

An Integrated Approach for the Operational Design of a Cellular Manufacturing System

Ayesha Maroof¹, Adnan Tariq², Sahar Noor³

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ABSTRACT

Shorter product life cycles, unpredictable demand patterns and the ever-shrinking time to market, have been constantly keeping the manufacturing firms under a lot of pressure. To face these challenges the manufacturing organizations have been shifting to Cellular Manufacturing (CM) due to its benefits of reducing manufacturing costs, increasing flexibility and delivering orders on time. Despite having several benefits, designing a Cellular Manufacturing System (CMS) for a real-life application is a tough ask. The main challenge is the part-machine grouping in cells. It becomes even more challenging when the group scheduling (GS) problem is handled alongside the part-machine clustering. To take up this challenge, an integrated model is developed during this research which handles the machine-part grouping and the GS problems, simultaneously. To optimize the multiple objectives of maximizing Grouping Efficacy (GE) and minimizing Makespan (C_{max}), concurrently, a Hybrid Genetic Algorithm (HGA) based approach is developed. The proposed technique is validated through the famous benchmark problems, unlike the several approaches already available in literature. The computational results have shown that the integrated approach, presented in this paper, is more effective as compared to a sequential technique. Also, its accuracy remains intact even if it is applied to large sized problems.

Keywords: Cellular Manufacturing System, Grouping Efficacy, Makespan, Hybrid Genetic Algorithm

1. INTRODUCTION

Cellular Manufacturing System (CMS) is a manufacturing concept based on the philosophy of Group Technology (GT). It is implemented by arranging the entire manufacturing system into cells, where parts having similar processing requirements are processed inside a single cell. This particular arrangement (identification of part families and corresponding machine groups) of the system makes the production flow simpler and shorter which significantly decreases the lead times and material handling costs. This is the reason that

CMS is largely considered to have the ability of economically producing parts in medium volume and variety as compared to the conventional manufacturing systems. Main cause for the success of CMS is its capacity to reduce: set-up times, work in process, lot sizes, production equipment and enhanced productivity [1]. Cellular Manufacturing (CM) is the approach which is best suited to the present day's competitive market environment where manufacturers consistently strive to increase their efficiency by reducing delivery times and improving product quality without substantially enhancing investments [2]. Despite being hugely beneficial,

¹ Department of Industrial Engineering, Istanbul Ticaret University, Istanbul, Turkey.

Email: ayesha.maroof@istanbulticaret.edu.tr (Corresponding Author).

² Department of Mechanical Engineering, Wah Engineering College, University of Wah, Wah Cantt, Pakistan.

Email: adnan.tariq@wecuw.edu.pk

³ University of Engineering and Technology, Peshawar, Pakistan. Email: sahar@uetpeshawar.edu.pk

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Cellular Manufacturing Systems An Integrated Approach

A.K. Kamrani,H.R. Parsaei,D.H. Liles



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CELLULAR MANUFACTURING SYSTEMS : AN INTEGRATED APPROACH PARASHAR, B.S.

NAGENDRA,2008-10-24 Cellular manufacturing an application of group technology is a stepping stone to achieve world class manufacturing status It has emerged as an important technique to cope up with fast changing industrial demands for the application of newer manufacturing systems This comprehensive and well written text deals with all facets of cellular manufacturing right from introduction to application in a chronological order The book first introduces cell formation techniques followed by elimination of exceptional components evaluation of solutions cell characteristics and production control issues like scheduling line balancing and inventory control Finally it discusses about the application of cellular manufacturing in a large public sector The text is supported by numerous figures tables and examples and also furnishes simple algorithms for complex methods Primarily intended for the postgraduate students of mechanical engineering and production engineering with specialization in manufacturing systems group technology it will also be useful for the researchers scientists and professionals as a reference book

An Integrated Approach for the Design and Operation of Cellular Manufacturing Systems Wen-Shiom Lian,1989

Agile Manufacturing A. Gunasekaran,2001-01-25 Agile manufacturing is defined as the capability of surviving and prospering in a competitive environment of continuous and unpredictable change by reacting quickly and effectively to changing markets driven by customer designed products and services Critical to successfully accomplishing AM are a few enabling technologies such as the standard for the exchange of products STEP concurrent engineering virtual manufacturing component based hierarchical shop floor control system information and communication infrastructure etc The scope of the book is to present the undergraduate and graduate students senior managers and researchers in manufacturing systems design and management industrial engineering and information technology with the conceptual and theoretical basis for the design and implementation of AMS Also the book focuses on broad policy directives and plans of agile manufacturing that guide the monitoring and evaluating the manufacturing strategies and their performance A problem solving approach is taken throughout the book emphasizing the context of agile manufacturing and the complexities to be addressed

An Integrated Approach in the Design of Cellular Manufacturing Systems for Dynamic Production Requirements Fantahun Melaku Defersha,2006

Planning, Design, and Analysis of Cellular Manufacturing Systems A.K. Kamrani,H.R. Parsaei,D.H. Liles,1995-04-11

Leading researchers in the field of cellular manufacturing systems from academia and industry have contributed to this volume The book aims to report the latest developments and address the central issues in the design and implementation of cellular manufacturing systems Cellular Manufacturing CM is one of the major concepts used in the design of flexible manufacturing systems CM also known as group production or family programming can be described as a manufacturing technique that produces families of parts within a single line or cell of machines The first part of the book describes various

techniques for design and modeling of cellular manufacturing systems The second part is concerned with performance measure and analysis followed by a section which presents the applications of artificial intelligence and computer tools in cellular manufacturing systems

Manufacturing System Faieza Abdul Aziz, 2012-05-16 This book attempts to bring together selected recent advances tools application and new ideas in manufacturing systems Manufacturing system comprise of equipment products people information control and support functions for the competitive development to satisfy market needs It provides a comprehensive collection of papers on the latest fundamental and applied industrial research The book will be of great interest to those involved in manufacturing engineering systems and management and those involved in manufacturing research

Artificial Intelligence in Mechanical and Industrial Engineering Kaushik Kumar, Divya Zindani, J. Paulo Davim, 2021-06-20 Artificial Intelligence in Mechanical and Industrial Engineering offers a unified platform for the dissemination of basic and applied knowledge on the integration of artificial intelligence within the realm of mechanical and industrial engineering The book covers the tools and information needed to build successful careers and a source of knowledge for those working with AI within these domains The book offers a systematic approach to explicate fundamentals as well as recent advances It incorporates various case studies for major topics as well as numerous examples It will also include real time intelligent automation and associated supporting methodologies and techniques and cover decision support systems as well as applications of Chaos Theory and Fractals The book will give scientists researchers instructors students and practitioners the tools and information needed to build successful careers and to be an impetus to advancements in next generation mechanical and industrial engineering domains

Design and Management of Manufacturing Systems Arkadiusz Gola, 2021-09-02 Although the design and management of manufacturing systems have been explored in the literature for many years now they still remain topical problems in the current scientific research The changing market trends globalization the constant pressure to reduce production costs and technical and technological progress make it necessary to search for new manufacturing methods and ways of organizing them and to modify manufacturing system design paradigms This book presents current research in different areas connected with the design and management of manufacturing systems and covers such subject areas as methods supporting the design of manufacturing systems methods of improving maintenance processes in companies the design and improvement of manufacturing processes the control of production processes in modern manufacturing systems production methods and techniques used in modern manufacturing systems and environmental aspects of production and their impact on the design and management of manufacturing systems The wide range of research findings reported in this book confirms that the design of manufacturing systems is a complex problem and that the achievement of goals set for modern manufacturing systems requires interdisciplinary knowledge and the simultaneous design of the product process and system as well as the knowledge of modern manufacturing and organizational methods and techniques

Industrial Engineering in the Digital Disruption Era Fethi Calisir, Orhan

Korhan,2020-03-16 This book gathers extended versions of the best papers presented at the Global Joint Conference on Industrial Engineering and Its Application Areas GJCIE held on September 2 3 2019 in Gazimagusa North Cyprus Turkey It covers a wide range of topics including decision analysis supply chain management systems modelling and quality control Further special emphasis is placed on the state of the art and the challenges of digital disruption as well as effective strategies that can be used to change organizational structures and eliminate the barriers that are keeping industries from taking full advantage of today s digital technologies *Computational Optimization in Engineering* Hossein

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and evaluating facilities plans

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1. Understanding the eBook Cellular Manufacturing Systems An Integrated Approach
 - The Rise of Digital Reading Cellular Manufacturing Systems An Integrated Approach
 - Advantages of eBooks Over Traditional Books
2. Identifying Cellular Manufacturing Systems An Integrated Approach
 - 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 Cellular Manufacturing Systems An Integrated Approach
 - User-Friendly Interface
4. Exploring eBook Recommendations from Cellular Manufacturing Systems An Integrated Approach
 - Personalized Recommendations
 - Cellular Manufacturing Systems An Integrated Approach User Reviews and Ratings
 - Cellular Manufacturing Systems An Integrated Approach and Bestseller Lists
5. Accessing Cellular Manufacturing Systems An Integrated Approach Free and Paid eBooks
 - Cellular Manufacturing Systems An Integrated Approach Public Domain eBooks
 - Cellular Manufacturing Systems An Integrated Approach eBook Subscription Services
 - Cellular Manufacturing Systems An Integrated Approach Budget-Friendly Options

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

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