in automation and computer systems, data from manufacturing processes is becoming more and more available. Although traditional data analysis tools have been successfully used in improving quality of products and processes, now better tools exist to mine massive data sets collected through computerized systems in the industry.

Quality problems may involve several input and output variables that are not easy to model and/or optimise. As Yang and Trewin (2004) point out, data mining (DM) and knowledge discovery in databases (KDD) have been successfully used for solving QI and control problems involving multivariate data in various stages of product/process life cycles. Yet, a review of such problem solving approaches is needed to guide practitioners.

The aim of this study is to extensively review DM applications in manufacturing industries to handle QI problems that are of wide interest to practitioners as well as to outline related future research directions and challenges for researchers. Recently, some other reviews of DM applications in manufacturing and/or product design have also appeared in the literature (see Braha, 2001; Choudhary, Harding, & Tiwari, 2008; Feng & Kuslák, 2006; Harding, Shahbaz, Srinivas, & Kuslák, 2006; Kuslák, 2006; Pham & Afify, 2005; Wang, Tong, Eymard, Roucoules, & Matta, 2007a). However, these reviews are concerned with DM applications in manufacturing in general, and cover only a small sample of the papers that are reviewed in this study. Furthermore, their context is too broad to answer the following open research questions in the scope of our interest:

1. What are the characteristics of data collected in these applications? Which data preparation and preprocessing approaches are used?
2. How many DM applications have been published (within the scope of this study) in different manufacturing industries and how does this number change over time? Which manufacturing industries have applied DM frequently and for what purpose (quality task)? Which DM methods are commonly used for each quality task and manufacturing industry?

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