



Review

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

Gülser Köksal ^{a,*}, İnci Batmaz ^b, Murat Caner Testik ^c

^a Department of Industrial Engineering, Middle East Technical University, Sımsık Blvd., Ankara 06321, Turkey

^b Department of Statistics, Middle East Technical University, Ankara 06321, Turkey

^c Department of Industrial Engineering, Hacettepe University, Ankara 06800, Turkey

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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 & Kusiak, 2006; Harding, Shahbaz, Srinivas, & Kusiak, 2006; Kusiak, 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?

* Corresponding author. Tel.: +90 312 2102285; fax: +90 312 2104786.

E-mail addresses: koksal@ie.metu.edu.tr (G. Köksal), ibatmaz@stat.metu.edu.tr (I. Batmaz), mtestik@hacettepe.edu.tr (M.C. Testik).

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Table of Contents Data Mining For Design And Manufacturing

1. Understanding the eBook Data Mining For Design And Manufacturing
 - The Rise of Digital Reading Data Mining For Design And Manufacturing
 - Advantages of eBooks Over Traditional Books
2. Identifying Data Mining For Design And Manufacturing
 - Exploring Different Genres
 - Considering Fiction vs. Non-Fiction
 - Determining Your Reading Goals
3. Choosing the Right eBook Platform
 - Popular eBook Platforms
 - Features to Look for in an Data Mining For Design And Manufacturing
 - User-Friendly Interface
4. Exploring eBook Recommendations from Data Mining For Design And Manufacturing
 - Personalized Recommendations
 - Data Mining For Design And Manufacturing User Reviews and Ratings
 - Data Mining For Design And Manufacturing and Bestseller Lists
5. Accessing Data Mining For Design And Manufacturing Free and Paid eBooks
 - Data Mining For Design And Manufacturing Public Domain eBooks
 - Data Mining For Design And Manufacturing eBook Subscription Services
 - Data Mining For Design And Manufacturing Budget-Friendly Options

6. Navigating Data Mining For Design And Manufacturing eBook Formats
 - ePub, PDF, MOBI, and More
 - Data Mining For Design And Manufacturing Compatibility with Devices
 - Data Mining For Design And Manufacturing Enhanced eBook Features
7. Enhancing Your Reading Experience
 - Adjustable Fonts and Text Sizes of Data Mining For Design And Manufacturing
 - Highlighting and Note-Taking Data Mining For Design And Manufacturing
 - Interactive Elements Data Mining For Design And Manufacturing
8. Staying Engaged with Data Mining For Design And Manufacturing
 - Joining Online Reading Communities
 - Participating in Virtual Book Clubs
 - Following Authors and Publishers Data Mining For Design And Manufacturing
9. Balancing eBooks and Physical Books Data Mining For Design And Manufacturing
 - Benefits of a Digital Library
 - Creating a Diverse Reading Collection Data Mining For Design And Manufacturing
10. Overcoming Reading Challenges
 - Dealing with Digital Eye Strain
 - Minimizing Distractions
 - Managing Screen Time
11. Cultivating a Reading Routine Data Mining For Design And Manufacturing
 - Setting Reading Goals Data Mining For Design And Manufacturing
 - Carving Out Dedicated Reading Time
12. Sourcing Reliable Information of Data Mining For Design And Manufacturing
 - Fact-Checking eBook Content of Data Mining For Design And Manufacturing
 - Distinguishing Credible Sources
13. Promoting Lifelong Learning
 - Utilizing eBooks for Skill Development
 - Exploring Educational eBooks
14. Embracing eBook Trends
 - Integration of Multimedia Elements

- Interactive and Gamified eBooks

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