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PRODUCTION AND INVENTORY MANAGEMENT



Second edition

THANWADEE CHINDA

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Photocopying instead of using books
is destroying intellectual creativity.

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Second edition

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I dedicate this book to my family.

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Preface

Production and inventory management is a combination of production management and inventory management. They are the exciting areas of management that have effects on the productivity of both manufacturing and service industries. This text book aims to present various perspectives of production and inventory management, both in theories and real case studies. Topics include sales and operations plan, master production scheduling, material requirements panning, distribution requirements planning, capacity planning, inventory management, inventory management: managing uncertainties, theory of constraints, waiting line theory, and lean operations.

Many examples and problems are provided in each chapter with step-by-step solutions. Exercises at the end of each chapter are provided for the readers to practice. Case studies, specifically in Thailand, help the readers to better understand the chapters and apply the knowledge in the real practices. It is hoped that this text book provides readers valuable insights to the practice and management of production, operations, and inventory.

I would like to thank my parents, my family, my friends, the institution staff, and all related person to make this text book happen.

Thanwadee Chinda



Chapter 1

Introduction to Production and Inventory Management

This chapter includes the following topics:

- What is production management?
- What is inventory management?
- Uncertainties in production and inventory management
- What is covered in this textbook?

1.1 What is Production Management?

Production and operations management is the set of activities that creates value in the form of goods and services by transforming inputs into outputs. According to ME Mechanical (2018), production management deals with decision making related to production processes so that the resulting goods or services are produced according to specifications, in the amount and by the schedule demanded, and out of minimum cost. Activities creating goods and services take place in all organizations, both manufacturing and service industries. In the manufacturing industry, product is tangible. In the service industry, however, product is intangible, and may take such forms as the transfer of funds from savings to checking accounts, the reservation of the tables in the restaurants, and the classes provided to the students.

To create goods and services, every organization must perform three functions, as follows:

- Marketing: This function generates demand or orders for a product or service. This demand is used to develop sales and operations and other production plans for the company.
- Production: This function creates the product. A number of constraints must be considered when planning for a production, such as waiting time and bottleneck work centers.
- Finance/accounting: This function tracks how well, in financial term, an organization is performing.

Production management aims to produce goods and services of right quality and right quantity at the right time and right manufacturing cost.

- Right quality: The quality of the product is established based on the customer needs in the market. The right quality is not necessarily the best quality of the product. It is rather determined by the cost of the product and the technical characteristics as suited to the specific requirements of the customers in the market environment.
- Right quantity: The manufacturing organization should produce the products in the right quantity. Overproduction results in the capital blocked up in the form of inventory; underproduction, on the other hand, leads to a shortage of products.
- Right time: Timeliness of product delivery is one of the critical parameters to judge the effectiveness of the production department.
- Right manufacturing cost: Manufacturing costs incur before the products are manufactured and released into the market. Hence, all attempts should be made to produce the products at a pre-established or standard cost, and avoid any unforeseen costs.

There are a number of functions performed in the production management, including

- Design and development of the production process,
- Production planning and control,
- Implementation of the plan and related activities to produce the desired output,
- Administration and coordination of the activities of various components and departments responsible for producing the necessary goods and services,
- Get real-time insight into the production,
- Improve performance with flexible routing, and
- Monitor production costs with ease (MBA TUTS, 2017).

1.2 What is Inventory Management?

Inventories are items accumulated for sales, in the process of manufacturing, or in the form of materials yet to be utilized. An inventory system is the set of policies and controls that monitor levels of stocks, and determine what levels should be maintained, when the stocks should be replenished, and how large the orders should be. The inventory management, therefore, is defined as the system used by a firm to control its investment in inventory. It involves the recording and monitoring of stock levels, forecasting future demand, and deciding on when and how to order. The primary goal of inventory management is to have adequate quantities of high quality items available to serve customer needs, while also minimize the carrying inventory cost (John et al., 2015). Companies can reduce costs by reducing the inventory; however, this may create stock out, resulting in customer dissatisfaction. On the other hand, an overstock can be a potential source of waste, if it is expired or outdated.

An effective inventory management requires such information as machine capacity, ordering amount, supplier availability, delivery time, bottleneck work center, and customer demand. Having an effective inventory management assists the company in 1) avoiding product spoilage, especially those with short life cycles, 2) avoiding dead stock (i.e. stock that can no longer be sold for various reasons, such as out of season and out of style), and 3) saving on storage costs. In addition, an effective inventory management improves cash flow, as shown in Example 1.1.


Example 1.1

An effective inventory management improves cash flow.

Jade Company, a furniture manufacturer in Pathumthani, has the following income statement:

Sales	\$6,000,000
Cost of goods sold	\$3,300,000
General administrative expenses	\$1,206,000
Marketing expenses	\$1,050,000
Net income before taxes	\$444,000

This results in the return on sales of 7.4% (i.e. $444000/6000000$). If the company improves the inventory management, this might reduce the cost of goods sold by 2%, thus reducing general administrative expenses by 1% through the reduction of storage and insurance costs. These result in:

Sales	\$6,000,000
Cost of goods sold	\$3,234,000
General administrative expense	\$1,193,940
Marketing expenses	\$1,050,000
Net income before taxes	\$522,060

With small cost reduction through an effective inventory management, the company now receives 8.7% in the return on sales, 17.6% higher than the previous percentage.

1.3 Uncertainties in Production and Inventory Management

Any uncertainties in production and inventory management can cause severe results. A case study of inventory management of petroleum products in Thailand in 2014 revealed that the uncertainties induce businesses to hold more of the inventory-to-sale ratio than required (see Figure 1.1). The uncertainty in the ex-refinery price contributes mostly to the uncertainty in the inventory management, while the impact

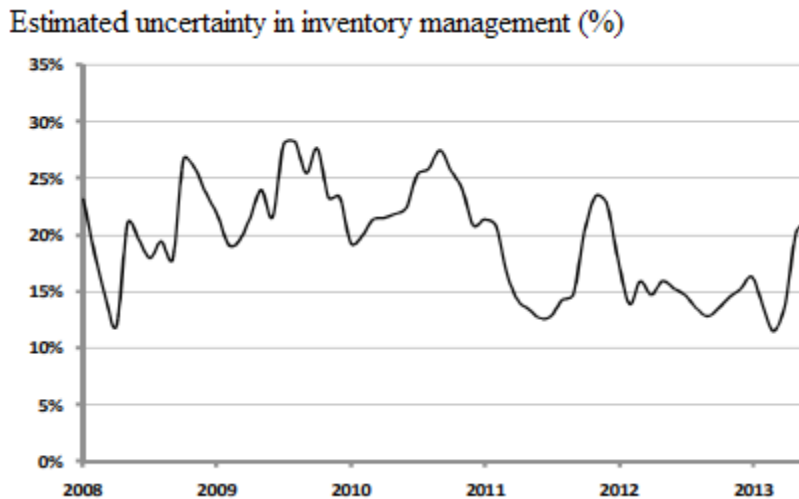


Figure 1.1 Case study of estimated uncertainty in inventory management (Roekchamnong et al., 2014)

of uncertainty in the oil fund on the uncertainty in the inventory management is relatively small. The results also indicate that uncertainty in future prices can help mitigate the uncertainty in the inventory management, and gives support to the existence of the future markets (Roekchamnong et al., 2014).

Another case study attempts to design an inventory management system for motorcycle parts to control inventory of raw materials (see Figure 1.2). Make-to-stock production is currently used, with the order amount based mainly on entrepreneur's decision. This, however, results in an overstock. The inventory management system is then developed to decide whether an order for the inventory should be made. With this inventory management system, the company can keep track of flows of products and supplies, and reduce total inventory cost.



Figure 1.2 Examples of motorcycle parts (Treerattrakoon and Lersbuasin, 2015)

1.4 What is Covered in this Textbook?

This textbook looks at production and inventory management in various perspectives. It is organized into 11 chapters, as the followings.

- Chapter 1: Introduction to Production and Inventory Management. This chapter overviews the production management, inventory management, and uncertainties in production and inventory management.

- Chapter 2: Sales and Operations Plan (S&OP). This chapter details fundamentals of the S&OP. Different strategies used to develop the S&OP are presented, such as chasing strategy, leveling strategy, and mixed strategy.

- Chapter 3: Master Production Scheduling (MPS). This chapter considers the MPS in different production environments. Details of an MPS, including forecast demand, orders booked, ending inventory, available-to-promise, lot sizing decision, and safety stock are described in details. Managing the MPS in a dynamic environment utilizing freezing period is also discussed.

- Chapter 4: Material Requirements Planning (MRP). This chapter details key information in an MRP, including bill of materials and backward scheduling. The chapter also discusses key data used in an MRP record, including gross requirement, scheduled receipt, ending inventory, net requirement, planned receipt, and planned order. An updated MRP, when changes occur, is also presented.

- Chapter 5: Distribution Requirements Planning (DRP). This chapter considers DRP in the supply chain, and relationships between the MPS, MRP and DRP.

- Chapter 6: Capacity Planning. This chapter introduces short-, medium-, and long-term capacity plans. A number of capacity techniques, including capacity planning using overall factors, capacity bills, resource profiles, and capacity requirements planning are considered in capacity management.

- Chapter 7: Inventory Management. This chapter utilizes an and a cycle counting approach to manage inventory. To determine an ordering amount, a number of inventory models are introduced, such as economic order quantity and discounting. Reorder point and safety stock are, on the other hand, presented to determine the lead-time or ordering period necessary to avoid the stock out.

- Chapter 8: Inventory Management: Managing Uncertainties. This chapter presents indices, service level, and average inventory used to measure inventory performance. The chapter also focuses on inventory management when demand and performance cycle time are uncertain. Different policies to manage inventory are also discussed.
- Chapter 9: Theory of Constraints (TOC). This chapter explains various TOC concepts. Group scheduling and transfer batches are introduced to manage with bottleneck work centers. The TOC scheduling is also developed using processing time and workload schedules.
- Chapter 10: Waiting Line Theory. This chapter explains cost of waiting and cost of service in the waiting line theory. Different characteristics of a waiting line system are presented.
- Chapter 11: Lean Operations. This chapter discusses advantages of lean production. Various lean perspectives are pinpointed. Kanban system and Poka Yoke technique, which are the approaches in the lean production, are also discussed in details.