Evaluation and Competitiveness of the Enterprises

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Abstract: - To survive in the current complex and unpredictable environment, the enterprise must have the capacity to react quickly in order to re-position itself in a favorable market position. Acquiring and maintaining this capacity is an effort for enterprises, as endogenous and exogenous factors are involved and the process is dynamic, continuous and difficult to predict. According to the specialized literature, a enterprise is competitive on a certain market when it manages to obtain certain economic indicators at an acceptable level: turnover, profit, market segment comparable or superior to that of other competing companies operating on the same market. In the paper, competitiveness will be understood as the capacity of the enterprise to function efficiently in a specific macroeconomic context and at a given time. Moreover, through a competitiveness metric (considered as an essential indicator of performance), the extent to which the enterprise achieves its purpose for which it was created will be assessed. Therefore, the paper aims to make a numerical assessment of technical-economic competitiveness and to manage the manufacturing system to achieve maximum competitiveness.

Key-Words: - competitive management; companies; competition; business; profit rate; management of the manufacturing system.

Received: June 16, 2025. Revised: September 21, 2025. Accepted: December 22, 2025. Published: June 17, 2026.

1 Introduction

In recent years, important and unpredictable changes have occurred on the market, such as: increasing frequency of introduction of new products that are often personalized, wide fluctuations in the structure and volume of orders, new government regulations especially related to the environment and consumer safety, fundamental changes in technology, from macro to micro and nano products. These changes have led to aggressive economic competition on a global scale and the need to establish a new balance between economy, technology and society.

In order to survive in this new technological environment, companies must be able to react quickly and economically efficiently to these changes [1], [2], [3].

As a result, competitiveness has become the most synthetic of the economic categories as it reflects the essential aspects of industrial activity and completely characterizes the viability of a company [3], [4], [5]. The other economic categories, such as cost, productivity, quality, profit can no longer be studied separately, being necessary to holistically model technical-economic competitiveness and evaluate it based on an appropriate metric.

Enterprises have to face competition under specific conditions, which lead to the identification of priorities, namely:

- the orders they can obtain are many as number, small in volume, very varied and must be obtained by frequently participating in a large number of tenders to which enterprises must respond in short terms, without having sufficient time for the thorough evaluation and analysis of each order; as a result, there are frequent cases in which either tenders are lost or won, but the efficiency of the concluded contracts is low, as a result of the insufficiently accurate evaluation of the cost and duration of the orders;
- the recent increase in the frequency with which the market demands not only mechanical components with usual dimensions, but also small-scale mechanical components, made of materials with special properties, for which companies cannot bid and, therefore, lose the respective orders;
- enterprises have to be equipped with technological facilities (machines, equipment, devices) very diverse in structure, purchased for possible future use, but which have a low average load; therefore, a good part of the capital invested by enterprises is stagnant, which negatively affects the efficiency and competitiveness of enterprises;

- the products that companies manufacture and send to beneficiaries are extremely poorly known by those who manufacture them, in terms of their exploitation behavior, since companies have neither the methodology nor the equipment for functional simulation of products and evaluation of their exploitation behavior; as a result, companies very rarely offer warranty periods for manufactured products, in order not to risk major expenses arising as a result of the warranty, and therefore the products are not sufficiently competitive.

The development of the concept of competitive management of enterprises will be based on the results already obtained in the research projects, regarding the rigorous and general analytical description of the econometrics of a generalized technological system, composed of machine tools, devices, parts and tools [2], [3].

The structure of the paper is as follows: section 2 competitive management of manufacturing systems from the enterprise, section 3 is the model of the business integrated, section 4 presents a study case and section 5 contains the main conclusions achieved.

2 Competitive Management of Manufacturing Systems from the Enterprise

The regulation of processes from the manufacturing system is done so that the enterprise obtains maximum profit, profit being the difference between the selling price of the product and the manufacturing cost of the same product.

Figure 1 presents a summary synthesis of the conclusions obtained in the case of cutting processes.

In figure 1 is represented the spatial profited the what maximum is can obtained the in conditions date. It demonstrates that the maximum profit depends on the competitiveness of the enterprise.

Analyzing figure 1, which, in ZOY plan, presents the cost curve, c, and productivity curve, p, depending on the intensity, R, it can be noted that c has a minimum point for which the process intensity takes the value Rc and the productivity curve, p has a maximum point for which the process intensity has the value Rp. Because analytically, Rc is different from Rp, it follows that it is never possible to simultaneously achieve minimum cost and maximum productivity.

It appears the question: to produce many expensive or little and the cheap in order to obtain how much elder profit is demonstrated as produced falls flat on sale, competitiveness is good. For maximum profit results that when competitiveness is high becomes more important the productivity (curve p) than the cost (curve c) and the intensity of the process gets closer to the point which Rp represents the intensity of the process for productivity maxim. If the productivity C" it is otherwise little, its results profit P''_{max}, the cost becomes more important and the intensity of the process gets closer to the point which Rc represents the intensity of the process for minimum expenditures. In the case of minimum expenditures (c_{min}) the profit is zero. These are output from previous team members and shall constitute the origination of present research. Competitiveness once established shall cause for each element of the manufacturing system the optimum level of intensity of the process, that is the optimum level of the costs and

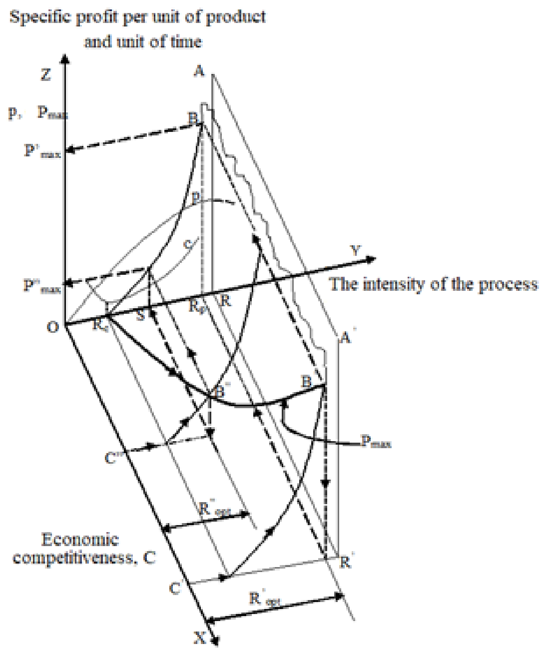

Fig.1: Curve of maximum profit

the optimum level of productivity.

In order to model the interaction between the elements of the manufacturing-market system, behavioral modeling of this ensemble will be performed. The term behavioral modeling is introduced to present the interaction of elements H_1 and H_2. According to Figure 2, element H_1 establishes a connection between input x and output y. Element H_2 has input y and output x. By modeling their (behavioral) interaction, it means that the pairs of values (x,y) that satisfy the functions H_1 and H_2 are established. The set of solutions that satisfy both H_1 and H_2 functions

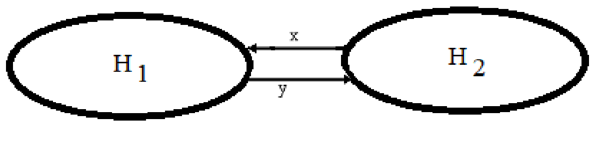

Fig.2: Comportamental modelling

represent the behavioral model because they describe the behavior of the H_1 and H_2 elements.

For example, in the case of this work, H_1 could represent the manufacturing system and H_2 the market. Behavioral modeling is also performed within the manufacturing system based on online learning.

The algorithm for modeling the market-manufacturing system relationship includes the use of a database from the economic environment (auctions), knowledge extraction through data-mining and the creation of the model through the reinforcement learning technique.

In order to obtain the punctual competitiveness indicators, databases will be created from the competitive environment and knowledge will be extracted in order to evaluate competitiveness.

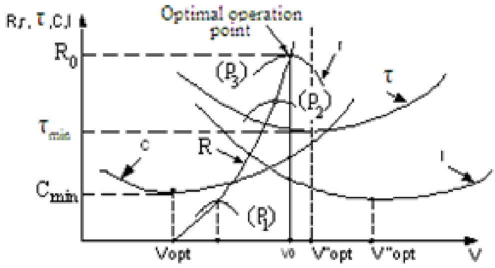

Fig.3 Business model of the manufacturing system

The multitude of solutions which satisfy both transfer functions H1 and H2 represent the behavioral model because they describe the behavior of the elements during their interaction.

The market offers enter the competitive environment to generate contracts for the manufacturing system and the manufacturing system modeling algorithm is performed starting from the contractual specifications and monitoring the system. Using data mining techniques, data sets regarding functional and economic parameters will be generated and the model obtained through unsupervised learning techniques, [6], [7], [8].

The paper aims, in the field of manufacturing technologies, at approaching issues of manufacturing systems, in order to develop a concept of management, which is in line with dynamics of the current market.

Based on the above models, behavioral modeling of the entire manufacturing system - market and implementation of the management system is carried out. The manufacturing system will receive instructions on how to conduct manufacturing processes in order to increase the technical and economic competitiveness of the enterprise.

3 The Model of the Business Integrated

Business integrated model is based on the modelling of the manufacturing operation taking into account its corresponding business operation. At a practical level, the aim is to create the business integrated manufacturing model of the machining system, available for any part operation and its use for either on-line or off-line control. Machining system interacts with the “market” carrying out a certain “service” (machining “service”) for a specified “client” (the workpiece), with which establishes a full economic relationship. This relationship is characterized by the following variables: the service quality, the service necessary investment, the service profit rate, as well as the environmental impact which occurs during the service.

The business integrated model takes into consideration as input the characteristics of the process, as output characteristics of the “service”, while as parameters characteristics of the machining system-market relationship [3], [9], [10], [11]. The generic business model is shown in Figure 3, where the process characteristic is the cutting speed v, the service characteristics are the cost C_0, the time τ, the rate of profit r (for three levels of the price - P_1, P_2, P_3) and the impact of environmental I while the price P of the machining operation is the model parameter.

Service characteristics of the business integrated model developed in this paper are: the cost c, the time τ, the profit rate r and the environmental impact I.

The cost c is defined as

$$c = \frac{C_0}{S}[\text{Euro/cm}^2] \qquad (1)$$

where:

C_0 – it is the expenses of manufacturing process;

S - the machined surface area.

Consequently, the cost is given by the following relation:

$$c = \frac{c_\tau}{10vs} + \frac{\tau_{sr}c_\tau + c_s}{10Tvs} + \frac{t \cdot c_{mat}}{10} +$$

$$+ \frac{K_e c_e}{10000vs} + \frac{c_M}{10K_M} v^{\alpha-1} s^{\beta-1} t^{\gamma} [\text{Euro/cm}^2] \qquad (2)$$

where:

c_τ – the total cost is directly proportional to time;

τ_{sr}- the time it takes to switch tools and set up the tool [min];

c_s- the cost of the tool between two successive reshaping;

c_{mat} - the cost of the tool allowance;

c_e –the cost of 1 kWh of electrical energy;
K_e- coefficient of energy [wh/min];
K_M – the coefficient of the machine-tool;
C_M – the cost of the machine-tool [Euro];
v – cutting speed [m/min];
s – feed rate [mm/rot];
t – depth of cut [mm];
α, β, γ – coefficients;

T – tool durability, as determined by the Taylor relation:

$$T = \frac{C^{\frac{1}{m}}}{v^{\frac{1}{m}} s^{\frac{x}{m}} t^{\frac{y}{m}}} [\text{min}] \tag{3}$$

The equation for calculating the time τ required to process a 1 cm^2 surface area is as follows:

$$\tau = \frac{T+\tau_{sr}}{10Tvs} [\text{min/cm}^2] \tag{4}$$

The profit rate r is a further feature of the service, and it is calculated using the formula below:

$$r = \frac{p-c}{\tau} [\text{Euro/min}], \tag{5}$$

where p is the exact price, [Euro/cm^2].

The formula for the environmental impact I [kg Co_2/cm^2], is:

$$I = \left[c_e K_{I_{energy}} + \frac{t\rho K_{I_{mat}}}{10} + \frac{m_{tool}\tau K_{I_{tool}}}{NT}\right] (6)$$

where:

$K_{I\ energy}$, – environmental impact coefficients are determined by energy use;

$K_{I\ mat}$ - the environmental impact coefficients of the K_{Imat} are dependent on the use of steel through the tooling allowance;

$K_{I\ tool}$ - coefficients of the environmental impact are determined by the tool material;

ρ– is the mass density of workpiece material [kg/cm^3];

m_{tool} –mass of the tool [kg];

N – is the number of reshaping.

4 Study Case

By means of relations presented above, an example of an updated business model was carried out. Figure 4 represents the structure of the most important expenses: salaries, tool cost, tooling allowance cost, the cost of energy and the cost of machine-tool for 10 business integrated model's simulations. It is important to note that the minimum cost c_{min}=0.00978 Euro/cm^2 is obtained for the optimal cutting speed v'_{op}=84m/min. Before v'_{op}, the salaries have the greatest influence, but after the v'op, the tool cost influences mostly the total cost. The tooling allowance cost is constant. The weight of the energy cost and machine-tool cost is greater before v'_{op}. As seen in Figure 4, through the business integrated manufacturing model, the machining process becomes transparent because all the technical and economic process characteristics (as cost, time, profit rate and environmental impact) are evaluated. Human/machine interface permanently displays the values of these characteristics and the online updated business model, as well.

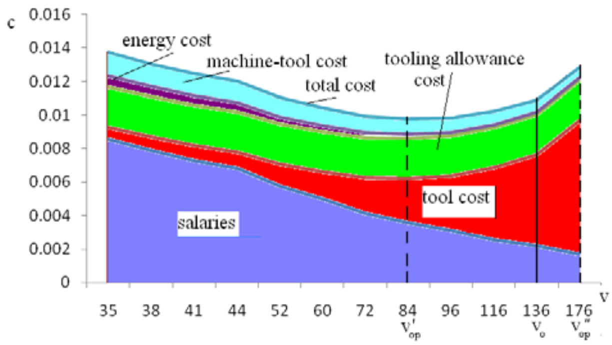

Fig.4: Business integrated model for a turning process

This allows the operator to evaluate the operating point position with respect to the business-model and to correct it, aiming for an enhanced set of the above-mentioned characteristics values.

Along with optimization considering also environmental impact, the productivity can increase, reducing the machining time τ as a consequence of the process optimization. Through implementation of the business integrated model, the profit rate increases even by 100%.

5 Conclusion

The new approach and new concepts regarding the evaluation and then management towards competitiveness of the enterprise meet the urgent need of the current stage, that of finding and implementing scientific solutions with broad practical applicability for acquiring technical-economic competitiveness.

The major impact of the work consists in approaching competitiveness of the enterprise in an original, comprehensive and analytical manner, which opens new scientific horizons, advanced in imagining leadership systems capable of operating behaviorally with technical, economic, managerial and commercial aspects, thereby covering a previously unexplored field of study, which links the manufacturing system to the economic environment.

From an industrial point of view, the impact of the paper is embodied in the development of a manufacturing system management technique capable of fully and sustainably capitalizing on scientific advances in the knowledge-based economy, promoting a new balance between technology, economy and society.

This new generation of enterprises based on the concept of competitive management will reach the capacity to economically produce personalized products at the level of quality required by the market.

References:

[1] S.Yekimov, M. Vondráček, T Egorushkina, and M. Podburtnyy, Analysis of the competitiveness of the enterprise based on the theory of utility, E3S Web of Conferences 431, 07001, ITSE-2023.
[2] L. Daschievici, D. Ghelase, Order earning power assessment of make-to-order manufacturing system, ModTech International Conference–New face of TMCR, 2012.
[3] L. Daschievici, D. Ghelase – Holonic Approach to manufacturing systems – The Annals of Dunarea de Jos University of Galati, XIV, vol. II, pg. 17 – 20, 2016.
[4] Epureanu, A.; Marin, F.B. & Marinescu, V., Reconfigurable machine tool programming- A new approach, WSEAS Transaction on System and Control, vol. 3, pp. 463-472, 2008.
[5] H'nida, F.; Martin, P. & Vernadat, F., Cost estimation in mechanical production: The Cost Entity approach applied to integrated product engineering, International Journal of Production Economics, pp. 17-35, 2006.
[6] Marinescu, V.; Constantin, A. & Epureanu, A., Online adaptive learning system for reconfigurable machine tool, WSEAS Transaction on System and Control, vol. 3, pp. 473-482, 2008.
[7] Özbayrak, M.. Activity –Based Cost Estimation in a Push/Pull Advanced Manufacturing System, International Journal of Production Economics 87, pp. 49-65, 2006.
[8] Paladini, E.P., A pattern recognition and adaptive approach to quality control, WSEAS Transaction on System and Control, vol. 3, pp. 627-643, 2008.
[9] Rooney, A. Handbook on the knowledge economy, Cheltenham Edward Elgar, ISBN 1843767953, 2005.
[10] Simao, L.M.; Stadzisz, P.C. & Morel, G., Manufacturing execution systems for customized production, Journals of Materials Processing Technology, Elsevier Science B.V., pp. 268-275, 2006.
[11] Thamarajah, A., A self-organizing view of manufacturing enterprises, Computers in Industry, Elsevier Science B.V., pp. 185-196, 2003.

Contribution of Individual Authors to the Creation of a Scientific Article (Ghostwriting Policy)

The authors equally contributed in the present research, at all stages from the formulation of the problem to the final findings and solution.

Sources of Funding for Research Presented in a Scientific Article or Scientific Article Itself

No funding was received for conducting this study.

Conflict of Interest

The authors have no conflicts of interest to declare that are relevant to the content of this article.

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