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## Editorial: New trends in Manufacturing Systems Engineering

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Guest Editor: Katsundo Hitomi

It is my great pleasure and honour to be asked to edit this special issue on New Trends in Manufacturing Systems Engineering for the *International Journal of Manufacturing Technology and Management*. The background, procedures, and contents are briefly mentioned below.

### Historical background of Manufacturing Systems Engineering

The term 'manufacturing (or production) system(s)' has been employed since the first Industrial Revolution emerged in England more than two hundred years ago. In 1815 Robert Owen, a utopian socialist, used this terminology to mean 'factory system'.

Nowadays, this phrase signifies a broad systematic view of manufacturing, and a new term, 'Manufacturing Systems Engineering', emerged in the 1970s. In 1973 Development Digest, USA, produced a sound cassette, 'Manufacturing Systems Engineering, a real challenge for real IE's', a speech presented by L.O. Gillette at the conference of American Institute of Industrial Engineers. In 1975 Bradford University in Britain established the first department of Manufacturing Systems Engineering in the world. In the same year I published a Japanese book, *Manufacturing Systems Engineering*, by Kyoritsu Publishing, Tokyo, first of its kind in the world, introducing a new academic discipline. The English version of this book was published in 1979 by Taylor & Francis, London, with a subtitle, 'A unified approach to manufacturing technology and production management'. Thus this academic subject aims to integrate 'hard' technology (flow of materials) and 'soft' technology (flow of information).

Fortunately, the Japanese version was revised in 1990, and the English version, in 1996; this second edition includes the cost aspect in manufacturing (flow of costs) as the subtitle, 'A unified approach to manufacturing technology, production management, and industrial economics', implies, and emphasizes the social roles of manufacturing such as manufacturing strategy, global manufacturing, environmentally-conscious (green) manufacturing, manufacturing excellence, etc. Both Japanese and English books written by this editor have been translated into Korean and into Chinese. Meanwhile, Professor Shumpei Minato of Matsuyama University, Japan, published a Japanese book, *Manufacturing Systems Engineering for Process Industries*, by the Business & Technology Newspaper Company, Tokyo, in 1987, Professor C.Z. Xiao of Shanghai University of Mechanical Engineering, China, a Chinese book, *Manufacturing Systems Engineering*, by the Mechanical Industry Press, Beijing, in 1987, Professor Stanley B. Gershwin of Massachusetts Institute of Technology, USA, an English book, *Manufacturing Systems Engineering*, by Prentice-Hall, USA, in 1994, and Professors F. Liu, D. Yang, and J. Cheng (editors) of Chongqing University, China, a Chinese Book, *Manufacturing Systems Engineering*, by the Defense Industry Publishing, Beijing, in 1995, all citing my idea, concept, and procedures from my Japanese and English books.

In 1989 Professors M. Anjanappa, and D.K. Anand edited a proceeding, *Advances in Manufacturing Systems Engineering* (American Society of Mechanical Engineers). In 1992 *Mini Guides: the Lucas Manufacturing Systems Engineering Handbook* (Solihull: Lucas Engineering & Systems) and in 1995 *Integrated Manufacturing Systems Engineering* (London: Chapman & Hall) were published in England.

This academic subject is now recognized as having an impact, and quite a few departments/institutes, chairs and lectures bear this name worldwide.

It should be mentioned that in 1982, the International Business Machines (IBM) Corporation developed the Manufacturing Systems Engineering (MSE) curricula for the Master's course with five universities in the United States of America, and contributed to the advancement of this academic subject. The University of Wisconsin-Madison, USA, established a program for this research, and Professor Rajan Suri, Director of its program mentioned that the term 'Manufacturing Systems Engineering' was coined by me. In 1995 Chongqing University, China, established the Institute of Manufacturing Systems Engineering, which is directed by President Liu Fei, and held a conference on Manufacturing Systems Engineering with a keynote speech by this editor.

### **Approach and procedures of Manufacturing Systems Engineering**

An academic subject is required to contain:

- A concept,
- B theory,
- C history, and
- D policy,

so does 'Manufacturing Systems Engineering'. This subject also stresses the following six aspects/approaches:

- i designing the manufacturing systems, especially, the material flow (systems engineering approach);
- ii optimum decision-making for manufacturing (management science/operations research approach);
- iii automating manufacturing – factory automation/computer-integrated manufacturing (control engineering approach);
- iv information processing for production management – manufacturing information systems (information technology approach);
- v cost engineering for manufacturing/management (economics approach);
- vi social aspects for manufacturing excellence towards 21st century production (social science approach).

The flow of information, namely procedures of the manufacturing system are vital in the age of 'market-in' for customer satisfaction by quick manufacture; the procedures consist of the following two phases and five steps;

- I Strategic production planning dealing with strategic production issues existing between the production system and the external environment.
- II Operational (or tactical) production management dealing with operational production problems of the manufacturing system with five stages.
  - 1 Aggregate production planning determines kinds of product items and the quantities to be produced.
  - 2 Production process planning determines the sequence of production processes.
  - 3 Production scheduling determines an implementation plan for the time schedule for every job.
  - 4 Production implementation executes actual production operations according to the time schedule.
  - 5 Production control modifies the deviation between the production schedules and the actual production performances.

### **Outline of this special issue**

This special issue contains the following eleven articles concerning ‘Manufacturing Systems Engineering’.

Katsundo Hitomi’s ‘Manufacturing Systems Engineering – A review’ historically reviews Manufacturing Systems Engineering by defining manufacturing/production, systems, and manufacturing systems, and mentions the social role and the future perspective of manufacturing systems (engineering), stressing ‘socially appropriate manufacturing’ as manufacturing excellence for the 21st century. This discusses (A) ~ (D), approaches and procedures of this academic subject.

Kazushige Okuda’s ‘Hierarchical structure in manufacturing systems – a literature survey’ surveys the research literature of hierarchical structures in manufacturing systems, and presents the new trend in multi-division models and/or decentralized models, several application models in hierarchical production planning, aggregation-disaggregation model, and multilevel lot sizing problems. This discusses (B), (ii), (I), and (II-1).

Masaharu Ota’s ‘The concepts of production-marketing integration toward agile manufacturing’ specifies ‘agility’, and proposes the production-marketing matrix to achieve agility. The managerial issues to construct computer-aided operation systems and computer-based information systems are investigated. This discusses (A), (D), (iv), and (I).

Hiroki Ishikura’s ‘New product development and planning’ discusses economical risks in product development in the competitive age, frequent development of high value-added products which give consumers mental satisfaction with low risks by mathematical analysis, and examples to be applied to real market situations. This is concerned with (D), (ii), (I) and (II-2).

Soemon Takakuwa’s ‘Current and future use of simulation in designing and analysing manufacturing systems’ mentions the current use and the potential use in the future of simulation technology for designing and analysing the manufacturing systems.

Typical examples for applying the simulation to actual manufacturing systems are demonstrated to prove the effectiveness of the simulation. This is concerned with (D), (i), (II-2) and (II-3).

Kazumasa Ohashi's 'Dynamic process planning systems in competitive environment' describes a dynamic process planning system for pallet-based machining operations of a flexible manufacturing system (FMS). This makes hierarchical strategic decisions, and revises the process plan, comparing it with the competitive performance data. An actual system architecture of this dynamic process planning model is also shown. This discusses (D), (i), (iii), (II-2) and (II-5).

Kenji Yura's 'Cyclic schedules in production and operations management' surveys the typical analytical methods, some important features and planning procedures for the cyclic scheduling of flow-shop type manufacturing systems, job-shop-type manufacturing systems, and the other related problems in manufacturing activities. This is concerned with (B), (ii), and (II-3).

Sang-Jae Song and Jung-Hee Choi's 'Integrated autonomous cellular manufacturing – a new view for 21st century' mentions the development of models, methods and tools suitable for effective, profitable, and autonomous cellular manufacturing as a new vision for 21st century production. This is concerned with (D), (i), (iii), (II-2) and (II-5).

Sang-Jae Song and Jung-Hee Choi's another paper, 'Flexible integrated manufacturing – future challenges toward socially responsible manufacturing' aims to develop flexible integrated manufacturing, which ensures social requirements while providing superior performance in thriving an integrated autonomous cellular manufacturing. Socially responsible manufacturing and human-enriching cooperative manufacturing are also discussed. This is concerned with (A), (D), (i), (vi), (II-2) and (II-5).

Katsundo Hitomi, Kazumasa Ohashi, Kazushige Okuda, Masaharu Ota, Kenji Yura, and Hiroki Ishikura's joint article, 'A proposal of recycling-oriented industrial systems' proposes green and clean environment in the current industrial society by resource-recycling methods to prevent environmental degradation, giving major attention to reuse of industrial waste in an attempt to make the world safer and cleaner; a better place to live. This is concerned with (A), (D), (vi) and (I).

The final article, Katsundo Hitomi's 'Historical trends and the present state of Japan's industry and manufacturing' explains the historical developments of Japan's industry, especially manufacturing industry during the period 1955 to 1996, and Japan's manufacturing efficiency is analysed and evaluated, compared with that other industrialized countries, which results in rather Japan's low productivity. This is concerned with (C), (vi), and (I).

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