# OVERVIEW OF PRODUCTION SYSTEMS

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**Keywords:** Manufacturing, flexible manufacturing systems, production, productivity.

**Abstract**. The paper makes an overview of the fundamentals of production systems. The paper is structured in three parts. The first part presents the notion of manufacturing system and also presents an short evolution of production. The second parts present the notion of flexibility in production systems and presents ways to define mathematically the flexibility of a system. The third part of the paper presents the notion of productivity and aspects related to the productivity of the flexible system.

## 1. MANUFACTURING SYSTEMS.

Production system is defined as an entity that through processes of movement and transformation of the work object (input elements in the system), in a certain period of time, lead to the creation of goods and / or services (output items from the system) [1].

Production system is crossed by three streams, namely the first is the flow of raw materials, energy flow and material flow. The main component of the production system is manufacturing subsystem (MS), which is "surrounded" by other subsystems ensures proper functioning [1]. Production practically appeared with the need for goods but the development of what causes the production systems was done by the appearance crafts [2]. Figure 1 shows the evolution of production systems.

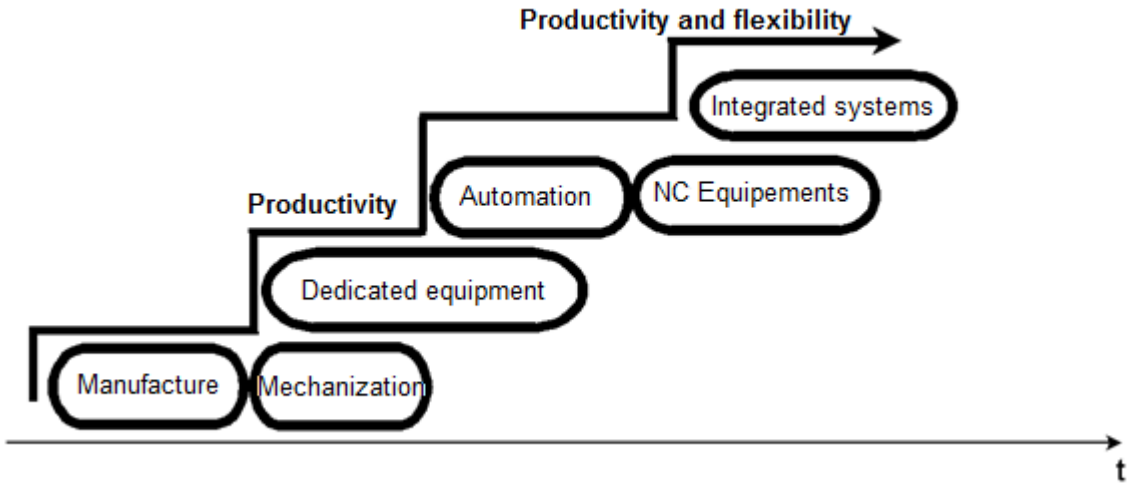


***Figure 1. Evolution of production systems.***

The production process can be classified according to several criteria but in the scientific community two criteria are prevalent, namely in the degree of intervention of the human operator that manufacturing system according to the cost required to switch from one product to another. Depending on the degree of intervention of human operator manufacturing system manufacturing systems meet classic, mechanized, automated [2].

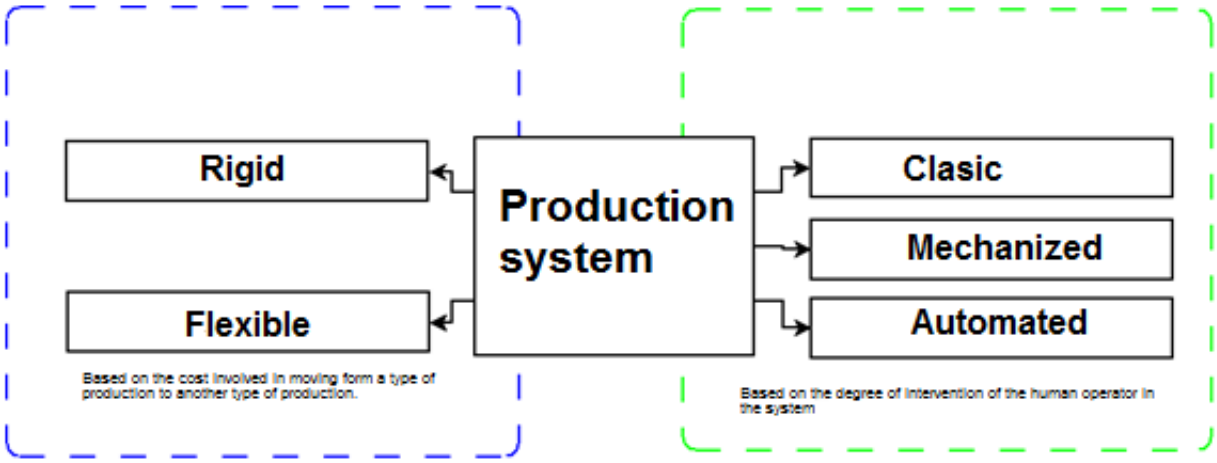


***Figure 2. Classification of production systems.***

Traditional manufacturing is characterized by the fact that the human operator is present in all phases of production. Mechanized production process is characterized by the use of artificial energy sources, external devices such as, working tools and machines so that exercise of the human operator is reduced, and its presence is only required process control activities [2].

Automated manufacturing process has as main characteristic the human operator's non-participation in the management and conduct of operations in the manufacturing process, its role being to supervisor (supervisory) process [2].

## 2. FLEXIBILITY OF PRODUCTION.

Flexibility can be defined as the ability to adapt to changing manufacturing systems manufactured tasks [3]. Flexibility can be defined as the ability to respond effectively to changing circumstances: the state when the system operates in diverse conditions such as order of operations, different tracks, changing volume, etc. production and action, which refers to the volume changes required to change the machine working conditions, etc. working devices[2].

The types of factors acting on the system are varied, but if we focus on the production systems these factors can be classified factors in external factors (raw materials, energy, information as input factors and volume of orders, typology, product features that output factors) and factors of production system (technical condition, equipment, equipment characteristics), which are also internal and individual to each system.

The evolution of flexible manufacturing systems was determined by two factors: increased productivity, on the one hand and increasing the number of types of products that can make the system [3].

Expressing flexibility in mathematical terms is possible by using a set of indicators generally named as degree of flexibility. These indicators are[3]:

- Degree of flexibility expressed by costs,
- Degree of flexibility expressed by time,
- Flexibility indicator ,

- The coefficient of readiness of the system ,
- Average coefficient of flexibility,
- Coefficient of flexibility of the structure.

Each indicator can be used to evaluate the flexibility of a certain system, based on punctual criteria. The most relevant of the above mentioned criteria is the average coefficient of flexibility.

$$F = \frac{\sum_{j=1}^{n} t_{pj}}{\sum_{j=1}^{n} t_{pj} + \frac{2}{n-1} \cdot \sum_{j=1}^{n} \sum_{i=1}^{n} t_{ij}} \quad (1)[3]$$

- F is the average coefficient of flexibility,
- $t_{pj}$ is the time necessary to manufacture item j
- $t_{ij}$ is the time necessary to prepare the system for transition from the item j to item i.
- n is the maximum number to types of items manufactured in the system

From an ensemble point of view an important criteria is coefficient of flexibility of the structure. This criterion takes into account all the components of the system and gives an indicator about the flexibility of the manufacturing system as a structure.

$$K_s = \frac{1}{q_{max} - q + 1} \quad (2)[3]$$

- $K_S$ Coefficient of flexibility of the structure.
- $q_{max}$ the maximum number of links between system components and determine the equation $q_{max} = \frac{n!}{2(n-2)!}$ , n being the number of components in the system.

### 3. PRODUCTIVITY.

In terms of economy productivity is defined as synthetic expression of the efficiency of utilization of the production factors in activities that have as a result economic goods. Productivity can also be interpreted as the efficiency with which the production factors are used . Mathematically the productivity is defined as the as the ratio between the effect of economic activities (Q), and effort included in economic activity (F).

$$W = \frac{Q}{F} \quad (3)[3]$$

Thus we define productivity in production systems as a report that determines whether the input elements (inputs) are converted into economic value output elements (products).

Each type of production system has an optimal point of productivity depending on the type and amount of product that should it occur. There is a close relationship between system productivity and unit cost of product produced.

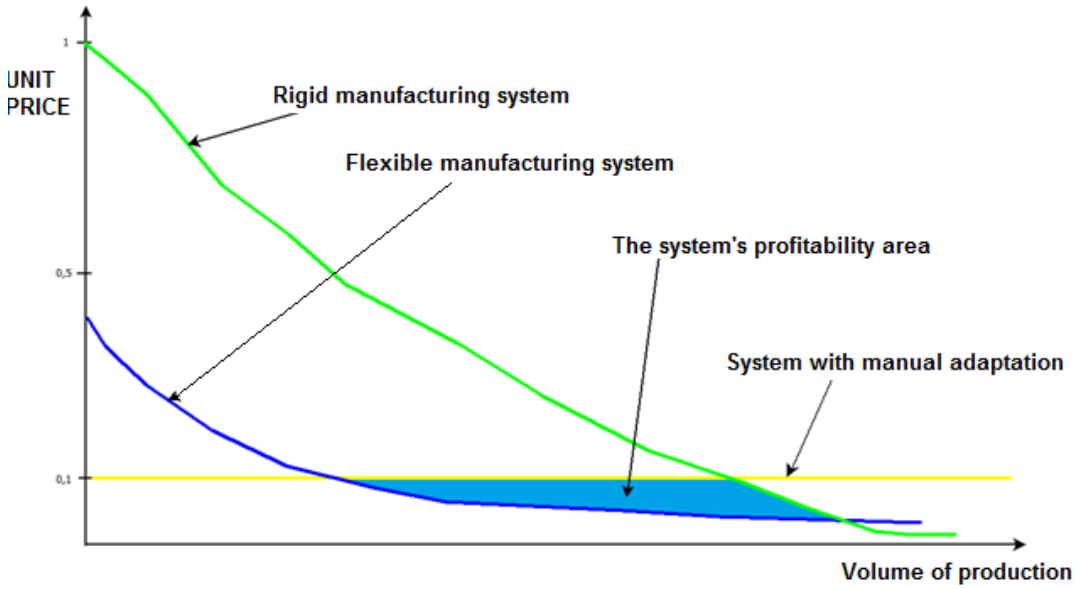


***Figure 3 Change in productivity.***

Elements contributing to the productivity of a given system can be divides into two categories according to their origin. External sources are those induced from outside the system: product complexity, variations of types and sizes of products, quality of product required, the quality of the production. Internal factors determining productivity of a production system are related to the technical equipment of the system, the organization of production flows, the technical condition of the systems.

In production systems, partial productivities can be defined. Thus energy productivity is defined as the ratio between output and energy to get them, material productivity as the ratio between output and raw materials consumed to get them.

## AKWNOLEDGEMENT

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