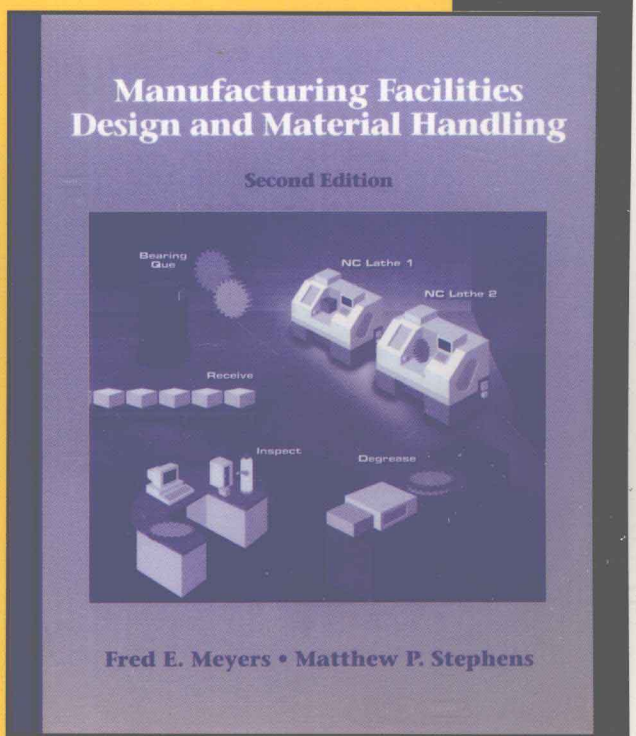
国外大学优秀教材——工业工程系列（影印版）

Fred E. Meyers　Matthew P. Stephens

制造设施设计和物料搬运

（第2版）



清华大学出版社
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SECOND EDITION

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（京）新登字 158 号

制造设施设计和物料搬运（第 2 版）
Manufacturing Facilities Design and Material Handling, second edition.
EISBN: 0-13-674821-X

北京市版权局著作权合同登记号：图字：01-2002-3023

书　　名：制造设施设计和物料搬运（第 2 版）
作　　者：Fred E. Meyers　Matthew P. Stephens
出 版 者：清华大学出版社（北京清华大学学研大厦，邮编 100084）
http:// www.tup.tsinghua.edu.cn
责任编辑：张秋玲
印 刷 者：清华大学印刷厂
发 行 者：新华书店总店北京发行所
开　　本：787×960 1/16　**印张**：27
版　　次：2002 年 8 月第 1 版　2002 年 8 月第 1 次印刷
书　　号：ISBN 7-302-05666-8/TB・46
印　　数：0001～3000
定　　价：53.00 元

PREFACE

The second edition of *Manufacturing Facilities Design and Material Handling* embraces the same practical approach to facilities planning as the first edition. Two new chapters—Chapter 3, Time Study, and Chapter 15, Simulation—have been added. Various new topics are included, such as application of automatic identification and data collection (AIDC) and ergonomics. The chapters conclude with a rich collection of discussion questions and problems.

The goals of this project-oriented facilities design and material handling textbook are to provide students and practitioners with a practical resource that describes the techniques and procedures for developing an efficient facility layout and to introduce some of the state-of-the-art tools such as computer simulation.

This how-to book leads the reader through the collection, analysis, and development of vital and relevant data to produce a functional plant layout. Our systematic and methodical approach allows the novice to follow along step by step. However, the textbook has been structured so that it may also be used easily and productively by more experienced planners and serve as a useful guide and reference.

The mathematical background and requirements for this textbook have been intentionally kept at the level of high school algebra. Although quantitative analyses and the manipulation of numbers are extremely important for planning an efficient facility, these skills can be developed without confusing the process with obscure mathematical procedures.

Some experience with computers and computer-aided design (CAD) software packages will prove beneficial for the facilities planner and for other professional careers in manufacturing and technology. Those techniques are discussed and emphasized.

On the average, a manufacturing facility will undergo some re-layout once every 18 months. Furthermore, the efficiency, productivity, and profitability of any given enterprise are directly correlated with the efficiency of the layout and the material handling systems. Thus individuals with skills in this area are in demand and well compensated.

The design of the facility and material handling systems starts with collecting data from various departments. Chapter 2 describes the sources and the significance of this information. The marketing department provides data on various customer requirements that determine production volume and various manufacturing capabilities. The product engineering department supplies blueprints and bills of materials, and assists with equipment requirement determination. Inventory and investment policies are determined according to management policies which in turn dictate space requirements, make or buy decisions, production start dates, and so on.

Among the most basic and fundamental data are principles of time and motion economy and time standards. On the basis of this information, machine and personnel requirements are calculated, assembly lines are balanced, and workload in manufacturing cells are

leveled. Chapter 3 has been added to introduce the reader to the concepts of motion and time study.

Chapter 4 describes the development of route sheets, the sequence of operations, assembly charts, assembly line balancing, and fraction equipment calculation. Use of computer simulation has also been added. Chapter 5 analyzes material flow to assure proper placement of machines and departments to minimize costs. Seven techniques are discussed in the chapter, as well as the use of computer-aided flow design and analysis.

Chapter 6 describes the activity relationship diagram. The importance of relationships among departments, people, offices, and services, and its effect on the layout is explored. The activity relationship leads to the creation of the dimensionless block diagram.

Space calculation and ergonomic considerations are major and significant aspects of facilities planning. Chapter 7 discusses workstation design, Chapter 8 covers auxiliary services' space requirements, Chapter 9 discusses employee services' space requirements, and Chapter 12 covers office layout techniques and space requirements.

The dimensionless block diagram, which was developed in Chapter 6, is used as a guide to area allocation, and is discussed in Chapter 13. The area allocation procedure results in an area allocation diagram. At this point, a plot plan and a detailed layout are created. Chapter 14 discusses the many techniques of layout construction.

Many other functions require space. Some of these areas need as much space as the production department. The stores and warehouse departments are good examples. Good analysis and knowledge of design criteria can save much space and promote efficiency of both personnel and equipment. Other functions and spaces such as receiving, shipping, lunchroom, bathrooms, first aid rooms, and offices need careful consideration by the facilities planner. The location and size of each activity can have an effect on the overall operational efficiency. Chapters 8, 9, and 12 are dedicated to these topics.

Material handling systems are discussed in Chapters 10 and 11. The reader is introduced to new and exciting material handling concepts and equipment. Application of automatic identification and data collection (AIDC) and ergonomic considerations are emphasized. We encourage the reader to integrate material handling with other functions to increase productivity and efficiency.

Chapter 15 has been added to discuss the concept of simulation and introduces the reader to various applications and the power of computer simulation in the facilities planning arena. Some state-of-the-art simulation software packages are introduced to the reader, and case studies are discussed.

Chapter 16 covers selling the layout through a project report and oral presentation, an important part of any project.

The resultant facility design is only as good as the data and the data analyses upon which the plan has been based. Probably no single factor affects the operational efficiency and safety of an enterprise than its layout and material handling system.

This book is designed to assist the student and the practitioner in designing an efficient manufacturing facility. Students should select a simple product with at least 10 parts, each requiring five manufacturing operations, and attempt to prepare a layout capable of producing at least 1,000 units per 8-hour shift. The final project should be a written report and an oral presentation.

Fred E. Meyers
Matthew P. Stephens

Forward

This textbook series is published at a very opportunity time when the discipline of industrial engineering is experiencing a phenomenal growth in China academia and with its increased interests in the utilization of the concepts, methods and tools of industrial engineering in the workplace. Effective utilization of these industrial engineering approaches in the workplace should result in increased productivity, quality of work, satisfaction and profitability to the cooperation.

The books in this series should be most suitable to junior and senior undergraduate students and first year graduate students, and to those in industry who need to solve problems on the design, operation and management of industrial systems.

Gavriel Salvendy

Department of Industrial Engineering, Tsinghua University

School of Industrial Engineering, Purdue University

April, 2002

前　言

本教材系列的出版正值中国学术界工业工程学科经历巨大发展、实际工作中对工业工程的概念、方法和工具的使用兴趣日渐浓厚之时。在实际工作中有效地应用工业工程的手段将无疑会提高生产率、工作质量、合作的满意度和效果。

该系列中的书籍对工业工程的本科生、研究生和工业界中需要解决工程系统设计、运作和管理诸方面问题的人士最为适用。

加弗瑞尔·沙尔文迪
清华大学工业工程系
普渡大学工业工程学院（美国）
2002 年 4 月

ABOUT THE AUTHORS

Fred E. Meyers, PE, is President of Fred Meyers and Associates, an industrial engineering management consulting company. Mr. Meyers is a registered Professional Industrial Engineer, senior member of the Institute of Industrial Engineers, and has 35 years of industrial engineering experience. He has worked for Caterpillar Tractor Co., Boeing's aerospace division, Mattel Toy Co., Times Mirror Corporation, Ingersol-Rand's Proto Tool division, and Spaulding's golf club division. He taught for 20 years at Southern Illinois University–Carbondale, College of Engineering, while starting and operating his consulting business. He was a director of applied research and an associate professor. Mr. Meyers has worked for over 100 companies as a consultant, and has been responsible for installing incentive systems, performance control systems, plant layouts, and new product startup and cost-estimating systems. He has worked in heavy equipment manufacturing, aerospace, consumer products, appliance manufacturing, lumber, plywood, paper, oil blending and packaging, furniture, tooling, fiberglass, and many other areas. His variety of assignments has given him plant layout experience that is equaled by only a few.

Fred E. Meyers has taught plant layout to over 60 classes, including professional engineers and managers, union people, and college students. He has presented seminars to the National Association of Industrial Technology, many industrial plants, several Air Force and Navy bases, and labor unions. He also wrote *Motion and Time Study: For Lean Manufacturing* (Prentice Hall, 1999).

Matthew P. Stephens, Ph.D., CQE, is an associate professor in the Department of Industrial Technology at Purdue University where he teaches graduate and undergraduate courses in facilities planning, statistical quality control, and production planning. Professor Stephens holds undergraduate and graduate degrees from Southern Illinois University and the University of Arkansas, with specialization in operations management and statistics.

Prior to joining academe, Dr. Stephens spent nine years with several manufacturing and business enterprises, including flatbed trailer and washer and dryer manufacturers. He also has been extensively involved as a consultant with a number of major manufacturing companies.

Professor Stephens has numerous publications in the areas of simulation, quality and productivity, and lean production systems. He has served various professional organizations, including the National Association of Industrial Technology and the American Society for Quality, of which he is Senior Member and a Certified Quality Engineer.

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