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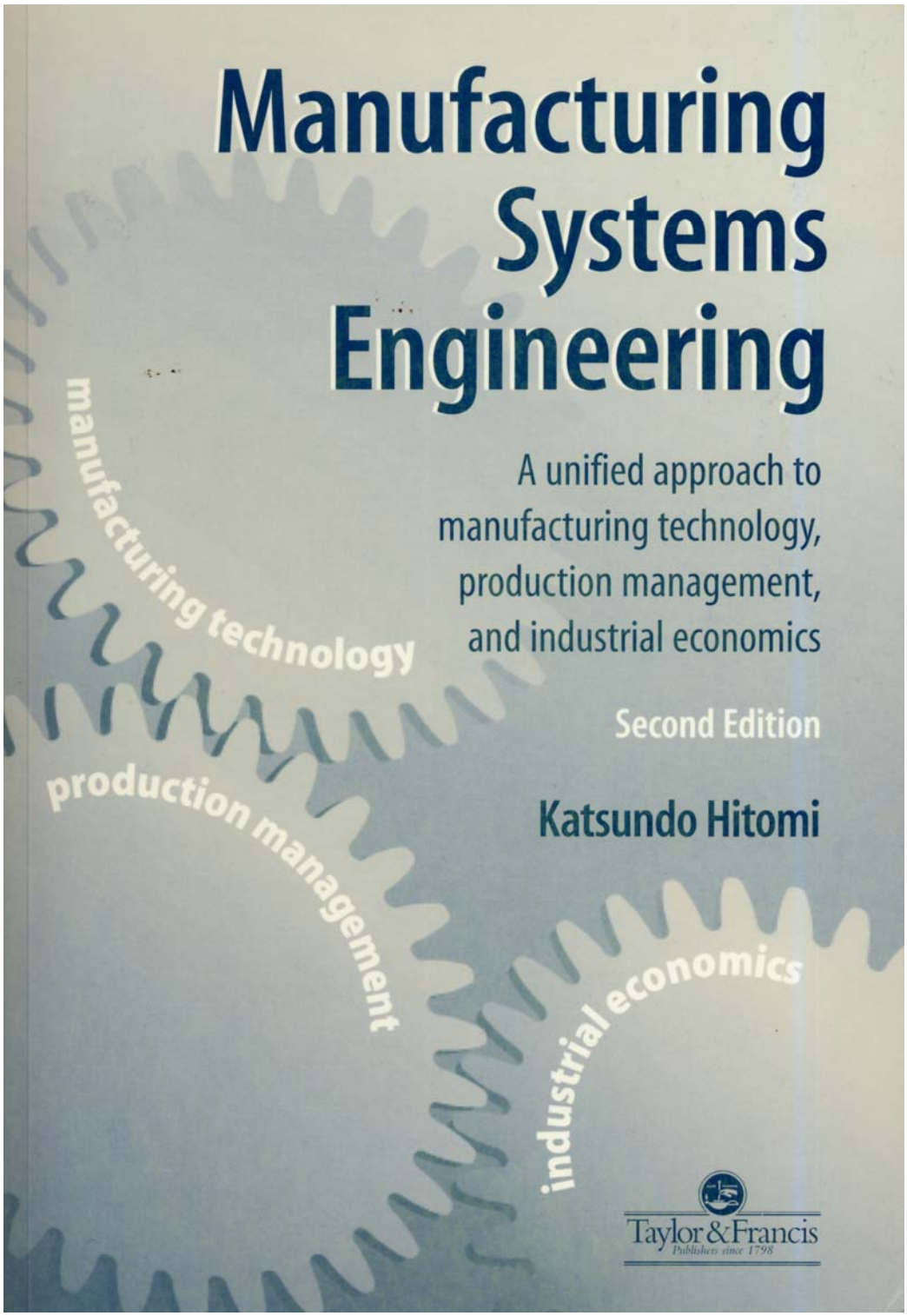
■ Outline of Hitomi's Book: Manufacturing System Engineering ■

● Katsundo Hitomi's "Manufacturing Systems Engineering", London: Taylor & Francis

・First Edition: 1979 - A unified approach to manufacturing technology and production management, 310+xiii pp.(This is the first book in the world as to "Manufacturing Systems Engineering".)

・Second Edition: 1996 - A unified approach to manufacturing technology, production management, and industrial economics, 536+xix pp.



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Publisher: SciTech Media Inc.
http://www.scitech.co.kr
2000, pp.595+xxii

A. Purpose of this book: This book was written to provide a modern introductory text for mechanical, industrial, and production engineering students and a reference book for mechanical, industrial, and production engineers and managers who are concerned with manufacturing technology and production management in industry. This book is intended to integrate the following three aspects:

- manufacturing (or production) technology,
- production management, and
- industrial economy (or economics).

'Manufacturing technology' is concerned with the 'flow of materials' from raw material acquisition, through conversion in the workshop, to the shipment of finished goods to the customers. 'Production management' (or 'management technology') deals mainly with the 'flow of information', so as to manage the flow of materials efficiently by planning and control. 'Industrial economy' (or 'production economics') treats the 'flow of costs' in order to reduce the product[ion] cost so as to set the price reasonably.

The majority of the study of manufacturing technology has been concerned with manufacturing processes, machine tools, etc., in the areas of mechanical and production engineering, whereas management technology, such as production management, information technology for manufacturing, etc., has been within the fields of industrial engineering and business administration. As to industrial or production economics, this has been investigated and taught in the economics department, though it is an important subject in manufacturing studies.

'Manufacturing' is the production of tangible goods (products); it is a basic historical process which has lasted for several thousand years. Manufacturing matters, in that it is a basic means of human existence, it creates the wealth of nations, and it contributes towards human happiness and world peace. In 1991 the National Academy of Engineering/Sciences in Washington, D.C. rated manufacturing as one of the three important subjects necessary for America's economic growth and national security, the others being science and technology. In Japan the importance of these three subjects was pointed out as early as 1935.

These days 'manufacturing' is taken to include software and its serviceability. In this respect manufacturing is to be considered not only from the technological viewpoint, but also from the wide standpoints such as management, economy, social sciences, philosophy, . . . In other words, study of manufacturing/production must include both hard and soft technologies. Such an integrated, systematic study of manufacturing is termed 'manufacturing systems engineering'.

B. Contents of this book: Based on the foregoing ideas and objectives, this volume contains seven parts with 36 chapters as follows.

Part I, Essentials of Manufacturing Systems, describes basic concepts and principles of manufacturing systems and manufacturing systems engineering. Principles of production and manufacturing (Chapter 1) and systems (Chapter 2) are discussed, then manufacturing systems are defined within three aspects — structure (plant layout), transformation (production process), and procedure (manufacturing management) (Chapter 3). In addition, two important modes of production — mass production and multi-product, small-batch production — are mentioned (Chapter 4). Fundamental frameworks of integrated manufacturing [and management] systems are displayed (Chapter 5).

Part II, Process Systems for Manufacturing, describes basic principles of production process technology — 'material flow' as well as 'technological information flow' (Chapter 6), which is the most essential activity in production/manufacturing. Fundamentals of product planning and design for new product development (Chapter 7), process planning and design dealing with the effective conversion of raw materials into finished products (Chapter 8), and layout planning and design concerning spatial allocation of production facilities (Chapter 9) are mentioned. Logistic planning and design for solving the transportation and the traveling salesperson problems (Chapter 10) and manufacturing optimization for deciding optimum machining conditions based on the minimum time, the minimum cost, and the maximum profit rate (Chapter 11) are also discussed.

Part III, Management Systems for Manufacturing, describes basic principles of production management technology — 'managerial information flow'. The meaning of this flow and the functions and decision problems of strategic production planning and operational production management are introduced (Chapter 12). Basic theories and solution algorithms of production planning including product mix, economic lot size. MRP, and production forecasting (Chapter 13), production scheduling including PERT/CPM (Chapter 14), inventory management which is 'stock in the material flow'(Chapter 15), production control including just-in-time (JIT) production, productive maintenance, and replacement (Chapter 16), and quality engineering including quality control (QC), quality function deployment (QFD), and the Taguchi method (Chapter 17) are discussed.

Part IV, Value Systems for Manufacturing, describes basic principles of production economy or economical production — 'flow of value/costs' against the 'flow of materials' and the 'flow of information', which are mainly concerned with technical production. The concept of cost and the time-series value of money (Chapter 18), the product cost structure including price-setting methods and typical cost accounting and control procedures (Chapter 19), profit planning and break-even analysis determining the optimum plant size and production scale (Chapter 20), and effective capital investment with typical evaluation methods for manufacturing automation (Chapter 21) are introduced.

Part V, Automation Systems for Manufacturing, describes basic principles and the present state of factory automation (FA) and computer-integrated manufacturing (CIM) for automated 'flows of materials and technological information', in connection with Part II. Industrial automation (Chapter 22) introduces the development and kinds of automation, and CIM (Chapter 23) is defined as a system of integration of computer aids of design, production and management functions. Computer-aided design (CAD) including computer-automated process planning (CAPP), auto-programming systems, and computerized layout planning (Chapter 24) and computer-aided manufacturing (CAM) including numerical control (NC), flexible manufacturing systems (FMS), flexible assembly systems (FAS), industrial robots, automated warehouse, and a real-life example of an unmanned factory (Chapter 25) are explained.

Part VI, Information Systems for Manufacturing, describes basic principles and software of manufacturing information processing for automated 'flow of managerial information', in connection with Part III and as an extension of Part V. Fundamentals of information technology including [management/strategic] information systems (MIS/SIS) and information network techniques are introduced (Chapter 26). Two effective methods for multi-product, small-batch production with computers are introduced — parts-oriented production information systems for order entry by customers (Chapter 27) and on-line production control and information systems for an efficiently running shop floor (Chapter 29). Computerized production scheduling introducing interactive group scheduling techniques and computer-aided line balancing (Chapter 28), and computer-based production management and manufacturing information systems are discussed. The communications-oriented production information and control system (COPICS) and the business and manufacturing control system (BAMCS) (Chapter 30) are explained as early versions of enterprise resource planning (ERP).

Part VII, Social Systems for Manufacturing, describes basic principles of the social aspect of production and manufacturing systems. Social production structure in connection with consumption and inventory with the historical development of production modes (Chapter 31) is discussed. Essentials of manufacturing strategy stressing the strategic side of CIM (Chapter 32) and global manufacturing including theories of globalization and export/import of industrial products (Chapter 33) are introduced. The industrial pattern shifts from primary industry (agriculture) to secondary (manufacturing), and further to tertiary (service), as the economies of a nation grow. This industrial development and manufacturing efficiency (Chapter 34) and the input-output analysis expressing the influences among industrial sectors (Chapter 35) are mentioned. In the last chapter of this book (Chapter 36) a concept of 'manufacturing excellence' is proposed for the 21st century production to enhance the elegance of goods production, and as its ultimate realization 'socially appropriate manufacturing' is introduced to save our only earth from destruction caused by today's excess production and consumption accompanied by huge waste of useful resources.

This is also stressed in Concluding Remarks with other issues such as human problems, the concept of philoso-technology, etc.

Each chapter contains references [and supplementary reading]. Review Questions and Problems are listed for the students at the end of this book.

Concepts, basic theories, algorithms and software technologies are emphasized with respect to manufacturing systems analysis/design/engineering/technology/management/economics. Hardware technologies for production facilities, machines, materials, jigs and tools are not explained in such detail.

C. Basic approaches to integrated manufacturing studies: In describing the concepts, fundamentals and principles of manufacturing system analysis/design and production management, as mentioned in the above, the following six approaches are vital.

1. To clarify the concept of manufacturing systems and their structure and functions; i.e. systems analysis and design for manufacturing, particularly, the 'flow of materials' (Parts I and II).
2. To optimize planning, implementation and control of manufacturing systems; i.e. optimum decision-making for production (Part III).
3. To recognize economy for manufacturing systems; i.e. cost engineering/management and profit planning, particularly, the 'flow of cost' (Part IV).
4. To automate manufacturing systems; i.e. factory automation (FA) and computer-integrated manufacturing (CIM) (Part V).
5. To process manufacturing information systems; i.e. information technology in production management, and timely 'flow of information' (Part VI).
6. To understand the social aspect of manufacturing; i.e. strategic and global manufacturing, industrial structure and input-output analysis, proposing 'manufacturing excellence' for future production perspectives (the 'flow of value) (Part VII).

D. How to use this book: This book may be used as a textbook of production engineering, production management, manufacturing systems [engineering], and other related courses. For one quarter Parts I-IV should be treated, and Parts V-VII may be handled in the following quarter.

Practicing engineers and managers can consult this book as a sort of 'map of manufacturing' by finding their present situation and issues from the global standpoint. The Index will help them to understand the meaning of technical, managerial, and industrial keywords.

E. Brief history of this book: The first book entitled Manufacturing Systems Engineering was published in 1975 in Japanese by Kyoritsu Publishing, Tokyo. This was translated into English and the English version with enlargement was published in 1979 by Taylor & Francis, London. The second edition of the Japanese book was published in 1990 and the second edition of the English book, in 1996. These Japanese and English books were translated into Korean and into Chinese.

In 1979 the concept of manufacturing systems engineering was recognized as one of the disciplines concerning industrial engineering and management (T. Furukawa, Journal of Japan Industrial Management Association, Vol.34, No.2), and several book reviews appeared (e.g. D.A. Dornfeld (1981), ASME Journal of Dynamic Systems, Measurement, and Control, Vol.103, No.4).

It should be mentioned that in 1982 the International Business Machines (IBM) Corporation developed the Manufacturing Systems Engineering (MSE) curricula for Master's courses with five universities in the United States, and contributed to the advancement of this academic subject (IE News (Manufacturing Systems), Vol.18, No.3). It is noted that this world-class giant company, who is accustomed to guarding their own intellectual property with great care, paid no attention to the earlier advocacy of this academic discipline, nor to the term manufacturing systems engineering, as developed by me.

The subject is now recognized as having an impact potentially as great as a second Industrial Revolution (K.P. White and C.M. Mitchell (1989), IEEE Transactions on Systems, Man, and Cybernetics, Vol.19, No.2), and quite a few departments, chairs and lectures bear this name. The University of Wisconsin-Madison established a program for this research; the director of its program mentioned that the term 'manufacturing systems engineering' was coined by me and has since become global (R. Suri (1993), Journal of Manufacturing Systems, Vol.12, No.3). It was also stated that I proposed the concept of manufacturing systems engineering as 'integrated manufacturing unifying material flow (manufacturing processes) and information flow (production management)' (G.J. Colquhoun, R.W. Baines and R. Crossley (1993), International Journal of Computer Integrated Manufacturing, Vol.6, No.4). Chongqing University in China established the Institute of Manufacturing Systems Engineering; the director of this institute also mentioned that the concept of 'manufacturing systems engineering' was first proposed by me in the

1970s (F. Liu et al. (eds.) (1995), Manufacturing Systems Engineering (in Chinese), Beijing: Defense Industry Publishing, p. 2). It was a great pleasure and honor to me to be called by Emeritus Professor J.T. Black of Auburn University, Director of the Advanced Manufacturing Technology Center. 'Mr. Manufacturing Systems Engineering' in a dedication of his book (J.T. Black (1991), The Design of the Factory with a Future, New York: McGraw-Hill).

For a brief history and for future perspectives of manufacturing systems, refer to my article (1994): 'Manufacturing systems: past, present and for the future' (International Journal of Manufacturing System Design, Vol.1, No.1), K. Hitomi(guest editor/2001): 'New Trends in Manufacturing Systems Engineering' (International Journal of Manufacturing Technology and Management(editor-in-chief: M.A. Dorgham/www.inderscience.com), Vol.3, No.3), and Special issue(2001/2002): 'Manufacturing System Design' (Journal of Manufacturing Systems, Vol.20, No.6(7 articles)).

F. Contents:

G. Manufacturing Systems Engineering for the 21st Century

a. Manufacturing systems: social impacts

It should be noted that from a wider viewpoint the manufacturing (production) system not only plays a role inside each firm, but it also forms the socially spatial interaction structure together with the settlement system and the public system. The production structure also plays a part in constructing the international structural power in the

world system, interacting with the security structure, the finance structure, and the knowledge structure.

b. Globalization of manufacturing systems

In social life 'production' is closely related to 'consumption' and 'inventory'. The balance of these three functions plays a vital role in developing as well as stabilizing the economic trends in the long run.

Manufacturing of goods by private firms is no longer confined within their domestic country; they can establish production sites in any foreign countries where labor costs are low, even though de-industrialization occurs in their own country. This international production is now common for world-class manufacturers in order to keep a competitive edge.

c. Human-centered manufacturing systems

Recently young people's feelings towards the value of labor have changed and there has been a strong tendency to hate repetitive and dirty jobs, especially in highly developed countries. One approach to cope with this trend is to establish a labor-saving organization by installing the computer-integrated, fully automated manufacturing system, though this system needs a huge amount of capital investment.

The other approach is to design jobs for an individual worker in order to achieve an improved quality of working life. Human problems within man-machine manufacturing systems are everlasting problems which need adequate solutions. Establishing human-centered aspects in integrated-manufacturing systems is of vital importance today, in order to make a huge variety of products for mass customization.

d. Proposing socially appropriate manufacturing for environment-preserving and green production

There is no need to mention the importance of production resources, especially raw materials, which are being drained from the world. Excess production and consumption associated with a huge amount of waste is now going to result in destruction of our only Earth; hence, although human beings have the responsibility of producing goods, production is now dead!(J. Baudrillard/1982)

Today we have to firmly recognize that manufacturing/production is an activity that destroys the Earth. Accordingly manufacturing for the future should be friendly to the Earth, aiming at resource conservation by recycling of waste as much as possible and preventing the generation of environment-polluting 'public bads (or hazards)' (creation of 'negative' utility). Excess production must be stopped; for this purpose I now propose "socially appropriate manufacturing (or production)". The 'satisfaction-consciousness' principle based upon Buddhism and Taoism in the Orient will give a hint to save the Earth from drainage of natural resources, the contamination of the atmosphere, and the extinction of all living creatures. The present mass (excess) production and mass (excess) consumption associated with a huge amount of waste, which have formed a sort of 'manufacturing (or throw-away) culture' in the 20th century, is to be replaced by 'satisfaction-conscious' production and 'satisfaction-conscious' consumption associated with the minimum amount of disposal, which is an ultimate 'manufacturing excellence' for the 21st century production.

e. Social role of manufacturing systems engineering

Manufacturing ethic is of vital importance to achieve the ultimate goal of socially appropriate manufacturing. For this purpose the traditional and conventional production technique and technology are raised up to the level of the so-called 'philoso-technology' to be discussed as manufacturing philosophy.

Manufacturing/production is an essential useful activity in human history; we can not live at all without this activity in our highly civilized societies. Manufacturing technologies, production management techniques, and industrial or production economics are the most powerful tools for both efficiently technical and effectively economical production, thereby generating a variety of useful goods for living, while creating the wealth and benefiting our social welfare. 'Manufacturing systems engineering (or [philoso-]technology)' is a vital tool for this purpose. This discipline searches for excellence in human [working] life, symbiosis of all life on Earth, and world peace.

This tool is only for human happiness; it is strictly prohibited to apply manufacturing systems engineering to the fabrication of any weapons, and any drugs that are contrary to human moral welfare and to any manufacturing aimed merely at profit-making. Keep in mind that in old Chinese saying "Do not seek profit for the sake of profit. The profit should be based on justice and morality—Confucian doctrine."

In the end, keep in mind that technology, science, management, economics, sociology, philosophy, . . . are all in one for manufacturing (systems engineering) for the future. (The End)