MODERN APPROACH OF TECHNICAL-ECONOMICAL COMPETITIVENESS FOR MANUFACTURING SYSTEMS

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ABSTRACT
On world wide plan, enterprises are confronted with a dynamics more and more an accelerated and unpredictable of the changes. This is influenced by the technical and scientifically progress, dynamic requirements of the customers, science of management and mathematical economy /1/. These changes enforce an aggressive competition to the global scale what assume settlement of new equilibrium between economy, technology and society. For the survival in actual complex and unpredictable environment, the manufacturing system must have the capacity of quick reaction in the sense of resituating on the favorable position on the market. The acquirement and preservation of this capacity is the most difficult overtue for enterprises, because it involves many endogenous and exogenous factors and the process is continuously, dynamically and difficult predictable. The aim work is the achievement of modern and general approach of technical-economical competitiveness of the manufacturing systems taking into consideration the dynamic of the interaction factors from the economical environment.

KEYWORDS: Competitiveness, Competitive management, Manufacturing system

1. INTRODUCTION
On world wide plan, enterprises are confronted with a dynamics more and more an accelerated and the unpredictable changes. This is influenced by the technical and scientific progress, dynamic requirements of the customers, science of management and mathematical economy /1/. These changes enforce an aggressive competition at the global scale what assumes the request of a new settlement equilibrium between economy, technology and society.

The characteristic aspects of the actual market, in the particular case of the mechanical parts market, are the following:

i) the current dimension of requests is decreasing continually, what drives to composition of the manufacturing small series;

ii) accentuated tendency of personification of products drives to a marked diversity of the forms, of the sizes and another characteristics of the mechanical components requested by the market;

iii) the flexibility, efficient management of the manufacturing systems tending to become the characteristics what determined in the way decisively competitiveness of manufacturers of components and mechanics buildings on market. The current dynamism of industrial and business environment represents a big global provocation and we must manage it.

This paper presents a new approach of technical-economical competitiveness for manufacturing systems, and a new type of competitive management of them, so that their technical-economical performance to be maximized.

Through manufacturing system understand the technological systems ensemble, which are...
used for obtaining of particular product. Each of these technological systems is composed of machine tool, tools, appliance, parts, operator and manufactures one of technological process operation for realization of the product. The manufacturing system is composed when the product is started into manufacturing and stay in this structure just up to the completion execution produced respectively. After when another product is started, the problem of manufacturing system structure is rerun from begin.

In literature, a manufacturing system is competitive on a certain the market when it obtains certain economic indicator: encipher of business, profits, segments of the comparable its superior market with one have another competitors. The approaches of the competitiveness problem /2/, /3/, /4/, /5/, /6/, /7/, /8/, /9/ show that, in this time, the competitiveness is defined though economical factors and indicators obtained and it is a suggested notion than numerical evaluation. In world exist the prestigious research centres of competitiveness, such us: Centre for International Development - Harvard University USA, European Institute of Technology with its centres from Cambridge, Geneva, Oxford and Organizational Competitiveness Research Unit of Sheffield Hallam University - Great Britain, which approach the competitiveness at global, regional level up to enterprise level. But, approaches, are economical and managerial nature, unless noticed the link with technical aspects of competitiveness.

Thence, it follows at the current level the competitiveness is defined by the economical factors and indicators obtained.

We can say as through competitiveness of the enterprises we understand the capacity (the potential) of enterprise operated comparative performant with other enterprises in the punctual context macro economical concrete to a given moment. The performance is measure in which the enterprise meet aim for which is creased.

In this moment the algorithm for technical-economical competitiveness evaluation is not defined and, more the technical factors are not taken into account, also consumptions and expenses caused by the technological processes are generated by the technical actions. In this context, competitiveness notion has new valences, because it assembles the factors and politics which determine the enterprise capacity to occupy a favourable place on market, to keep that place and to improve the position. Unless the competitiveness characterizes synthetically and completely the viability of enterprise.

It isn’t reported in the special literature a approach of the ensemble manufacturing system-market. It isn’t known an algorithm of management of ensemble manufacturing system - market, but just algorithm of technical management of the manufacturing system and economical of the relation with the market /9/. Today the manufacturing systems are managed through the programs of the machines tools with numerical program /10/, /11/.

Management is exclusive technique because don’t exist an economical variable which in fact is an ultimate consequence. Dynamics changes and the general progress of society translated to the level of the enterprise through many commands as the little volume, very varied, obtained through frequent auctions with answers in short terms, carry it doesn’t offer the times for analysis pertinence statements.

Consequence, it doesn't managed for a long time. It is enforced a method of the fluctuant online, prompt reaction, speeder management /12/. The dynamism from the market is transmitted into the management.

2. THE ALGORITHM OF COMPETITIVE MANAGEMENT WITH APPLICATION TO THE MANUFACTURING SYSTEMS OF THE MECHANICS BUILDINGS

Through application of the competitiveness management at manufacturing system of the mechanics buildings, can release a management of these systems. The authors of the paper propose a block scheme and on its base can elaborate a competitive management algorithm, figure 1.

The manufacturing system receives contracts after auctions of the market. The competitive management system means the competitiveness evaluation and, on its base to action on manu-
facturing system through instructions about caring on mode of the manufacturing process to obtain maximum competitiveness.

On the other hand, in aabt the competitiveness evaluation, the management system must give the elaborate possibility of the competitive offers which will enter in auctions.

To realise these two objects, the competitive management system uses reinforcement learning method to know the market and on-line unsupervised learning method to know the manufacture system.

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**Figure 1:** Block scheme for competitive management.

The next step is the comportamental modelling of the system for elaboration of the necessary adjustment instructions of the technological process and management politics. Watching each line from block scheme (figure 1), we can see the following:

- the modelling algorithm of the market-manufacturing system relation includes using the data base from economical environment (auctions), extraction of the knowledge through data mining and realisation the model through reinforcement learning;
- for obtaining of the punctual competitiveness indicators will be constituted the data bases from competition environment and will extract knowledge to evaluate the competitiveness;
- the offers from market enter in competition environment to generate contracts for manufacturing system;
- the modelling algorithm of the manufacturing system is realised leaving from the contract specifications and identifying the system.

Using data mining, will be obtained data set about functional and economic parameters, the dates which will be used for development of the model through unsupervised learning methods.

On base of above learning processes will be realised the comportamental modelling of the ensemble of the manufacturing system – market and a possible implementation of the management system. The manufacturing system will receive instructions about the way of development of manufacturing processes to achieve the maximum level of the efficiency (maximum profit).

The algorithm will be able to materialize through relations system between numerical values of the hexogen and endogen factors of the manufacturing system taken over from the reality, through the modelling of the manufacturing system- economical environment relation, on of part, and functional modelling of the manufacturing system, on the other hand. The algorithm is
based on the reinforcement learning method and on-line learning. The testing of the elaborated algorithm will be done through the simulations on the virtual enterprise.

The algorithm follows conceptual and it will be materialized through the system of relations between the value measures of exogenous and endogenous factors of the manufacturing system come from reality through relation modeling manufacturing system – economical environment and functional modelling of the manufacturing system. The modeling is based on the reinforcement learning and on-line learning. The stages of the algorithm are:

- the determination of the relations of the manufacturing system with economical environment through reinforcement learning;
- the determination of the relations results from functional modelling of the manufacturing system;
- the determination of the system of relations among the groups of endogenous and the exogenous factors of the manufacturing system.

3. CONCEPTION OF A METHODOLOGY ON MATHEMATICAL EVALUATION AND THE ON-LINE IDENTIFICATION OF TECHNICAL - ECONOMICAL COMPETITIVENESS IN MANUFACTURING SYSTEM

For most industrial companies, the estimation method of the cost determines especially the performances of two strategic functions: product design and the offer (the price of product). In general, is commonly admitted that product design can engage up to 70-80% of the total product cost. The recent progress achieved in Integrated Engineering such as concurrent engineering or integrated design opens a new field for cost estimating during the design stage.

In a competitive market, the incapacity of the company to quickly and adequately successful request for quotation can echo severely on its capacity to survive economically. Indeed, an underestimated cost will result in losses while an overestimated cost will prevent the company from remaining competitive. So, there is a strong need expressed by industry to have sound cost estimating solutions, both in terms of design and quotation, that can improve the performance of these strategic functions.

To face this need, and to replace the analytical-based methods commonly used in manufacturing process planning, many companies apply parametric and analogous cost estimation methods. These methods are really fast because they are essentially synthetic, they provide the total cost of the product according to some of its characteristics.

After a detailed study of the cost estimating problem in mechanical engineering, it can conclude that two support models are required: a knowledge model and reasoning model.

In manufacturing, cost estimating is the art of predicting what it will cost to make a given product or batch of products. Various techniques exist for cost estimating. The manufacturing cost of a part can be estimated using one of four basic methods: intuitive, analogous, parametric and analytical.

Based on the theories about comportamental and complexity, is an design a cognitive and adaptive mechanism that manages processes by responding flexibly to the demands of the economical environment, figure 2.

This mechanism is characterized by an ability to perceive the economical process environment and make real-time decisions about interactions among the manufacturing system and the economical environment.

The comportamental approach is characterized by an ability to perceive the economical environment and make real-time decisions about tasks.

The competitive management includes and bases on comportamental modelling and on-line learning, and it is necessary to know in every moment the manufacturing system state, namely the relation between its capacity to function at the performance optimum parameters and economical environment, suddenly, in a given situation.

The answer at this necessity is generated by the mathematic evaluation methodology of the technical-economical competitiveness of a manufacturing systems in a given frame. In the con-
crete case of the manufacturing system, the performance can evaluate through profit rate $P$, given by the relation:

$$P = (p - c)q \text{ [Euro/hour]}$$  \hspace{1cm} (1)

where $p$ is the price, $c$ is the cost and $q$ is the productivity. This relation will be analysed in connection with other aspects, such as, investment amount and business efficiency.

For identification of system state relation, is necessary to establish and multiply of some manufacturing system attributes – productivity, quality, flexibility, saving, predictability both its with external environment attributes- owned market section, the evolution of client requirements dynamic, market price, concurrent systems.

These attributes are state variables of system with which is operated and through their logical connection is determined the state relation. This relation characterizes in a concrete mode the system competitiveness for a $X$ product, at the moment $T$, on $Y$ market in the concrete conditions.

Comportamental modelling offers the possibility that attributes which could be modified and became in this way control and management variables, to be used for functional system setting, for optimal values of competitiveness achievement.

Mainly, the methodology of mathematical evaluation and on-line identification of competitiveness will generate solutions for competitiveness measures knowledge, in a concrete mode above explained, and based on-line learning and give to the management disposal dates and solutions to elaborate the politics which follow to get, to keep and to increase the technical-economical competitiveness level.

For the verification of the accuracy and applicability of the concept of competitive management of the manufacturing systems it is necessity to obtain results on a concrete case. In this sense, it is simulated and modeled a real manufacturing system of a pilot enterprise which works in the real conditions on a real market with values of parameters tacked from the economical reality.

4. CONCLUSIONS

This paper proposes a modern approach about manufacturing system competitiveness because:

- manufacturing system competitiveness is approached in a new manner, original by using investigation modern methods, which are taken into account all the factors which influence the realisation, keeping and increasing of industrial enterprise competitiveness;
- it is proposed a mathematical evaluation methodology of technical-economical competitiveness of manufacturing system;
- it is proposed a new management concept of manufacturing systems, based on comportamental modelling of ensemble of manufacturing systems-market and management setting at the manufacturing system level, which is all levels applicable and proper to the actual market requirements.
In this context, of competitive management can offer solutions for development and competitive enterprises. Through this type of management the technical phenomenon is associated with the economical phenomenon.

Increase competitiveness is not a process of exploit of a short-time advantages but it appears as a complex process and constitutes the support of an economic structures based on capital investments, on scientific research, development and innovate. It is necessary to put in obvious the correlations among economical average (the market, competition) and the manufacturing system and to study the role which they have it in the acquirement and the increase of enterprise competitiveness. This becomes still more pressing due to the fact as the special literature consigns studies about competitiveness at least to the level of the enterprise and studies about process and technology of manufacturing system don’t connection between the two entities in the context of the technical economical competitiveness.

The paper develops the notion of competitive management of the manufacturing system through comportamental modelling and on-line learning.

5. REFERENCES