


Introduction to Materials Management



Third Edition

J. R. Tony Arnold



Introduction to Materials Management

THIRD EDITION

J. R. Tony Arnold, CFPIM, CIRM



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Preface

Introduction to Materials Management is an introductory text designed for students in community colleges and university programs. It is used in technical programs such as industrial engineering or manufacturing engineering, and in business programs. The text has also proved suitable for 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 in other parts of the world. It is listed in the American Production and Inventory Control Society (APICS) *CPIM Exam Content Manual* as the text reference for the *Basics of Supply Chain Management* (BSCM) CPIM certification examination. It is used by production and inventory control societies in other countries, such as South Africa, Australia, New Zealand, and France. As well, it is used by consultants in presenting in-house courses to their customers.

While the second edition covered most of the content of the BSCM examination, there were some gaps. These gaps have been addressed in the third edition. Two new chapters have been added, Products and Processes (Chapter 14), and Total Quality Management (Chapter 16). Materials management must react to whatever processes exist, and processes are largely determined by the design of products. The chapter on products and process design examines some of the basic factors and concepts in designing products for ease of manufacture, and in designing and selecting processes. Total Quality Management has become a major concept in operations management. This chapter explores the concepts and philosophy of total quality management.

Materials management means different things to different people. In this text, materials management includes all activities in the flow of materials from the supplier through to the consumer. Such activities include physical supply, operations planning and control and physical distribution. Other terms sometimes used are business logistics and supply chain management. Often the emphasis in business logistics is on transportation and distribution systems with little concern for what goes on in the factory. While there are chapters in this text devoted to transportation and distribution, most 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 utilizing 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 operated, 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.

The American Production and Inventory Control Society has defined the body of knowledge, the concepts, and the vocabulary used in production and inventory control. This is important, not only in developing an understanding of production and inventory control, but in making clear communication possible. Where applicable, the definitions and concepts in the text subscribe to APICS vocabulary and concepts.

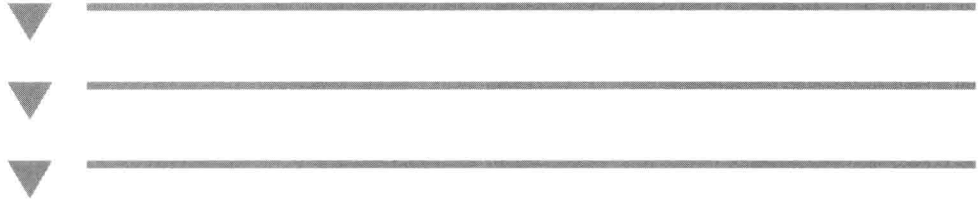
The first six chapters of this text cover the basics of production planning and control. Chapter 7 discusses the important factors in purchasing; Chapter 8 is on forecasting. Chapters 9, 10, and 11 look at the fundamentals of inventory management. Chapter 12 discusses physical inventory and warehouse management, and Chapter 13 examines the elements of distribution systems including transportation, packaging, and material handling. Chapter 14 discusses the factors influencing product and process design. Chapter 15 looks at the philosophy and the environment of Just-in-Time manufacturing. It explains how operations planning and control systems relate to Just-in-Time. Chapter 16 examines the elements of total quality management.

The text covers all the basics of supply chain management and production and inventory control. The material, examples, questions, and problems lead the student logically through the material. The style is simple and user-friendly. Students who have used the material attest to this.

I have received help and encouragement from a number of valued sources, among them my friends, colleagues, and students at Fleming College. I thank the faculty of other colleges and the many members of APICS chapters who continue to offer their support and helpful advice. I also thank my wife, Vicky, for her assistance and patience throughout the time *Introduction to Materials Management* has been in preparation.

This book is dedicated to those who have taught me the most—my students.

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1

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? It 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, farm land, and forests, these are only potential sources of wealth. A production function is needed to transform our resources into useful goods. Production takes place in all forms of transformation—extracting minerals from the earth, farming, lumbering, 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 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.

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 pre-sale 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. 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.

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, this 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.

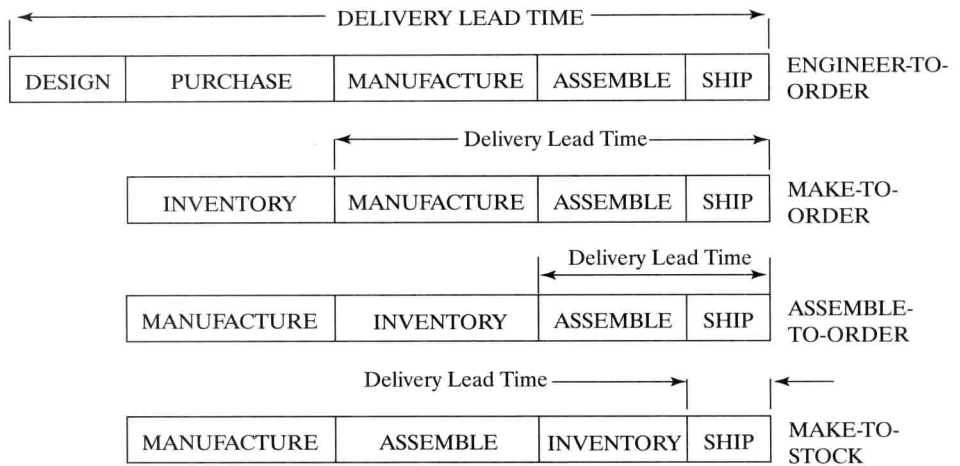


Figure 1.1 Manufacturing strategy and lead time.

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 design lead time as well.

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.

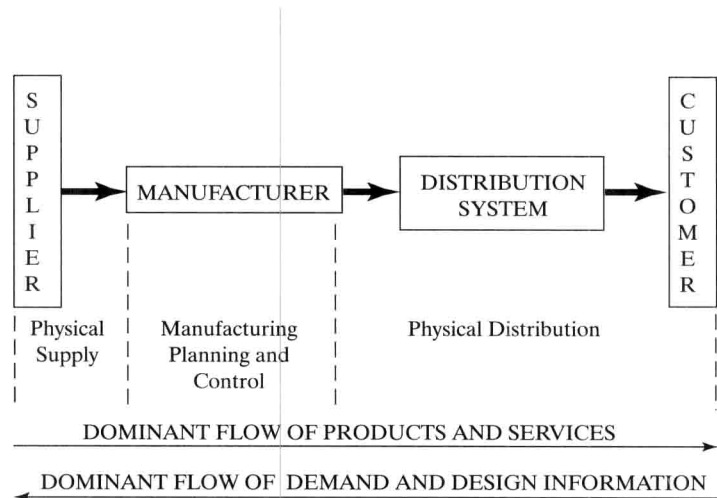
Assemble-to-order means that the product is made from standard components that the manufacturer can inventory and assemble according to a customer order. Delivery lead time is reduced further because there is no design time needed and inventory is held ready for assembly. Customer involvement in the 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 finished goods inventory. Delivery lead time is shortest. The customer has little direct involvement in the product design.

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. While 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 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.

Figure 1.2 Supply-production-distribution system.



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.
- While 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 and 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.

Conflicts in Traditional Systems

In the past, supply, production, and distribution systems were organized into separate functions that reported to different departments of a company. Often policies and practices of the different departments maximized departmental objectives without considering the effect they would have on other parts of the system. Because the three systems are interrelated, conflicts often occurred. While each system made decisions that were best for itself, overall company objectives suffered. For example, the transportation department would ship in the largest quantities possible so it could minimize shipping costs. However, this increased inventory and resulted in higher inventory-carrying costs.

To get the most profit, a company must have at least four main objectives:

1. Provide best customer service.
2. Provide lowest production costs.
3. Provide lowest inventory investment.
4. Provide lowest distribution costs.

These objectives create conflict among the marketing, production, and finance departments because each has different responsibilities in these areas.

Marketing's objective is to maintain and increase revenue; therefore, it must provide the best customer service possible. There are several ways of doing this:

- Maintain high inventories so goods are always available for the customer.
- Interrupt production runs so that a noninventoried item can be manufactured quickly.
- Create an extensive and costly distribution system so goods can be shipped to the customer rapidly.

Finance must keep investment and costs low. This can be done in the following ways:

- Reduce inventory so inventory investment is at a minimum.
- Decrease the number of plants and warehouses.
- Produce large quantities using long production runs.
- Manufacture only to customer order.

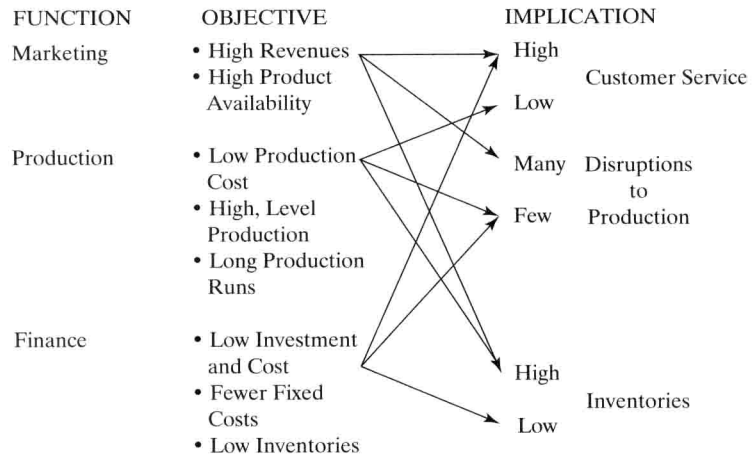
Production must keep its operating costs as low as possible. This can be done in the following ways:

- Make long production runs of relatively few products. Fewer changeovers will be needed and specialized equipment can be used, thus reducing the cost of making the product.

- Maintain high inventories of raw materials and work in process so production is not disrupted by shortages.

These conflicts among marketing, finance, and production center on customer service, disruption of production flow, and inventory levels. Figure 1.3 shows this relationship.

Figure 1.3 Conflicting objectives



Today the concepts of Just-in-Time (JIT) manufacturing stress the need to supply customers with what they want when they want it and to keep inventories at a minimum. These objectives put further stress on the relationship among production, marketing, and finance. Chapter 15 will discuss the concepts of JIT manufacturing and how it influences materials management.

One important way to resolve these conflicting objectives is to provide close coordination of the supply, production, and distribution functions. The problem is to balance conflicting objectives to minimize the total of all the costs involved and maximize customer service consistent with the goals of the organization. This requires some type of integrated materials management or logistics organization that is responsible for supply, production, and distribution. Rather than having the planning and control of these functions spread among marketing, production, and distribution, they should occur in a single area of responsibility.

WHAT IS MATERIALS MANAGEMENT?

The concept of having one department responsible for the flow of materials, from supplier through production to consumer, is relatively new. Although many companies have adopted this type of organization, there are still a number that have not. If companies wish to minimize total costs in this area and provide a better level of customer service, they will move in this direction.