PRODUCTION AND INVENTORY CONTROL

SYSTEMS AND DECISIONS

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Preface

THIS BOOK, I have discovered through the years of the first edition, plays to many and varied audiences. Not only does it serve the requirements of junior-senior business and engineering students, but it also is used extensively in two-year technology and community colleges. To my pleasure, many students find it worthwhile to retain their book as a reference after graduation. In addition, many industrial people use the book as a handbook for solving day-to-day production and inventory control problems.

Some reorganization of the material has been made to suit the various needs of this wide audience. The sections and chapters have been arranged so that the book can be used to any depth desired. It can be used for an in-plant short course or an extensive graduate level course.

There are several important additions in this second edition worth pointing out. One is the emphasis on computer software packages. The background of software packaging is developed early so that each module, such as the bill of materials processor (BOMP), materials requirements planning (MRP), inventory control, and others can be developed in its appropriate chapter.

Many new subjects have been included such as materials requirements planning, which is just being introduced in industry. Inventory techniques involving exponential smoothing, part-period-lot sizing, and probabilistic models are just a few of the new additions. There are also a number of new approaches to the complex scheduling problem.

The trend towards the broader concept of materials management is recognized by the inclusion of such subjects as sales-order processing, purchasing, and capacity planning.

The material in the text is developed in seven sections with the thought

that the instructor can outline his course to meet his objectives. For example, if he wishes a traditional course he may exclude the designing of a system as covered in Section Five. Or, if he is teaching an advanced group, he may wish to skip some of the basic sources of information which are discussed in Section Two.

Section One emphasizes the basics of production and inventory systems along with the logic used in developing these systems. Emphasis in computers has shifted from custom programming to pre-packaged software, and on-line terminals operating in the real-time mode. This section will give the reader a comprehensive view of this type of modern production control system.

Section Two develops all of the input information needed for a production and inventory control system. This information includes the quantities derived from sales orders or forecasts as well as the engineering, processing, and cost information required for an efficient system.

Section Three is devoted to inventory control decisions. Accounting and record keeping are not slighted in this development, which extends through practical probabilistic models to the mean absolute deviation (MAD).

Section Four is dedicated to decision making for production control. The techniques such as PERT, CPM, and critical ratio are developed along with the tools which are used to make them practical.

Section Five prepares the advanced student to be able to design production control systems. These systems range from basic manual systems to sophisticated computerized systems.

Section Six is for those who are managing, or aspire to manage, a production and inventory control system.

Man is a mosaic of his innumerable experiences. How can he recognize, let alone credit, all those who have influenced him? I recognize a debt of gratitude to too many people to list them all here. Among those are the many members of the American Production and Inventory Control Society committees with whom I have had the pleasure of working—in particular the contributors and editors who helped me put together the *APICS Handbook*.

I am deeply grateful to those at the State University of Iowa who assisted me toward my educational goals. Also, to those colleagues at Purdue who have been a constant stimulation during my teaching career. Above all, I probably owe the greatest debt for the development of this text to the graduate students whom I have supervised. I had the pleasure of being not only their teacher but also their student. In particular, I would like to thank Mamdouh Bakr, Thomas Rehg, Chandry Rao, Christian Neve, Capt. Neil Saling and Richard Scott.

Dr. Aaron Glickstein has kindly contributed the results of some of his research to the text, for which I would like to express my gratitude. Betty and Joseph Havlicek have graciously shared their knowledge in some of the technical fields.

To my wife, Barbara, goes my deepest gratitude. She had the courage to encourage me in this venture and had the foresight to prepare herself in home economics and journalism. No author could ask for more.

My objective with this book is to communicate some ideas as simply and painlessly as possible. In trying to do this, I have adhered to one of the lesser theories of Albert Einstein: Matters of elegance ought to be left to the tailor and the cobbler.

May 1974 JAMES H. GREENE

Contents

section one

Production and Inventory Control Basics

THE PURPOSE of this section is to give you an overview of production and inventory control so that the other sections of the book may be placed in proper perspective. It emphasizes the information and decision-making process that takes place in production and inventory control, and it should give you a good insight into how it occurs in industry. If you read no further, you would have a good introduction to the subject.

Section two is devoted to the input information needed for the production and inventory control systems. These are comprehensive chapters and consequently you may find that you are familiar with the subjects. If so, you can pass over them lightly without any loss. Or, perhaps you will want to use these chapters for review.

Section three and section four are devoted to the decision processes of the production and inventory control function. If you are interested in learning only how these systems operate, you need read no further. However, if you wish to learn how to design systems, you should study section five. And if you are interested in the management of the production and inventory control functions, you must study section six.

In section one there are three chapters:

Chapter 1. Production and Inventory Control Concepts

This chapter outlines the objectives and scope of production and inventory control. A typical, and basic, production control system is illustrated. Production and inventory control operations can take on different appearances in different companies. The reasons for these differences are explained in a classification of industrial systems.

Chapter 2. The Logic of System Designing and Decision Making

One cannot expect to go far in the study of production and inventory control systems without a logical, global perspective of the systems concept. The logic of system designing and decision making is to help you move beyond the provincial ideas generally included in texts on this subject.

Chapter 3. Modern Production and Inventory Control Systems

Modern production and inventory control systems have developed through a sequence of steps from no documentation to handwritten documents, card data processing, and custom-made computer programs, to prepackaged computerized systems. Since many of the chapters throughout the book will touch upon the packaged systems, a typical system will be presented. Not only will this chapter show you where production and inventory control is today, it will also give you another overview of the system.

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Production and Inventory Control Concepts

A TREND toward enlarging the subject of control is well established. In this text, emphasis is placed on the control problems directly related to production in a factory, but we must never forget that the methods to be discussed are equally suitable for many control problems.

Traditionally, production control texts emphasize the metal trade industries and give little consideration to the manufacture of other products, which, however, also require production control. Control problems also occur in other factory activities besides the production of goods. For example, the tooling, maintenance, materials handling, cost accounting, and personnel departments encounter control problems which are analogous to those found in the manufacture of a product.

The concepts of control can be expanded to include projects such as highways, dams, and buildings. It takes very little more imagination to apply these concepts to the design and operation of an airline ticket service, to a hotel room reservation service, or to the efficient utilization of hospital operating rooms. The methods used in designing control systems are identical, and many of the decision-making techniques are interchangeable.

Be aware of the broad spectrum of system designing and decision making for control, and apply your knowledge to any suitable problem.

Objectives of Production Control

Universally acceptable objectives for production control cannot be stated in a few words, for they are seen in the reflection of one's background. Experience with different products, markets, and plants will give different shades of meaning to the objectives.

Objectives of production control, which meet the minimum requirements, might be stated in this way: *The coordination of the production facilities to produce a product at an optimum cost.*

Those who would like more extensive objectives might be better satisfied with the definition of production control found in the Dictionary of Production and Inventory Control Terms:

Production control is the function of directing or regulating the orderly movement of goods through the entire manufacturing cycle from the requisitioning of raw materials to the delivery of the finished product to meet the objectives of customer service, minimum inventory investment, and maximum manufacturing efficiency. In this sense, production control includes inventory control.[1]

The literature abounds with other definitions and objectives for production control. An analysis of a few of these would illustrate the difficulty of establishing universally acceptable objectives.

In defining production control it is not uncommon to find it compared to the nervous system of the human body. This is an interesting and realistic comparison, for as the nervous system pervades the whole body, so does production control pervade the whole manufacturing organization as a comprehensive communications network. The nerve network assures conformance by many feedback links as does the production control system.

Production planning is frequently spoken of (and in the same breath) as production control. The distinction, if one is made, is that *planning* refers to establishing the requirements while production control refers to keeping production within these requirements; but most frequently production control refers to both of these activities. Recognition of the difference will be made when we discuss the *planning stage*, the *action stage*, and the *compliance stage* of production control.

Scope of Production Control

One difficulty in spelling out the objectives of production control occurs because different activities are combined in different organizations. These differences are caused by tradition, by variations in products and markets, and by numerous other reasons. Here is a list of activities (many overlapping) which might be included in the production control department:

Receive and record orders from the sales department.
Estimate the cost of new jobs.
Serve as a liaison between the factory and sales department or customer.
Forecast sales.
Issue purchase requisitions.

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[1] Richard C. Sherrill, *APICS Dictionary of Inventory Control Terms and Production Control Terms*, 3d ed., American Production and Inventory Control Society, 2600 Virginia Avenue, N.W., Suite 504, Washington, D. C. 20037.

Make decisions to make or buy.
Maintain control over raw materials and finished products.
Maintain stock rooms for raw materials and finished products.
Establish inventory levels.
Determine routing of purchased material.
Determine routing of finished goods.
Determine internal transportation of material.
Control stock in branch warehouses.
Estimate manpower and machine requirements from schedules.
Make schedules and maintain production throughout plant.
Replan schedules and minimize replanning failures.
Assign jobs to men and machines.
Make product "explosions."
Dispatch production orders.
Expedite orders.
Evaluate performance.
Issue and maintain engineering prints.
Issue and maintain engineering changes.
Print and duplicate manufacturing forms.
Design and redesign data-processing systems.
Data processing.
Install data-processing systems.
Program computers.
Evaluate data-processing systems.

Production Control and the Organization

The objective of the production control department is to coordinate production facilities, and consequently numerous communication interfaces occur with the other departments. They all have a common interest in making a product on schedule at an optimum cost, but the method of doing it is at times a source of disagreement.

The sales department is interested in sales, and repeated sales. This can be accomplished only if the customer is satisfied, and he is usually satisfied if he obtains a product of the quality he desires at a reasonable cost and on schedule. Usually the delivery date becomes the point of conflict between production control and the sales department. To the sales department, the schedule is more important than living within the budget because a record of poor delivery can damage customer relations beyond repair.

The purchasing department wants requisitions placed well in advance of the time the material is needed. It also wants to purchase all material in large quantities, and to have freedom to substitute whenever this is desired.

Engineering would like to have designs accepted by the factory, regardless of the manufacturing difficulties. It would like to have any design changes made instantaneously, no matter how difficult.

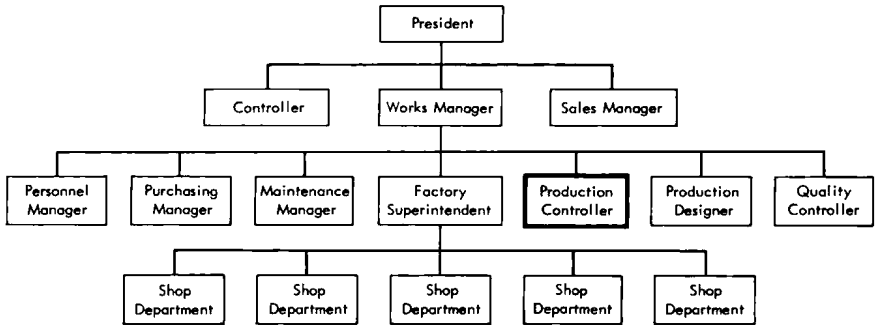
The tool department wants time to design and build tools, and, if necessary, to experiment with production methods. The tool department itself is a small production facility, having many of the scheduling problems which exist in the factory as a whole.

Quality control and inspection are concerned with meeting the product standards, regardless of the production schedules to be met. This sometimes leads to open conflict, but most often production and quality control recognize their common interests and work harmoniously.

The personnel department would like to maintain a constant labor force and supply the skills from the available labor pool. Factory management is interested in long production runs with infrequent changes. They would like to keep inventories low, but at the same time keep the factory busy.

The place of the production control department in the organization will depend on many factors, but a typical structure is illustrated in Figure 1–1.

Figure 1–1
Typical Organization Chart



Ultimately, of course, the president of the manufacturing concern is responsible for the production control, but production control is actually the responsibility of whoever is directly charged with production: the works manager, the plant manager, or the manufacturing vice president. Except in a very small organization, this individual has many problems and therefore delegates his responsibility for the coordination of the production facilities to produce a product on schedule at an optimum cost. These responsibilities are gathered under one function under the production controller as shown on the organization chart.

Since this is a text on production control, it will be worthwhile to dwell on this part of the organization and to scrutinize the responsibilities. These responsibilities for control consist of three stages: the planning, action, and compliance stages; and each production activity is subject to these three stages of control. When an activity does not comply with the plan, the planning and action stages must be repeated; so the stages continually cycle until the activity is completed.