

## 5th INTERNATIONAL MEETING OF THE CARPATHIAN REGION SPECIALISTS IN THE FIELD OF GEARS

### HISTORY, PRESENT TIME AND FUTURE OF MANUFACTURING ENGINEERING

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*Abstract: In paper is presented significance of manufacturing engineering as important area used on problem solution from area of manufacturing design and realization. Manufacturing engineering include all activities realised in manufacturing firm, which is needs to accomplish in time after finish of product design and before start of complete manufacturing processes. Main task of manufacturing engineer is to solve chosen technological problems included in processing of materials, tools design, manufacturing instruments and preparation of new or special devices needed at manufacturing of products in accordance to specified technical conditions.*

*Key words: production engineering, manufacturing engineering, manufacturing technologies*

#### 1. INTRODUCTION

Manufacturing engineering involves the analysis and modification of product designs so as to assure manufacturability, the design, selection, specification, and optimization of the required equipment, tooling, processes and operations: and the determination of other technical matters required to make a given product according to the desired volume, timetable, cost, quality level and other specifications. Manufacturing engineering is a relatively new term applied to some aspects of planning and control of manufacturing; it is a service function to the production department. Manufacturing engineering as a planning activity takes place between product design and the planning of the overall manufacturing process. Overall manufacturing planning is usually considered within the profession of industrial engineering. But in attitudes of greater specialization, manufacturing engineering may be considered a separate profession closely allied to industrial engineering [1].

#### 2. HISTORY AND DEFINITION OF MANUFACTURING ENGINEERING

Manufacturing, in its broadest sense, is the process of converting raw materials into products. It encompasses (1) the design of the product, (2) the selection of raw materials, and (3) the sequence of processes through which the product will be manufactured.

Manufacturing is the backbone of any industrialised nation. Its importance is emphasized by the fact that, as an economic activity, it comprises approximately 20% to 30% of the value of all goods and services produced. A country's level of manufacturing activity is directly related to its economic health. Generally, the higher the level of manufacturing activity in a country, the higher the standard of living of its people.

The word *manufacturing* is derived from the Latin *manu factus*, meaning made by hand. The word *manufacture* first appeared in 1567, and the word *manufacturing* appeared in 1683. In the modern sense, manufacturing involves making products from raw materials by means of various processes, machinery, and operations, through a well-organised plan for each activity required. The word *product* means something that is produced, and the words *product* and *production* first appeared sometime during the 15th century.

The word *production* is often used interchangeably with the word *manufacturing*. Whereas *manufacturing engineering* is the term used widely in the United States to describe this area of industrial activity, the equivalent term in other countries is *production engineering*.

Because a manufactured item has undergone a number of processes in which pieces of raw material have been turned into a useful product, it has a value defined as monetary worth or marketable price. For example, as the raw material for ceramics, clay has a certain value as mined. When the clay is used to make a ceramic cutting tool or electrical insulator, value is added to the clay. Similarly, a wire coat hanger or a nail has a value over and above the cost of the piece of wire from which it is made. Thus manufacturing has the important function of *adding value*.

Manufacturing is generally a complex activity involving a wide variety of resources and activities, such as the following [2]:

- Product design
- Purchasing
- Marketing
- Machinery and tooling
- Manufacturing
- Sales
- Process planning
- Production control
- Shipping
- Materials
- Support services
- Customer service

Manufacturing activities must be responsive to several demands and trends:

1. A product must fully meet design requirements and product specifications and standards.
2. A product must be manufactured by the most environmentally friendly and economical methods.
3. Quality must be built into the product at each stage, from design to assembly, rather than tested in after the product is made. Furthermore, the level of quality should be appropriate to the product's use.

4. In a highly competitive environment, production methods must be flexible enough to respond to changes in market demands, types of products, production rates, production quantities, and on-time delivery requirements.
5. New developments in materials, production methods, and computer integration of both technological and managerial activities in a manufacturing organisation must constantly be evaluated with a view to their appropriate, timely, and economical implementation.
6. Manufacturing activities must be viewed as a large system, the parts of which are interrelated. Such systems can now be modelled, in order to study the effect of factors such as changes in market demands, product design, and materials. Various other factors and production methods affect product quality and cost.
7. A manufacturing organisation must constantly strive for higher levels of quality and productivity (defined as the optimum use of all its resources: materials, machines, energy, capital, labour, and technology). Output per employee per hour in all phases must be maximised. Zero-based part rejection (and consequent reduction of waste) are also an integral aspect of productivity.

### **3. FUNCTION OF MANUFACTURING ENGINEERING**

Engineering activities involved in the creation and operation of the technical and economic processes that convert raw materials, energy, and purchased items into, components for sale to other manufacturers or into end products for sale to the public. Defined in this way, manufacturing engineering includes product design and manufacturing system design as well as operation of the factory. More specifically, manufacturing engineering involves the analysis and modification of product designs so as to assure manufacturability, the design, selection, specification, and optimization of the required equipment, tooling, processes and operations: and the determination of other technical matters required to make a given product according to the desired volume, timetable, cost, quality level and other specifications [3].

Manufacturing is one of the most complex of human group activities. It comprises hundreds or thousands of simultaneous and serial subactions, some of which occur in fractions of a second while others take hours, months, or even years to have full effect. These actions may be material, technical, informational, social or economic.

Historically, the function of manufacturing engineering was limited to developing and optimizing the production process. In brief, the manufacturing engineering function bridges

the gap between the product design and full production. This can best be understood by considering the total process through which a designer's concept becomes a marketable product:

1. From the results of a needs analysis or market analysis, a product designer conceptualizes a product and then drawings and one or more prototypes of this product are produced.
2. The finalised prototype and its part drawings are released to the group responsible for the manufacturing engineering function, which starts designing and building an economically justifiable process by which the product will be produced.
3. When the manufacturing process developed by manufacturing engineering has been thoroughly tried and proved workable, it is turned over to the production group, which assumes responsibility for product manufacture.

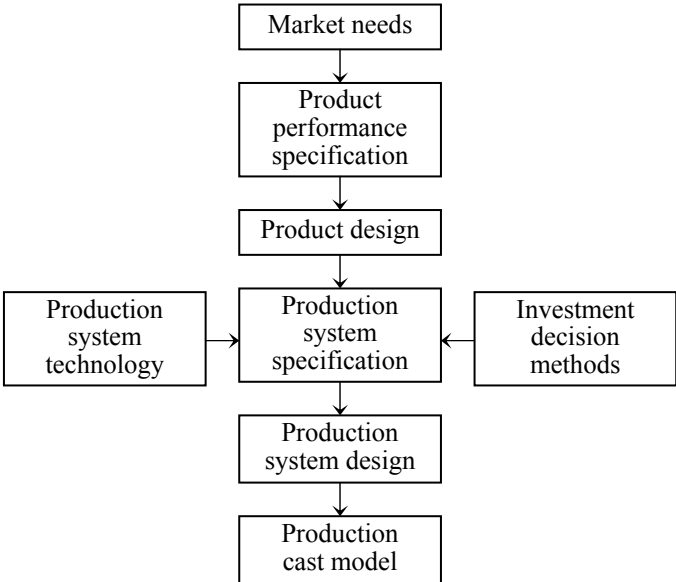


Fig. 1 Flow chart showing the components of the serial method of product production

This method is known as the serial method of product production or the conventional product-production system design process (Fig. 1). A method developed after the serial method, known as concurrent design/concurrent engineering, has been practiced in Japan since the late 1950s and since around 1980 in the most progressive companies in the United States. Concurrent design/concurrent engineering means the consideration of issues of product design, manufacture, and use concurrently, but not necessarily simultaneously. Team is formed of all the necessary specialists who meet periodically to review the status of the design, report on the success or difficulties in satisfying their individual functional

constraints, and collectively determine their next steps. An alternative arrangement has the team meeting continually. The starting point for a new design includes all the history of previous products, how they were designed and manufactured, as well as the institutions of people who did the work and who will do the next design. This concept is important, because, by the time the concept validation phase is finished, 75% of the total life-cycle cost of a product has been determined. Thus any downstream function can optimise only the remaining 25%, no matter what it does or how much money it spends [4].

The planning and control of the mechanical means of changing the shape, condition, and relationship of materials within industry toward greater effectiveness and value. Manufacturing engineering is a relatively new term applied to some aspects of planning and control of manufacturing; it is a service function to the production department.

As industry and technology evolve to greater levels of sophistication, complexity, and specialization, the broad area of figuring out what to do becomes more involved and at the same time better understood. By this process some of what had been originally performed by either the production department or the industrial engineer becomes a separate activity with its own background of knowledge, principles, and techniques.

#### **4. MANUFACTURING AND INDUSTRIAL ENGINEERING**

Manufacturing engineering as a planning activity takes place between product design and the planning of the overall manufacturing process. Overall manufacturing planning is usually considered within the profession of industrial engineering. But in attitudes of greater specialization, manufacturing engineering may be considered a separate profession closely allied to industrial engineering.

The purpose of production engineering is to refine and adjust the design of the product (preferably with the product designer) to the problems involved in its proposed manufacture. Conversely it should solve certain problems, mainly mechanical, such as those involved in processing, tools, dies, and new or special equipment necessary to manufacture the product efficiently and according to the established specifications.

Product design, manufacturing engineering, and industrial engineering overlap variously according to the situation, policy, and organization. The techniques of manufacturing engineering are mainly in the field of mechanical engineering, but some are closely related in concept and performance to, if not directly derived from industrial engineering.

Intelligent activity in manufacturing engineering requires a comprehensive understanding of both the intention and meaning of the product design and the means and principles of industrial engineering. The manufacturing engineer often acts as liaison between product design and industrial engineering [6].

## 5. CONCLUSION

The first operations in production engineering are to examine every detail in relation to its feasibility and economy with respect to the peculiar situation. The first question most likely to arise is whether to manufacture the part or purchase it. This is not always an easy question to answer. It depends upon many factors, from overall utilization of facilities and labor to company policy. For instance, many industries have expanded, by vertical diversification, into being their own suppliers, Like much of production engineering, the answer to this lies within the policy of top management and their vision of where they are going in the light of competition, economics, technology, and cultural change. Peculiarly, here production engineering must cooperate with sales, finance, and even basic research. Paper was prepared in time of realisation of VEGA project No. 1/1099/04.

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