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 Trewn (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 aims 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?

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[Data Mining For Design And Manufacturing](#)

Quan Jie Gao

Data Mining For Design And Manufacturing:

   Data Mining for Design and Manufacturing D. Braha,2013-03-14 Data Mining for Design and Manufacturing Methods and Applications is the first book that brings together research and applications for data mining within design and manufacturing The aim of the book is 1 to clarify the integration of data mining in engineering design and manufacturing 2 to present a wide range of domains to which data mining can be applied 3 to demonstrate the essential need for symbiotic collaboration of expertise in design and manufacturing data mining and information technology and 4 to illustrate how to overcome central problems in design and manufacturing environments The book also presents formal tools required to extract valuable information from design and manufacturing data and facilitates interdisciplinary problem solving for enhanced decision making Audience The book is aimed at both academic and practising audiences It can serve as a reference or textbook for senior or graduate level students in Engineering Computer and Management Sciences who are interested in data mining technologies The book will be useful for practitioners interested in utilizing data mining techniques in design and manufacturing as well as for computer software developers engaged in developing data mining tools   **Handbook of Data Mining for Design and Manufacturing** Fernando Sanchez Lasheras,Paulino Jose Garcia Nieto,2016-04   *Data Mining and Applications in Engineering Design, Manufacturing and Logistics* J. C.-X. Feng,2006   *Special Issue: Data Mining and Applications in Engineering Design, Manufacturing and Logistics* ,2006   **Intelligent Systems in Design and Manufacturing** ,2001   *Data Mining* Yong Yin,Ikou Kaku,Jiafu Tang,JianMing Zhu,2011-01-07 Data Mining introduces in clear and simple ways how to use existing data mining methods to obtain effective solutions for a variety of management and engineering design problems Data Mining is organised into two parts the first provides a focused introduction to data mining and the second goes into greater depth on subjects such as customer analysis It covers almost all managerial activities of a company including supply chain design product development manufacturing system design product quality control and preservation of privacy Incorporating recent developments of data mining that have made it possible to deal with management and engineering design problems with greater efficiency and efficacy Data Mining presents a number of state of the art topics It will be an informative source of information for researchers but will also be a useful reference work for industrial and managerial practitioners   *Knowledge Enterprise: Intelligent Strategies in Product Design, Manufacturing, and Management* Kesheng Wang,George L. Kovacs,Michael Wozny,Minglun Fang,2006-08-31 PROLAMAT PROgraming LAnguages for MAchine Tools is a series of international conferences devoted to the filed of manufacturing 1969 Roma Italy 1973 Budapest Hungary 1976 Stirling Scotland 1979 Ann Arbor USA 1982 Leningrad USSR 1992 Tokyo Japan 1995 Berlin Germany 1998 Trento Italy 2001 Budapest Hungary organized by IFIP the International Federation for Information Processing This triennial event has been a basic meeting for academic and industrial experts in manufacturing Recently not only the original topics but all other aspects of the computerized design and production of products and production systems

from traditional to virtual ones have been covered and dealt with including life cycle issues This volume contains the edited version of the technical presentations of PROLMAT 2006 the IFIP TC5 international conference held on June 15 17 2006 at the Shanghai University in China The main theme of this conference is Knowledge Enterprise These proceedings focus on the issue of how to translate data and information into knowledge in manufacturing enterprises Profitability is no longer only a function of price cost and adequate quality   E-manufacturing K. Cheng,2005 This book begins by presenting the concepts of and an engineering oriented approach to e manufacturing Next the enabling technologies and implementation issues for e manufacturing including topics such as Java programming database integration client server architecture web based 3D modelling and simulations and open computing and interaction design are reviewed There is then an exploration of application perspectives through a number of application systems Designed for final year undergraduate elective courses on e manufacturing and introductory courses on e manufacturing at postgraduate level this book can also be used as a textbook for teaching e engineering in general It will also provide a useful reference for design and manufacturing engineers company managers e business e commerce developers and IT professionals and managers Book Jacket   **Proceedings of the ... ASME Design Engineering Technical Conferences** ,2006   *Manufacturing Systems and Technologies for the New Frontier* Fumihiko Kimura,2008-05-19 Collected here are 112 papers concerned with new directions in manufacturing systems given at the 41st CIRP Conference on Manufacturing Systems The high quality material includes reports of work from both scientific and engineering standpoints   **Robust Manufacturing Control** Katja Windt,2012-12-14 This contributed volume collects research papers presented at the CIRP Sponsored Conference Robust Manufacturing Control Innovative and Interdisciplinary Approaches for Global Networks RoMaC 2012 Jacobs University Bremen Germany June 18th 20th 2012 These research papers present the latest developments and new ideas focusing on robust manufacturing control for global networks Today Global Production Networks i e the nexus of interconnected material and information flows through which products and services are manufactured assembled and distributed are confronted with and expected to adapt to sudden and unpredictable large scale changes of important parameters which are occurring more and more frequently event propagation in networks with high degree of interconnectivity which leads to unforeseen fluctuations and non equilibrium states which increasingly characterize daily business These multi scale changes deeply influence logistic target achievement and call for robust planning and control strategies Therefore understanding the cause and effects of multi scale changes in production networks is of major interest New methodological approaches from different science disciplines are promising to contribute to a new level comprehension of network processes Unconventional methods from biology perturbation ecology or auditory display are gaining increasing importance as they are confronted with similar challenges Advancements from the classical disciplines such as mathematics physics and engineering are also becoming of continuing importance   Multivariate Statistical Methods in Quality Management Kai Yang,Jayant Trewn,2004-03-17 Multivariate

statistical methods are an essential component of quality engineering data analysis This monograph provides a solid background in multivariate statistical fundamentals and details key multivariate statistical methods including simple multivariate data graphical display and multivariate data stratification Graphical multivariate data display Multivariate regression and path analysis Multivariate process control charts Six sigma and multivariate statistical methods **Data Mining** Nelson F. F. Ebecken,1998 Illustrating recent advances in data mining problems encompassing both original research results and practical development experiences this book features the proceedings of the International Conference on Data Mining held in Rio de Janeiro in September 1998 Contributions from academia and industry covering such diverse areas as machine learning databases statistics knowledge acquisition data visualization and knowledge based systems are included **CORDIS Focus** ,2002 Information Management Report ,2001 Frontiers of Manufacturing Science and Measuring Technology III Wen Pei Sung,Jimmy Chih Ming Kao,Ran Chen,2013-09-03 Selected peer reviewed papers from the 2013 3rd International Conference on Frontiers of Manufacturing Science and Measuring Technology ICFMM 2013 July 30 31 2013 LiJiang China **Numbers, Intelligence, Manufacturing Technology and Machinery Automation** Quan Jie Gao,2011-10-24 Selected peer reviewed papers from the 2011 International Academic Conference on Numbers Intelligence Manufacturing Technology and Machinery Automation MAMT 2011 December 24 25 2011 Wuhan China Advances in Materials Manufacturing Science and Technology II Chengyu Jiang,2006 The present volume contains 293 selected and peer reviewed papers carefully chosen from among the more than 500 papers presented by worldwide specialists from industry and academia at the 12th International Manufacturing Conference in China organized by the Northwestern Polytechnic University Advances in Materials Manufacturing Science and Technology XIII: Modern design theory and methodology, MEMS and Nanotechnology, and Material science and technology in manufacturing ,2009 **Tuning System Performance Using Data Mining Techniques** Varun Kohli,2006

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Table of Contents Data Mining For Design And Manufacturing

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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