



美国商学院原版教材精选系列

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# 物料管理入门

(第7版)

## Introduction to Materials Management

Seventh Edition

[加] 托尼·阿诺德 (J. R. Tony Arnold)

[美] 斯蒂芬·查普曼 (Stephen N. Chapman) 著

[加] 洛伊德·克莱夫 (Lloyd M. Clive)

清华大学出版社







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北京

北京市版权局著作权合同登记号 图字: 01-2012-2071

Original edition, entitled **Introduction to Materials Management**, 9780131376700 by **J. R. Tony Arnold, Stephen N. Chapman and Lloyd M. Clive**, published by Pearson Education, Inc., publishing as Prentice Hall, copyright © 2012.

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China edition published by **PEARSON EDUCATION ASIA LTD.**, and **TSINGHUA UNIVERSITY PRESS** Copyright © 2013.

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#### 图书在版编目(CIP)数据

物料管理入门: 第7版=Introduction to materials management 7: 英文/(加)阿诺德(Arnold, J. R. T.), (美)查普曼(Chapman, S. N.), (加)克莱夫(Clive, L. M.)著.--北京: 清华大学出版社, 2013

(美国商学院原版教材精选系列)

ISBN 978-7-302-32314-3

I. ①物… II. ①阿… ②查… ③克… III. ①企业管理—物资管理—高等学校—教材—英文 IV. ①F273.4

中国版本图书馆 CIP 数据核字(2013)第 091975 号

责任编辑: 贺 岩

封面设计: 漫酷文化

责任印制: 李红英

出版发行: 清华大学出版社

网 址: <http://www.tup.com.cn>, <http://www.wqbook.com>

地 址: 北京清华大学学研大厦 A 座

邮 编: 100084

社 总 机: 010-62770175

邮 购: 010-62786544

投稿与读者服务: 010-62776969, [c-service@tup.tsinghua.edu.cn](mailto:c-service@tup.tsinghua.edu.cn)

质量反馈: 010-62772015, [zhiliang@tup.tsinghua.edu.cn](mailto:zhiliang@tup.tsinghua.edu.cn)

印 刷 者: 清华大学印刷厂

装 订 者: 三河市新茂装订有限公司

经 销: 全国新华书店

开 本: 203mm×260mm 印 张: 26

版 次: 2013 年 6 月第 1 版

印 次: 2013 年 6 月第 1 次印刷

印 数: 1~5000

定 价: 48.00 元

产品编号: 043229-01

# 出版说明

成功路径与商科英文原版教材的效用

(作者)

在我国高校,用英语或双语教授专业课程(以下简称:英/双语教学)始于改革开放引进热潮,历经30年,虽发展不快,仍在缓慢推进。20世纪80年代,改革开放后留学归来的教育界学者们不仅引 为了适应经济全球化的发展趋势,满足国内广大读者了解、学习和借鉴国外先进的管理经验,掌握经济理论前沿动态的需求,清华大学出版社与国外著名出版公司合作影印出版一系列英文版经济管理方面的图书。我们所选择的图书,基本上已是再版多次、在国外深受欢迎,并被广泛采用的优秀教材,绝大部分是该领域中较具权威性的经典之作。在选书的过程中,我们得到了很多专家、学者的支持、帮助和鼓励,在此表示谢意!

由于原作者所处国家的政治、经济和文化背景等与我国不同,对书中所持观点,敬请广大读者在阅读过程中注意加以分析和鉴别。

我们期望这套影印书的出版对我国经济科学的发展能有所帮助,对我国经济管理专业的教学能有所促进。

欢迎广大读者给我们提出宝贵的意见和建议,同时也欢迎有关的专业人士向我们推荐您所接触到的国外优秀图书。

在经济开放和全球化的大趋势推动下,我国中小学英语教学分量加重,英语普及程度逐年提高,高校新生的英语基础愈益扎实;教师的英语能力也随着师资的新陈代谢 清华大学出版社 2013.4月

尽管如此,不同于以英语为主要语言的一些国家,英语在我国的普及率仍较低。在青少年中,英语的普及程度和英语应用能力还仅处于初级水平;高校中能用英语演讲的教师尚属少数,且熟练程度还有待大幅提高。这样的师生英语基础,使得英/双语教学面临巨大的挑战。

同时,在多数中国高校课堂里,教学任务多被视为逐章讲解某本教材的内容。本土中文教材通常是400~500页的32开本,含理论框架、主要知识点、计算方法和习题,但案例和故事不在其中,多由教师在讲解时添加,以表示和诠释理论要点。迄今仍然普遍通行的“填鸭式”、“满堂灌”的传统教学法侧重于传授知识,从多数评教指标可见,只要学生愿意听讲并能理解、能解愿,就算教学成功。

而引进的国外教材篇幅通常较长,16开大本,500~800页。习惯于上述传统教学法和评价标准的人们自然会产生一个疑问:在有限的课时内,这么厚的教材,怎么讲得完?其实,发达国家多数高校对学生阅读量的要求远远大于我国高校(即使是中文课本和资料),名校更是如此。它们的教材不仅涵盖理论框架和基本概念,而且富含长短不一、详简各异的演示性案例、故事和大量习题,总之它便于学生自学。课堂讲解只占一半课时,其余课时常被用于师生讨论和互助。于是,教师的讲解主要是勾勒理论框架,阐释重点和难点,还需针对事先布置的阅读材料和讨论题,引导学生展开讨论。可见,大厚本的教材适合于能力培训教学法。两者相辅相成,致力于调适学生



# 英/双语教学的成功路径与商科英文原版教材的效用

(代序)

在我国高校,用英语或双语教授专业课程(以下简称:英/双语教学)始于改革开放引进热潮,历经30年,虽发展不快,仍在缓慢推进。20世纪80年代,改革开放后留学归来的教育界学者们不仅引进了各学科先进的研究成果,也随之引进了西方高校的教材。以清华大学出版社为领军的国内出版社适时地引进了西方优秀教材的影印版,推动了一些高校开始在专业课程中开展英/双语教学。2007年以来,国家教育质量工程专设的“国家高校双语教学示范课程建设点”的评定项目被视为政府教育发展的政策风向标,正有力地推动着高校英/双语教学的发展。

但对英/双语教学的必要性,我国高校内部一直争议不断。争议首先围绕着中国人用英语教学的必要性。在公认英语是目前世界通用语言的前提下,英/双语教学的必要性取决于我国高校师生是否有必要及时汲取世界最新的知识和研究成果。答案是不言而喻的。况且英/双语教学省却了翻译过程,可以避免常见的信息减损和曲解问题。不过,信息发布者——教师的英语演讲能力和信息接收者——学生的英语解读能力不足又成为开展英/双语教学的障碍。因而常见的反对意见是,开展英/双语教学,课堂教学内容就会缩水,因为讲授者和听众都得花费精力和时间解译内容。如此看来,我国开展英/双语教学的高校教师必须应对挑战,洞察在我国现有条件下用英文原版教材开展英/双语教学的利和弊,并找到可行的扬长避短的路径。

在经济开放和全球化的大趋势推动下,我国中小学英语教学分量加重,英语普及程度逐年提高,高校新生的英语基础愈益扎实;教师的英语能力也随着师资的新陈代谢而日见增强。这一趋势无疑在为英/双语教学营造越来越有利的条件。尽管如此,不同于以英语为主要语言或官方语言的一些国家,英语在我国的普及率仍较低。在青少年中,英语的普及程度和英语应用能力还仅处于初级水平;高校中能用英语演讲的教师尚属少数,且熟练程度还有待大幅提高。这样的师生英语基础,使得英/双语教学面临巨大的挑战。

同时,在多数的中国高校课堂里,教学任务多被视为逐章讲解某本教材的内容。本土中文教材通常是400~500页的32开本,含理论框架、主要知识点、计算方法和习题,但案例和故事不在其中,多由教师在讲解时添加,以演示和诠释理论要点。迄今仍然普遍盛行的“填鸭式”、“满堂灌”的传统教学法侧重于传授知识,从多数评教指标可见,只要学生感觉教师讲得精彩、有条理、能解惑,就算教学成功。

而引进的国外教材篇幅通常较长,16开大本,500~800页。习惯于上述传统教学法和评价标准的人们自然会产生一个疑问:在有限的课时内,这么厚的教材,怎么讲得完?其实,发达国家多数高校对学生阅读量的要求远远大于我国高校(即使是中文课本和资料),名校更是如此。它们的教材不仅涵盖理论框架和基本概念,而且富含长短不一、详简各异的演示性案例、故事和大量习题,总之它便于学生自学。课堂讲解只占一半课时,其余课时常被用于师生讨论和互动。于是,教师的讲解主要是勾勒理论框架,阐释重点和难点,还需针对事先布置的阅读资料和讨论题,引导学生展开讨论。可见,大厚本的教材适合于能力培训教学法。两者相辅相成,致力于调动学生

的主动性：他们必须大量阅读和思考，才能在课堂上有上好的表现，真正成为学习的主人。结果，他们的能力获得了必要和切实的磨炼。

由此可见，英/双语教学不只是教学语言的改变，它可以达到三重效用：传授专业知识；传授英语知识；同时训练专业方法和英语的应用技能。也因此，一些非英语国家的高校不惜成本，开展英/双语教学，使用与之相配的教材。对我国高校来说，要想成功开展英/双语教学，恐怕首先需要改变传统的教育思想和教学方法。换言之，如果高校想要使教育、教学接近世界先进水准，用英文原版影印教材开展英/双语教学是有效的途径。

迄今为止，原版英文教材的缺点也很明显。鉴于发达国家的作者是以其母国为背景，多数教材不涉及中国国情。教师必须在教学中紧密结合中国国情，提供相关案例、资料和思考讨论题，适时引导师生思辨现有理论的普适性，激励师生发现和创作适合我国国情的经济学、管理学、营销学规律。在我国作者编写和出版足量的优质英文教材之前，这些额外的工作必须由开展英/双语教学的教师来承担。

古今中外，成才之士都乐于阅读和探索，而这种氛围却在当今我国的大学校园里愈见淡化。加之中国学生相对薄弱的英语基础，目前英/双语教学仍面临很大的挑战：“填鸭式”的讲授与之相悖；仅靠课堂讲授和互动也很难奏效。但如能培养学生阅读和探索真理的兴趣，并营造一个全方位的孵化温床或生态环境，英/双语教学是有望成功的。根据能力培育过程的所需，这个生态环境包含师生对教育、教学的共识，好学求知的校风，富有挑战和师生互动的课堂教学，从课外讲座、项目操作到校园竞赛等第二课堂活动，便于师生交流的校园互联网等。

要做到这些，教师亟待与时俱进。随着师资的年轻化和高学历化，如今年轻教师的英语基础更好。但逆水行舟，不进则退。英语能力的进退取决于使用频率的多寡，其实英/双语教学过程既是加强英语使用、提高英语能力，也是汲取世界新知的最佳机会。不过，这一过程通常比用汉语教学的付出大得多，且因学生也需成倍地付出，英/双语教学的课程不容易像汉语教学课程那样容易在短期内获得学生的好评。因此给予英/双语教学的教师足够的激励成为生态环境的首要组成部分；缺乏对教师的足够激励，上述英/双语教学的生态环境就无法营造。

诚然，在教育体制和环境不够理想的情况下，教师和学生仍然有个人自训和奋斗的条件。英语原版教材影印版在我国的出版和更新就是对英/双语教学的及时支持。清华大学出版社近期又有一批英文原版影印教材出版，相信必将更进一步推动英/双语教学的发展。如今，已有一些本土高校的教师与英语国家的教师合著英文教材；在可见的将来，还会有中国教师编写发行到世界各地的英文教材。总之，及时用好英文原版影印教材，编写优质的英文教材是我国高校教师的历史责任。

愿英/双语教学的师资队伍愈益壮大，愿英/双语教学更加有力地推动我国教学方法与国际接轨，愿我国高校各级学生在英/双语教学中受益良多，茁壮成长！

对外经济贸易大学

傅慧芬



# PREFACE

*Introduction to Materials Management* is an introductory text written for students in community colleges and universities. It is used in technical programs, such as industrial engineering and manufacturing engineering; in business programs; and by those already in industry, whether or not they are working in materials management.

This text has been widely adopted by colleges and universities not only in North America but also in other parts of the world. APICS—The Association for Operations Management recommends this text as the reference for certification preparation for various CPIM examinations. In addition, the text is used by production and inventory control societies around the world, including South Africa, Australia, New Zealand, Germany, France, and Brazil, and by consultants who present in-house courses to their customers.

*Introduction to Materials Management* covers all the basics of supply chain management, manufacturing planning and control systems, purchasing, physical distribution and quality management. The material, examples, questions, and problems lead the student logically through the text. The writing style is simple and user-friendly—both instructors and students who have used the book attest to this.

## NEW TO THIS EDITION

- All chapters have been updated to reflect new techniques and technology
- Case studies added to Chapters 2: Production Planning System, 9: Inventory Fundamentals, and 14: Products and Processes
- Re-organized content to emphasize lean production separate from but related to JIT
- Extensive updates to Chapter 15: Lean Production
- End of chapter problems have been altered
- Addition of information on sustainability and “green” production

In addition, we have retained several features from previous editions:

- Margin icons to note key concepts
- Key terms listed at the end of each chapter
- Example problems within the chapters
- Chapter summaries
- Questions and problems at the end of each chapter

## APPROACH AND ORGANIZATION

Materials management means different things to different people. In this textbook, materials management includes all activities in the flow of materials from the supplier to the consumer. Such activities include physical supply, operations planning and control, and physical distribution. Other terms sometimes used in this area are *business logistics* and *supply chain management*. Often, the emphasis in business logistics is on transportation and distribution systems with little concern for what occurs in the factory. Whereas some chapters in this text are devoted to transportation and distribution, emphasis is placed on operations planning and control.

Distribution and operations are managed by planning and controlling the flow of materials through them and by using the system’s resources to achieve a desired customer service level. These activities are the responsibility of materials management and affect every department in a manufacturing business. If the materials management system is not well designed and managed, the distribution and manufacturing system will be less

effective and more costly. Anyone working in manufacturing or distribution should have a good basic understanding of the factors influencing materials flow. This text aims to provide that understanding and also includes a chapter on quality management.

APICS defines the body of knowledge, concepts, and vocabulary used in production and inventory control. Establishing standard knowledge, concepts, and vocabulary is essential both for developing an understanding of production and inventory control and for making clear communication possible. Where applicable, the definitions and concepts in this text subscribe to APICS vocabulary and concepts.

The first six chapters of *Introduction to Materials Management* cover the basics of production planning and control. Chapter 7 discusses important factors in purchasing and supply chain; Chapter 8 discusses forecasting. Chapters 9, 10, and 11 look at the fundamentals of inventory management. Chapter 12 discusses physical inventory and warehouse management, and Chapter 13 examines the elements of distribution systems, including transportation, packaging, and material handling. Chapter 14 covers factors influencing product and process design. Chapter 15 looks at the philosophy and environment of just-in-time and lean production and explains how operations planning and control systems relate to just-in-time and lean production. Chapter 16 examines the elements of total quality management and six sigma quality approaches.

## ONLINE INSTRUCTOR RESOURCES

To access supplementary materials online, instructors need to request an instructor access code. Go to [www.pearsonhighered.com](http://www.pearsonhighered.com), click the Instructor Resource Center link, and then click Register Today for an instructor access code. Within 48 hours after registering you will receive a confirming e-mail including an instructor access code. Once you have received your code, go to the site and log on for full instructions on downloading the materials you wish to use.

## ACKNOWLEDGMENTS

Help and encouragement have come from a number of valued sources, among them friends, colleagues, and students. We thank the faculty of other colleges and the many members of APICS chapters who continue to offer their support and helpful advice. Many thanks to those who reviewed the sixth edition and provided suggestions for the seventh edition, including members of the APICS Basics of Supply Chain Management Certification Committee: Jim Caruso (Chair) of Tyco Healthcare; Carol Bulfer, Parker Hannifin Corp.; William Leedale, IFS; and Angel Sosa, University of Puerto Rico at Bayamon. Academic reviewers included Sheila E. Rowe, North Carolina A&T State University; David Lucero, Greenville Technical College; Floyd Olson, Utah Valley State College; Ralph G. Kauffman, University of Houston–Downtown; Ronald J. Baker, Shoreline Community College; and Richard E. Crandall, Appalachian State University.

Tony Arnold thanks his wife, Vicky Arnold, for her assistance throughout the years of writing and revising this text, and Steve Chapman thanks his wife, Jeannine, for her support as well. Lloyd Clive thanks his wife, Kathleen, for her continued support.

Overall, this book is dedicated to those who have taught us the most—our students.

J. R. Tony Arnold, Professor Emeritus, CFPIM, CIRM  
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Peterborough, Ontario

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*Introduction to Materials Management* is an introductory text written for students in community colleges and universities. It is used in technical programs, such as industrial engineering and manufacturing engineering; in business programs; and by those already in industry, whether or not they are working in materials management.

This text has been widely adopted by colleges and universities not only in North America but also in other parts of the world. A PICOP (Professional Institute of Operations Management) examination recommends this text as the reference for certification preparation for various CPIM examinations. In addition, the text is used by production and inventory control societies across the world, including South Africa, Canada, Germany, France, and Brazil, and by consultants who present in-house courses to their customers.

*Introduction to Materials Management* covers all the basics of supply chain management, manufacturing planning and control systems, inventory, physical distribution and quality management. The material, examples, questions, and problems lead the student logically through the text. The writing style is simple and direct, and both instructors and students who have used the book attest to this.

## NEW TO THIS EDITION

- All chapters have been updated to reflect new techniques and technology.
- Case studies added to Chapters 2: Production Planning and Control, 4: Inventory Fundamentals, and 14: Products and Processes.
- Re-organized content to emphasize lean production separate from but related to JIT.
- Extensive updates to Chapter 15: Lean Production.
- End of chapter problems have been altered.
- Addition of information on sustainability and "green" production.
- In addition, we have retained several features from previous editions:
  - Margin icons to note key concepts.
  - Key terms listed at the end of each chapter.
  - Example problems within the chapters.
  - Chapter summaries.
  - Questions and problems at the end of each chapter.

## APPROACH AND ORGANIZATION

Materials management means different things to different people. In this textbook, materials management includes all activities in the flow of materials from the supplier to the consumer. Such activities include physical supply, operations planning and control, and physical distribution. Other terms sometimes used in this area are *business logistics* and *supply chain management*. Often, the emphasis in business logistics is on transportation and distribution systems with little concern for what occurs in the factory. Whereas some chapters in this text are devoted to transportation and distribution, emphasis is placed on operations planning and control.

Distribution and operations are managed by planning and controlling the flow of materials through them and by using the system's resources to achieve a desired customer service level. These activities are the responsibility of materials management and affect every department in a manufacturing business. If the materials management system is not well designed and managed, the distribution and manufacturing system will be less

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# INTRODUCTION TO MATERIALS MANAGEMENT

## INTRODUCTION

The wealth of a country is measured by its gross national product—the output of goods and services produced by the nation in a given time. Goods are physical objects, something we can touch, feel, or see. Services are the performance of some useful function such as banking, medical care, restaurants, clothing stores, or social services.

But what is the source of wealth? Wealth is measured by the amount of goods and services produced, but where does it come from? Although we may have rich natural resources in our economy such as mineral deposits, farmland, and forests, these are only potential sources of wealth. A production function is needed to transform these resources into useful goods. Production takes place in all forms of transformation—extracting minerals from the earth, farming, lumbering, and fishing and using these resources to manufacture useful products.

There are many stages between the extraction of resource material and the final consumer product. At each stage in the development of the final product, value is added, thus creating more wealth. If ore is extracted from the earth and sold, wealth is gained from our efforts, but those who continue to transform the raw material will gain more and usually far greater wealth. Japan is a prime example of this. It has very few natural resources and buys most of the raw materials it needs. However, the Japanese have developed one of the wealthiest economies in the world by transforming the raw materials they purchase and adding value to them through manufacturing.

Manufacturing companies are in the business of converting raw materials to a form that is of far more value and use to the consumer than the original raw materials. Logs are converted into tables and chairs, iron ore into steel, and steel into cars and refrigerators. This conversion process, called *manufacturing* or *production*, makes a society wealthier and creates a better standard of living.

To get the most value out of our resources, we must design production processes that make products most efficiently. Once the processes exist, we need to manage their operation so they produce goods most economically. Managing the operation means planning for and controlling the resources used in the process: labor, capital, and material. All are important, but the major way in which management plans and controls is through the flow of materials. The flow of materials controls the performance of the process. If the right materials in the right quantities are not available at the right time, the process cannot produce what it should. Labor and machinery will be poorly utilized. The profitability, and even the existence, of the company will be threatened.

## OPERATING ENVIRONMENT

Operations management works in a complex environment affected by many factors. Among the most important are government regulation, the economy, competition, customer expectations, and quality.

**Government.** Regulation of business by the various levels of government is extensive.

Regulation applies to such areas as the environment, safety, product liability, and taxation. Government, or the lack of it, affects the way business is conducted.

**Economy.** General economic conditions influence the demand for a company's products or services and the availability of inputs. During economic recession the demand for many products decreases while demand for others may increase. Materials and labor shortages or surpluses influence the decisions management makes. Shifts in the age of the population, needs of ethnic groups, low population growth, freer trade between countries, and increased global competition all contribute to changes in the marketplace.

**Competition.** Competition is severe today.

- Manufacturing companies face competition from throughout the world. They find foreign competitors selling in their markets even though they themselves may not be selling in foreign markets. Companies also are resorting more to worldwide sourcing.
- Transportation and the movement of materials are relatively less costly than they used to be.
- Worldwide communications are fast, effective, and cheap. Information and data can be moved almost instantly halfway around the globe. The Internet allows buyers to search out new sources of supply from anywhere in the world as easily as they can from local sources.

**Customers.** Both consumers and industrial customers have become much more demanding, and suppliers have responded by improving the range of characteristics they offer. Some of the characteristics and selection customers expect in the products and services they buy are

- A fair price.
- Higher-(right) quality products and services.
- Delivery lead time.
- Better presale and after-sale service.
- Product and volume flexibility.

**Quality.** Since competition is international and aggressive, successful companies provide quality that not only meets customers' high expectations but exceeds them. Chapter 16 discusses quality in detail.

## Order Qualifiers and Order Winners

Generally, a supplier must meet set minimum requirements to be considered a viable competitor in the marketplace. Customer requirements may be based on price, quality, delivery, and so forth and are called **order qualifiers**. For example, the price for a certain type of product must fall within a range for the supplier to be considered by potential customers. But being considered does not mean winning the order. To win orders, a supplier must have characteristics that encourage customers to choose its products and services over competitors'. Those competitive characteristics, or combination of characteristics, that persuade a company's customers to choose its products or services are called **order winners**. They provide a competitive advantage for the firm. Order winners change over time and may well be different for different markets. For example, fast delivery may be vital in one market but not in another. Characteristics that are order winners today probably will not remain so, because competition will try to copy winning characteristics, and the needs of customers will change.

It is very important that a firm understands the order winners and order qualifiers for each of its products and in each of its markets because they should drive the manufacturing strategy. Since it is virtually impossible to be the best in every dimension of competition, firms should in general strive to provide at least a minimal level of acceptance for each of the order qualifiers but should try to be the *best* in the market for the order winner(s).

One also should recognize that the order winners and qualifiers for any product/market combination are not static. Not only will customers change perspectives as competitors jockey for position, but the order winners and qualifiers will often change based on the



concepts of the product life cycle. The product life cycle implies that most products go through a life cycle, including introduction, growth, maturity, and decline. For example, in the introduction phase, design and availability are often much more important than price. Quality and delivery tend to have increased importance during growth, while price and delivery are often the order winners for mature products. This life cycle approach is complicated in that the duration of the life cycle will be very different for different products. Although some products have life cycles many years long, the life cycle of other products (certain toys or electronics, for example) can be measured in months or even weeks.

## Manufacturing Strategy

A highly market-oriented company will focus on meeting or exceeding customer expectations and on order winners. In such a company, all functions must contribute toward a winning strategy. Thus, operations must have a strategy that allows it to supply the needs of the marketplace and provide fast on-time delivery.

**Delivery lead time** From the supplier's perspective, delivery lead time is the time from receipt of an order to the delivery of the product. From the customer's perspective, it may also include time for order preparation and transmittal. Customers want delivery lead time to be as short as possible, and manufacturing must design a strategy to achieve this. There are four basic strategies: engineer-to-order, make-to-order, assemble-to-order, and make-to-stock. Customer involvement in the product design, delivery lead time, and inventory state are influenced by each strategy. Figure 1.1 shows the effect of each strategy.

**Engineer-to-order** means that the customer's specifications require unique engineering design or significant customization. Usually the customer is highly involved in the product design. Inventory will not normally be purchased until needed by manufacturing. Delivery lead time is long because it includes not only purchase lead time but also design lead time.

**Make-to-order** means that the manufacturer does not start to make the product until a customer's order is received. The final product is usually made from standard items but may include custom-designed components as well. Delivery lead time is reduced because there is little design time required and inventory is held as raw material.

**Assemble-to-order** means that the product is made from standard components that the manufacturer can inventory and assemble according to a customer order. Delivery lead time is reduced further because there is no design time needed and inventory is held ready for assembly. Customer involvement in the design of the product is limited to selecting the component part options needed.

**Make-to-stock** means that the supplier manufactures the goods and sells from a finished-goods inventory. Delivery lead time is shortest. The customer has little direct involvement in the product design.

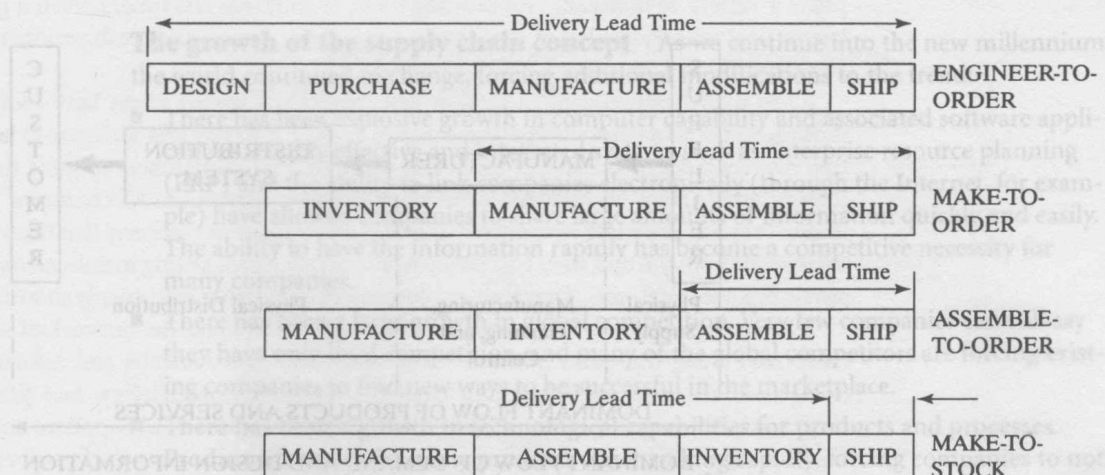


FIGURE 1.1 Manufacturing strategy and lead time.

**Postponement** is another application of assemble-to-order, described by the Association for Operations Management (APICS) as “a product design strategy that shifts product differentiation closer to the consumer by postponing identity change to the last possible supply chain location.” This strategy reduces the number of different items in the supply chain, lowering the amount of in-process inventory.

Computer printers for a global market use universal power supplies that can be switched to different voltages; on receipt of a customer’s order, they are packaged with the appropriate cords, instructions, and labeling. This avoids filling an entire supply chain with expensive printers destined for different countries. Some basic postponement can be done in a distribution center and often by third parties. Foreign suppliers of appliances such as vacuum cleaners destined for multiple customers postpone the packaging of their products, applying customer-specific labels, bar codes, boxes, instructions, and so forth until after receipt of the customer order.

## THE SUPPLY CHAIN CONCEPT

There are three phases to the flow of materials. Raw materials flow into a manufacturing company from a physical supply system, they are processed by manufacturing, and finally, finished goods are distributed to end consumers through a physical distribution system. Figure 1.2 shows this system graphically. Although this figure shows only one supplier and one customer, usually the supply chain consists of several companies linked in a supply/demand relationship. For example, the customer of one supplier buys a product, adds value to it, and supplies yet another customer. Similarly, one customer may have several suppliers and may in turn supply several customers. As long as there is a chain of supplier/customer relationships, they are all members of the same supply chain.

There are a number of important factors in supply chains:

- The supply chain includes all activities and processes to supply a product or service to a final customer.
- Any number of companies can be linked in the supply chain.
- A customer can be a supplier to another customer so the total chain can have a number of supplier/customer relationships.
- Although the distribution system can be direct from supplier to customer, depending on the products and markets, it can contain a number of intermediaries (distributors) such as wholesalers, warehouses, and retailers.
- Product or services usually flow from supplier to customer; design and demand information usually flows from customer to supplier. Rarely is this not so.

Although these systems vary from industry to industry and company to company, the basic elements are the same: supply, production, and distribution. The relative importance of each depends on the costs of the three elements.

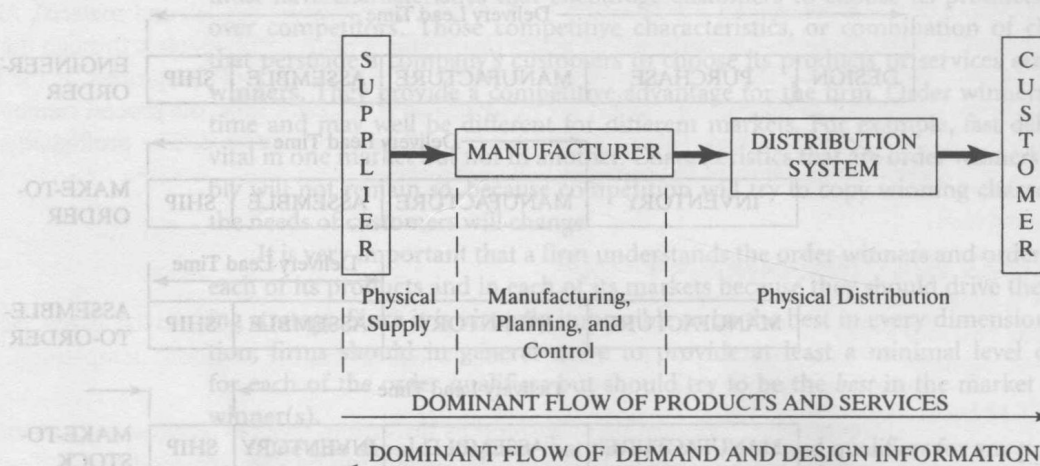


FIGURE 1.2 Supply-production-distribution system.



## Supply Chain Concepts

In recent years there has been a great deal of attention given to the concept of supply chain management (SCM). It is important to understand the fundamental issues behind this movement, as well as the impact on materials management.

**Historical perspective** In the past, many company managers placed most of their attention on the issues that were internal to their companies. Of course they were aware of the impact of suppliers, customers, and distributors, but those entities were often viewed as business entities only. Specialists in purchasing, sales, and logistics were assigned to “deal” with those outside entities, often through formal legal contracts that were negotiated regularly and represented short-term agreements. For example, suppliers were often viewed as business adversaries. A key responsibility of a purchasing agent was to negotiate the best financial and delivery conditions from a supplier, whose job was to maximize company profit. Organization theorists often called the functions that dealt with outside entities boundary spanners, indicating that for most people in the organization there were well-defined and rigid boundaries between their organization and the rest of the world.

The first major change in that perspective for most companies can be traced to the explosive growth in just-in-time (JIT) concepts, originally developed by Toyota and other Japanese companies in the 1970s. Supplier partnerships were felt to be a major aspect of successful JIT. With that concept, suppliers were viewed as partners as opposed to adversaries. In that sense the supplier and the customer had mutually linked destinies, in that the success of each was linked to the success of the other. Great emphasis was put on trust between the partners, and many of the formal boundary mechanisms, such as the receiving/inspection activity of incoming parts, were changed or eliminated altogether. As the partnership concept grew, there were many other changes in the relationship, including

- **Mutual analysis for cost reduction.** Both parties examined the process used to transmit information and deliver parts, with the idea that cost reductions would be shared between the two parties.
- **Mutual product design.** In the past the customer often submitted complete designs to the supplier, who was obligated to produce according to design. With partnering, both companies worked together. Often the supplier would know more about how to make a specific product, whereas the customer would know more about the application for which the design was intended. Together, they could probably produce a superior design compared to what either could do alone.
- **Enhanced information flow.** With JIT, the concept of greatly reduced inventory in the process and the need for rapid delivery according to need, the speed of accurate information flow became critical. Formal paper-based systems gave way to electronic data interchange and informal communication methods.

**The growth of the supply chain concept** As we continue into the new millennium, the world continued to change, forcing additional modifications to the trend:

- There has been explosive growth in computer capability and associated software applications. Highly effective and integrated systems such as enterprise resource planning (ERP) and the ability to link companies electronically (through the Internet, for example) have allowed companies to share large amounts of information quickly and easily. The ability to have the information rapidly has become a competitive necessity for many companies.
- There has been a large growth in global competition. Very few companies can still say they have only local competition, and many of the global competitors are forcing existing companies to find new ways to be successful in the marketplace.
- There has been a growth in technological capabilities for products and processes. Product life cycles for many products are shrinking rapidly, forcing companies to not only become more flexible in design but also to communicate changes and needs to suppliers and distributors.