

# CONSIDERATIONS ON THE FLEXIBILITY OF THE PRODUCTION SYSTEMS IN THE MACHINE BUILDING INDUSTRY

**Gabriel MIREA**

*The Bucharest University of Economic Studies, Romania*  
*migab\_champion@yahoo.com*

**Cătălin Cristian BABALÂC**

*The Bucharest University of Economic Studies, Romania*  
*babalac.catalin@gmail.com*

## **Abstract**

In the machine building industry, both the choosing products and their life are uncertainly, because the diversity of the machines models and equipment and faster and faster changes of the customer wishes prevents any prediction of demand. Thus, the production of the machines must adapt to the actual demand of each buyer and to have the flexibility for this goal, under acceptable economic conditions. The first part of this article was dedicated for defining the concept of flexibility and the connection between this and other concepts, then I tried to point out that under the increasing pressures of the consumers that request increased quality, a faster development of the product and better post-selling services, the companies are forced to adopt a high strategic flexibility, to which contributes all functions of the production systems.

**Keywords:** Flexibility, Process, Reorganization, Change, Strategy.

## **1. INTRODUCTION**

In the last few years, the economic conjuncture has made the world market of the produced goods, in the machine building industry, to know the profound changes, production in the large series faced many difficulties due to the strong mobility of the market and its demand, both in terms of quantity, and quality, which required increasing adaptability to the manufacturers and a rapid change of the manufacture. Also, many businesses turn to the problem of analyzing reducing the prices, so the costs, as a competitive priority.

To be successful or simply to survive the changing economic environment, companies need to know how to organize their work and how to set priorities that can be monitored, measured and completed in a timely manner (Cioană, 2011, p. 74).

Increasing the production diversity influenced the manufacturing, both the organizational and technological, given that it frequently passed from achieving a type of product to another. This has led to the necessity for achieving a greater flexibility in production, in terms of designing and technological. Thus, there were appeared more intensive concerns for developing new quality of the manufacture, namely flexibility, involving radical changes both in the manufacturing technology and in the management, leadership and organization of production.

At the moment, any facilitation is welcome in the business environment tried hardly by the consequences of the crisis, the role of decisions, strategies, policies and programs is essential in increasing the chance of survival and success of the organizations (Vlăsceanu, 2014, pp.35-36).

## 2. DEFINING THE FLEXIBILITY AND CONNECTION TO OTHER CONCEPTS

In the machine building industry production, the flexibility term refers either to the automating manufacturing or to the ability of a system to move from manufacturing a product to another, thereby at the technological elasticity. A definition of flexibility of the production systems in the machine building industry could be that "flexibility is the ability of the system to adapt with minimal costs to the variable production tasks, so that, in a long period, the system functions economically with minimal changes in its structure" (Savi and Cojocaru, 1981).

Given the current worldwide socio-economic context and the perspectives not at all encouraging, at least in the short term, I can say without fear of error, that only showing a high flexibility, the companies will survive and may develop in the unstable environment we are facing.

In the following, I shall make some references to the relationship between the flexibility and other concepts such as: change, survival, leadership responsibility, organizational conditions, innovation, competitive advantage, risk and profit, strategy, resource allocation and environmental diversity.

If we analyze the relationship between environmental diversity and flexibility, we can say that sometimes the diversity could be a source of competitive advantage. Environmental diversities are of two kinds: external that involving changes in the product life cycle, product characteristics and aggregate demand, and, internal that including the equipment failures, material properties, stiffness technologies or the production cost. To face the environmental diversity, there are known three methods: stocks, excess capacity and the flexibility of the manufacturing systems. With the stocks helping there is assured the flexibility in volume necessary to respond to the diversity of demand, in terms of quantity. The excess capacity is an effective method to combat the demand fluctuations, if the

equipment is not expensive, but it is flexible enough to make different products. The flexibility of the manufacturing system is the ability to respond to environmental uncertainty, without considering the opportunity costs associated with the stock or the excess capacity.

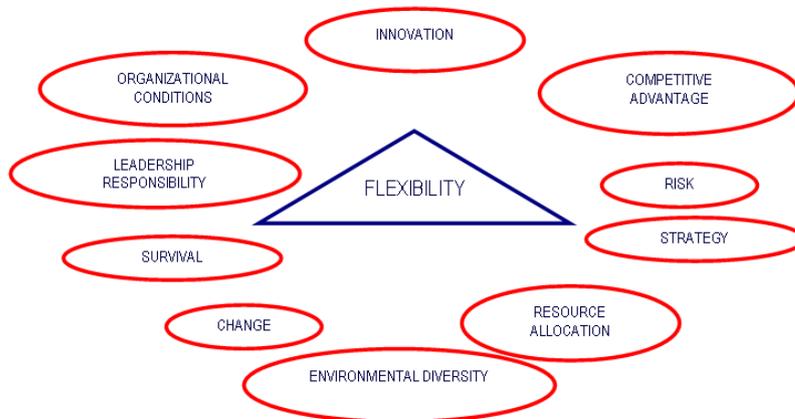


FIGURE 1 - THE CONNECTIONS OF THE FLEXIBILITY CONCEPT TO OTHERS  
Source: Deac, Badea and Dobrin, 2010.

People tend to resist to the change, for the following reasons: fear of the unknown, lack of confidence, fear of failure, job insecurity, relationship interruption of the group, personality conflicts, introducing the change in a forced way or in a difficult time, deficient reward systems, etc. Resistance to change is the main force behind the productivity growth and its overcoming is done in three stages: unfreezing, changing and refreezing. In order to respond to changes, the organizations need to be flexible, which must be seen as a time function and uncertainty.

There are three types of flexibility: real (R), which occurs due to using the certain resources and capacities and it is based on the experience, required (C) which is identified by the management after studying the environment and adapting the organization strategy being the desired type of flexibility, and, potential (P), which indicates the flexibility that can reach the organization. When  $R > C$ , the level of P is not relevant unless the organization recorded an excess of flexibility, heading towards a future use. If  $C > R$ , the management must use their potential, and if  $C > R$  and  $C > P$ , the management must influence the environment to achieve a lower required flexibility or to increase the level of the real flexibility.

Type of flexibility and its level is influenced by competitors, which means that the organization must study and analyze the competitors and their flexibility. The flexible organization records a competitive advantage through the speed and surprising, so through the faster development of the products and of the ways to carry out activities compared to that of the competitors.

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Between flexibility and risk there is an inverse relationship, so, the lower organization flexibility, the higher the level of risk. But on the other hand, an excessive flexibility can result in losses that will also increase the risk profile of the organization, creating a chaotic organization. Therefore, one of the challenges facing today's businesses in the machine building industry is identifying and resolving any existing weaknesses in the innovation of the products and processes. In this regard, the flexible organizations will redefine the strategy, while that would create a higher flexibility, better strategy options, so as to obtain an alignment with the context.

### 3. FLEXIBILITY OF THE PRODUCTION SYSTEMS IN THE MACHINE BUILDING INDUSTRY

In the following, I shall briefly present a classification of the flexibility on the hierarchical levels to specify the flexibility concept and to allow determination of its measurement methods (Table 1) (Deac, Badea and Dobrin, 2010). Thus, in an organization, the higher forms of the flexibility are met at the strategic level (level I), at the functional level (level II) and at the research-development subsystem (level III).

TABLE 1 - CLASSIFICATION OF THE FLEXIBILITY ON THE HIERARCHICAL LEVELS

No.	Level	Type of flexibility
I	Strategic	strategic
II	Functional	commercial research-development financial informational organizational manufacturing geographical
III	Research-development subsystem	products processes
IV	Manufacturing system	volume development product unattended manufacturing operation processes of manufacturing
V	Operational of the manufacturing system	execution paths operational individual resource
VI	Individual resource	material handling machine tools workforce

Due to the increasing pressures of the consumer that demand increasing the quality, a faster development of the product and better post-selling services, the companies from the machine building industry are forced to adopt a high strategic flexibility, to which contributes all functions of the production

systems. This can be supported by continuous increasing skills and implementing of some ways to identify and use the skills in the real time, such as decision support system (DSS).

We can identify four strategic issues in this field, respectively the quality, cost, time and range of products that companies base on during the simultaneous competition concerning the production. The quality consists in the consumer's experience on the product, the cost refers to the used resources to create the product, and time measures the speed with which the products are supplied. In this respect, my view is that flexibility is manifested by the ability to outperform competitors in terms of these issues.

We can look on the flexibility of the research-development as follows: a flexible department for research and development that must easy adapt to the market requirements and whose activities must be directed towards the achievement of the products and the flexible processes. The main activities taking place in the research and development subsystem are those of the constructive and technological design, simulation, prototyping, new product development and design of the processes in the organization.

The main processes in the machine building industry are designing of the new product, manufacturing and distribution. Therefore, we can define the flexibility of a process, through the number of the possible configurations to adapt to the environment and through the cost and the changing time of the configuration. The dilemma between flexibility and productivity (Schinner, 1974), which was at the origin of the references to the production policy, was based on the inability to reconcile the capacity of adaptability of the industrial processes and obtain a minimum cost. For reducing the operative cycle times, costs and deadlines for changing the products, we browse through several policies.

One of these policies consists in acting on the factors of constituting the lots, so to reduce the size. In the machines production, one of the factors that influence increasing the lots is the cost of preparing - finish of the manufacturing. This policy was popularized by the Japanese, who played a pioneering role in the field (Ohna, 1989). SMED which means "change of tools in one minute" was first used in the TOYOTA bodywork workshops. Time to change the press tools used to form the bodywork elements, was two-three hours in 1950, fifteen minutes in 1965 and three minutes in 1975 (Tarandeu, 1993).

For a product to be flexible, the reorganization should not involve large increases of time and costs, allowing the organization to be in line with the market demands and to bring quickly the new parts on the market. The product flexibility size can be measured by the cost of introducing the new products such as the cost of equipment and tools, or the cost of the numerical control programs needed to manufacture the new items.

Development flexibility refers to the maximum achievable production and helps to reduce the implementation time and the cost for the new products, to modify the existed production and to increase the capacity. To determine the economic value of the development flexibility, can be applied a simplified model based on the assumption that the flexibility of the development and can be measured by:

- Commissioning time of the new capacities.
- Additional investment cost.
- Additional average cost of the additional production expansion, due to increased demand.

The operational flexibility focuses on the quantitative planning and control of the production, taking into account the availability of the material, human and financial resources, and the range of the offered products. Determining the limits that define the domain in which a manufacturing system can effectively operate, involves identifying a lower limit established by the breakeven point and an upper limit determined by the maximum capacity of the system.

Policies for internal flexibility within companies in the machine building industry have two main variants:

- *Organizational or functional flexibility*, which involves incorporating the flexibility in the structure of the work processes, of the work organization and employment, also means the flexibility for detaching the staff. Production based on teamwork, includes measures such as acquiring the multiple skills and the task rotation. Working expanded into the team includes the teams with own leading and partnerships, promoting the acquisition and distribution of the knowledge, evolutionary learning, innovation at the workplace and product development.
- *Flexibility of the working time* is related to the flexibility in the program and the workplace. This could mean the continuous program in shifts or specific working times of day, week or year. It also might mean and the work during the displacements. At the same time, the working time flexibility refers to the flexibility of working week (part-time and full time program).

In the attempt to a better face of the cyclical fluctuations of the demand and to boost employee morale, the vehicle and aircraft manufacturing company GKN (<http://www.gkndriveline.com/drivelinecms/opencms/en>), which has a total of 20,000 employees in 40 subsidiaries that operates in over 20 countries tried to create a flexible mentalities of employees, introducing new methods of organization the work, that allows more flexibility in the production process. This includes a combination of trust, delegation of tasks, providing the responsibilities and measures for

developing skills, all of these are considered essential elements for achieving a more productive organization, based on a flexible mentality, from the top to the bottom (GKN, n.d.).

Internationally competition, increasing the production costs and pressure exerted by the customers were the main factors that determined the demarche towards increasing the flexibility in Palfinger ([http://www.palfinger.com/palfinger/2494\\_EN](http://www.palfinger.com/palfinger/2494_EN)), an Austrian company, that manufacturing the heavy machinery, especially the heavy cranes. The desire to avoid delocalisation and prevent the job losses led to introduction of three main steps with the consent of the employee representatives (negotiated flexibility). Teams with their own leadership, flexibility of the working time and the salary bonuses based on the teams' performance represented the basic measures that have made this company to stay at home, ensuring the economic recovery at the same time (Palfinger, n.d.).

Realigning the Saab Microwave Systems (<http://www.saabgroup.com>) company and its products to the market request, led to a large-scale reorganization and helped this unit Saab Group to become more flexible. The vision was to create an organization more economic, smaller and more efficient, thus, an organization oriented more towards the objectives and a shorter production cycle (flexibility by restructuring). Changes were necessary at all levels of the group, which are made with success, thanks to the power of the leaders' persuasion and to the investment in improving the employees' skills and competencies (Saab, n.d.).

Nowadays, in an era more and more globalized there is a tendency for creating virtual teams that are characterized by the geographical dispersion of members and are bound to communicate via modern electronic instruments (Mocanu, 2014, p. 52).

The virtual organizations are rapidly developing, and the information and communication technologies that are being used nowadays, the products and services that are being offered, are likely to guarantee the performances and the competitive advantage on the market (Croitoru and Stănescu, 2013, p. 36).

Therefore, the internal flexibility can improve the performance of the organizations in terms of increasing the adaptability, innovation and productivity. At the same time, it can contribute to work-life balance for employees, to the health and their employability. To achieve this objective, the internal flexibility should cover: balancing of the short-term market requests (productivity and the cost reduction) with the long-term demand for innovation and sustainability.

#### 4. CONCLUSIONS

The flexibility term in the machine building industry, as in all industries, refers to the ability of companies to react and adapt to the changes. Flexibility becomes appropriate and essential, considering that both employees and companies must become more and more adaptable. This aspect becomes important in an economic environment that is in a continuous changing, characterized by frequent restructuring of the companies and reallocation of the human resources, from a post and/or sectors to another.

Companies from the machine building industry, daily faced with the challenge of achieving a balance between the needs of the organization (such as productivity, short-term delivery, customer satisfaction, increasing the market share and innovation) and the needs and interests of employees (such as learning and continuous improvement, career development and achieving a better balance between work and personal life). For this reason, the flexibility initiatives may be an attractive option for both employers and employees.

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