

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

Ayesha Maroof<sup>1</sup>, Adnan Tariq<sup>2</sup>, Sahar Noor<sup>3</sup>

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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 problem, simultaneously. To optimize the multiple objectives of maximizing Grouping Efficacy (GE) and minimizing Makespan (Cmax), 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

**C**ellular 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,

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# Cellular Manufacturing Systems An Integrated Approach

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

## **Cellular Manufacturing Systems An Integrated Approach:**

### **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

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Peyvandi,2017-04-26 The purpose of optimization is to maximize the quality of lives productivity in time as well as interests Therefore optimization is an ongoing challenge for selecting the best possible among many other inferior designs For a hundred years in the past as optimization has been essential to human life several techniques have been developed and utilized Such a development has been one of the long lasting challenges in engineering and science and it is now clear that the optimization goals in many of real life problems are unlikely to be achieved without resource for computational techniques The history of such a development in the optimization techniques starts from the early 1950s and is still in progress Since then the efforts behind this development dedicated by many distinguished scientists mathematicians and engineers have brought us today a level of quality of lives This book concerns with the computational optimization in engineering and techniques to resolve the underlying problems in real life The current book contains studies from scientists and researchers around the world from North America to Europe and from Asia to Australia *International Journal of Manufacturing Technology and Management* ,2002 *Applied Mechanics Reviews* ,1995 **Proceedings of the 13th International Conference on Production Research** E. M. Dar-El,Reuven Karni,Yale T. Herer,1995

*International Journal of Business Performance Management* ,2004 **An Investigation of Labor Flexibility in Cellular Manufacturing Systems** Viviana I. Cesaní,1998 **Modeling and Analysis of Manufacturing Systems** Ronald G. Askin,Charles R. Standridge,1993-01-18 Manufacturing models Assembly lines reliable serial systems Transfer lines and general serial systems Shop scheduling with many products Flexible manufacturing systems Machine setup and operation sequencing Material handling systems Warehousing storage and retrieval systems General manufacturing systems analytical queueing models General manufacturing systems empirical simulation models *Advances in Manufacturing Systems*

George Chryssolouris,1990 **Manufacturing Processes for Engineering Materials** Serope Kalpakjian,Steven R. Schmid,2008 This comprehensive up to date text has balance coverage of the fundamentals of materials and processes its analytical approaches and its applications in manufacturing engineering *Journal of Engineering for Industry* ,1988

*Facilities Planning* James A. Tompkins,2003 Introducing various contemporary practices this book shows how to approach facilities planning with precision It guides the reader through each step in the planning process from defining requirements to developing alternative material handling techniques and manufacturing waterhouse operations to selecting

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