COMPETITIVENESS OF PRODUCTS, EQUIPMENT AND TECHNOLOGICAL PROCESSES IN MACHINE-BUILDING

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Summary

In the times of crisis, the competitive edge of a desired production acquires a special value. The paper considers the structure of competitiveness as a unity of quality, expenditure, profit and prices. It describes a method of forming competitiveness exemplifying, at the same time, an erroneous interpretation of competitiveness and methods of its "rapid determination". To analyze and synthesize an integral level of competitiveness, one may use the SADT-method of detailed step-by-step hierarchy of the objects under study.

Keywords: competitiveness, quality, SADT-method, product

Konkurencyjność wyrobów i procesów technologicznych w budowie maszyn

Streszczenie

Konkurencyjność produkcji w okresie kryzysu nabywa znaczenia podstawowego. W pracy rozważano strukturę konkurencyjności określaną jakością wytworzonego wyrobu, wszystkich rodzajów kosztów oraz zysku. Opisano jedną z metod, umożliwiającą natychmiastową ocenę konkurencyjności procesów produkcji. Na podstawie ogólnej definicji konkurencyjności przedstawiono krytyczne uwagi dotyczące sposobu jej omawiania. Dla poprawy dokładności ustalania poziomu konkurencyjności zaproponowano zastosowanie wykresów SADT, umożliwiających wyznaczenie modelu hierarchicznego czynników mających wpływ na ocenę rozważanego procesu produkcji.

Słowa kluczowe: konkurencyjność, jakość, wykresy SADT, wyrób

1. Introduction

In machine-building, as ultimately in other industries of the national economy, production, technological processes and processing equipment constitute a single complex providing competitiveness. In the conditions of crisis, the competitiveness of production acquires a special significance in the eyes of both customers-who insist upon the best product quality and acceptable price and producers in view of low cost production and the possibility of creating new workplaces. Simultaneously, a temporary decrease in profit may occur. The output of other production will result in its non-claiming,

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warehousing, stagnation of production and aggravation of the crisis. Competitiveness is favourably influenced by crisis, it is the only index, recipient of further perfection. As is generally known, competitiveness is a property of objects that is characterized by a degree of real or potential satisfaction of a particular need as compared to analogous objects on a certain market [1]. Competitiveness is an integral value characterizing the attractiveness of products for the user and their profitability for the producer. It is difficult to talk about the competitiveness of products with a high cost of production output, but even at acceptable expenses, yet considerable operating expenditure or a high cost of produce, its competitiveness may become doubtful. A concept of competitiveness is a compromise between the customer and the producer.

It is known that a competitiveness (***lat***. *concurre* to be rivals) is interpreted as a strife between the participants of market management for the most profitable conditions of production, purchase and sale of products and services, as well as appropriation of maximum profits [1, 2]. This means that competition itself should regulate economy by functions of allocation, adaptation and controlling. The object of competition is the customer and producer, its subjects being enterprises, industries, regions and the whole countries.

There are statistics [2] that only 10% of the developed technologies and constructions are put into operation. The others, in view of their low-level competitiveness, are rejected. A similar situation is observed with technological equipment, automatic in particular. Most publications on this subject are concentrated on the establishment of ready-made production competitiveness, although the forming of competitiveness in the process of its production appear to be of greater importance.

2. Method of determination of competitiveness

The information necessary to determine the level of competitiveness includes the indices of quality, all kinds of cost, profit and the price of sale (Fig. 1). Depending on whether this is a product, a process or a service, major indices of quality (1) are set. Then, the production (2) and operating (3) costs, profit (4) and price of sale (5) are calculated. These addends are included in the sum of the data necessary for determining the level of competitiveness (6). Following a reasonable choice of the prototype (7) a comparison index to determine competitiveness is developed. It is only through the reciprocal comparison of the indices of quality (8), cost (9), profit and the sale price (10) of the developed product, process or service (6) with the prototype (7) that one can obtain (11) partial integral levels of competitiveness (12), and through comparison (13) the integral level of the production competitiveness (14) is obtainable. The presented factors and the results of their processing are the well-known points for determining a level of competitiveness. The exclusion of any

of the factors does not make it possible to estimate, even approximately, the level of competitiveness, let alone a whole group of factors, such as cost, price etc. The same goes for the absence of a prototype. Having, for example, a product with the complete list of both indices of quality and of costs, profit and the price of sale, yet no prototype, it is impossible to judge about its competitiveness as the market can offer prototype products with both better or worse data, necessary for a determination similar results.

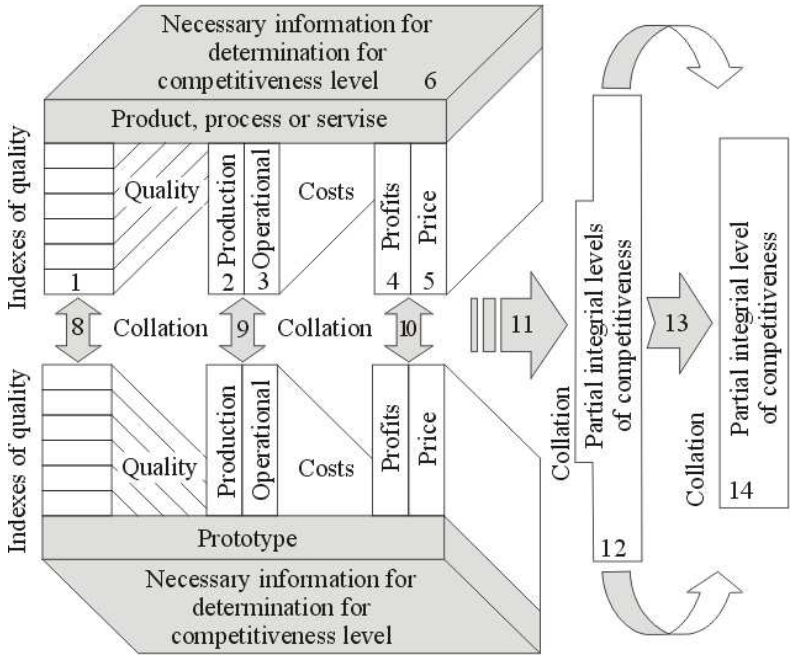

Fig. 1. Diagram for determining the level of competitiveness

The mechanism of forming the competitiveness of products envisages revealing and determining the influence of all the factors in the course of their production, sale and exploitation, relatively combined into seven groups. Expenses, related to making the production on design, technological and production levels, belong to the internal factors, which corresponds to the *construction - technology – manufacturing – and quality* – chain. It is known that the very design of the product is the basis for its competitiveness. Never once has any low-quality and hard-to-make produce been competitive. The mechanism of forming competitiveness is, at that, based on the application of the concept of virtual development, manufacturing and exploitation of the product, i.e. preliminary modelling of these processes on a computer with obtaining virtual constructions, technologies, exploitation and – on these grounds – an

advance estimation of competitiveness. Positive results and further – already real – development make it possible to enhance still more both the indices of quality and the level of competitiveness. The virtual planning and exploitation require special and costly programs rare as a complex so far.

3. Results of "rapid" of determination of competitiveness

The method for advance estimation of quality and competitiveness of products was published in paper [3]. However, the process of competitiveness management is hampered by its misinterpretation as well as methods of estimation occasionally occurring in some publications. Thus, for instance, papers [4, 5] published in Poland (2007) and Slovakia (2008) propose the «rapid method» of determining the competitiveness of flexible manufacturing systems (*FMS*) and technological processes on the proposed «criteria» whose values should be put in simple arithmetic formulas of the deformed averages to obtain the final result of the competitiveness level. Such a solution to the problems is tempting. What is the point in exploiting the sophisticate familiar methods requiring numerous calculations, if the same result is arrived at quickly without the account of concomitant costs, basic indices of quality and even in the absence of the prototype?

The proposed «rapid method» consists in the following. On the strength of a number of «criteria», having point age estimations within the limits of 1… 5 and the averaged deformed formulas in which it is necessary to put them and the values obtained, the «complex index of competitiveness» is determined. The distortion of the average data follows due to the increase of the number of values in the denominator and the introduction of the coefficients of scales for two groups of the selected «criteria». The proposed formulas for the estimation of FMS competitiveness take into account eight «criteria» only: flexibility, autonomy, productivity, reliability, serviceability, ecological compatibility, complexity and power consumption (Fig. 2a) which cannot be the criteria of competitiveness in any positive way. At the same time, the determinations of these «criteria» and their point age estimations are erroneous, although these are well-known determinations. By flexibility, for example, an indirect index, viz. degree of the use of time during the implementation of various tasks is meant, although it is common knowledge that flexibility is a possibility for a purposeful change of technological capacities within the range of changing the regulative parameters, i.e. a possible number of the processed products or their nomenclature. Autonomy is, for an unknown reason, defined as the time during which the FMS can operate unattended, although it is common knowledge that autonomy is independence, however, not of the maintenance staff. Productivity is not a correlation of the cost of the ready-made products over a certain period of time to the sum of the allocation costs related to the exploitation; neither is

reliability a correlation of the average time of shutdown to the useful fund of time [4] etc. Amusing is also the definition of ecological compatibility as a correlation of the mass of waste to that of the ready-made products, although it is known that one should take into account not the amount of the waste but their harmfulness for the environment. Almost all of the «criteria» have the same illiterate definitions.

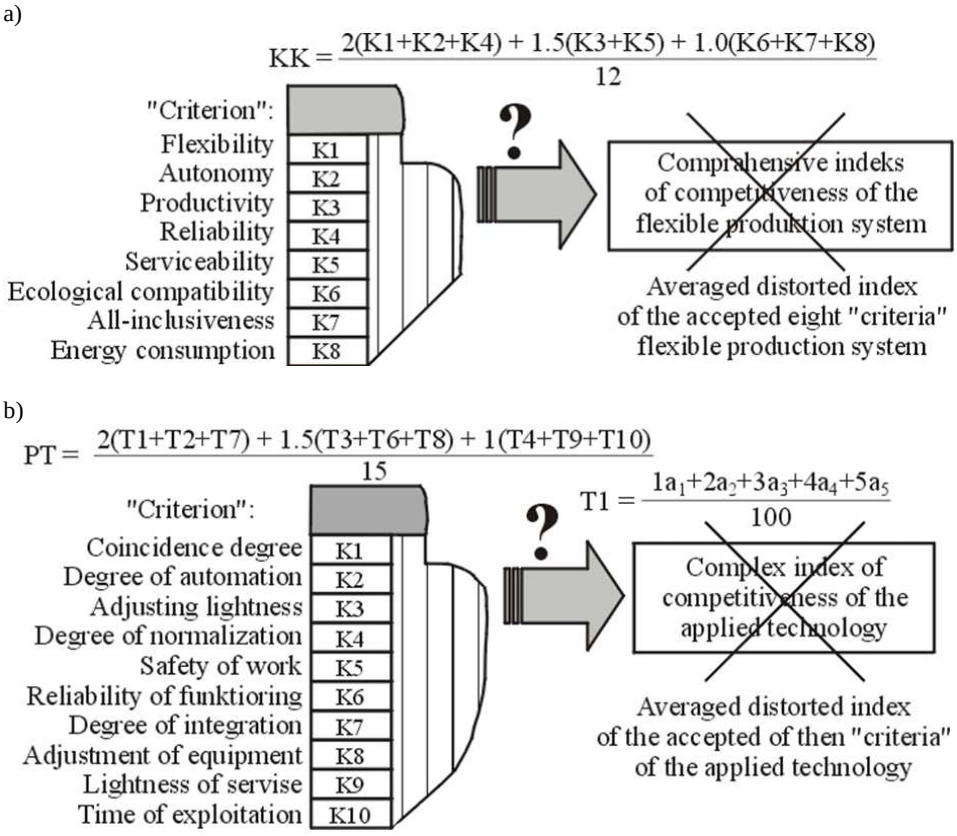

Fig. 2. Diagram for determining the «level of competitiveness» based on: a) flexibility, autonomity, productivity etc.; b) degree of automation, adjusting lightness etc.

As many as ten «criteria» are advanced for the applied technology [5], viz.: contemporaneity, automation possibility, simplicity of readjustment, degree of normalization, operating safety, reliability of functioning, extent of integration, adaptability of the equipment, easiness of service and term of use (Fig. 2b). By the way, many definitions of the «criteria» are also erroneous, although these are terms settled down long ago. Criteria such as productivity, accuracy, labor output ratio and others are, for an unknown reason, missing for the estimation of

the applied technology. Firstly, many factors determining competitiveness are not taken into account in these methods. Specialists know that competitiveness is determined by quality, production and operating costs, profits, price when compared to a prototype. For some reason, important indices without which it is, generally speaking, impossible to judge about competitiveness are not reflected here. These are, for instance, technical level, accuracy, standardness, stability, material capacity, transportability, maintainability, efficiency, longevity, safety, diagnostic ability, controllability, as well as production and operating costs, price, terms of supply, after-sale service etc. Totally absent is the comparison with the prototype. Secondly, if one substitutes the given formulas for the weights of the «criteria», most absurd results will be obtained. Thus, for instance, an FMS variant with a good flexibility, autonomy, productivity and reliability is equivalent to that with useless «criteria», like these, yet possessing a high serviceability, ecological compatibility, complexity and low-energy consumption. Such a «rapid» result is a proof of the total **untenability** of the method. Such a «rapid method» helps only erroneous estimations of the competitiveness of products, processes and equipment. The erroneousness of the «rapid method» is evident from the comparison of Fig. 1 and 2.

4. Use of the SADT – method for determining of optimum of competitiveness

To optimize the process of ensuring the level of competitiveness at lowered costs, one can apply the SADT (*Structured Analysis and Design Technique*) method of detailed successive hierarchy of the objects under study. On these hierarchical levels, the analyzed object is examined in greater detail, equivalently to the previous level; functions and blocks of realizing the tasks set are determined. Environmental effect is taken into account, too. However, the methods of dismemberment are wholly determined by the purpose set, and are not related to the SADT-method. The application of this method is related to the realization of the multivariable process of determining the integral level of competitiveness on the accepted set of the operating factors with their optimization.

The SADT-diagram of the entry level (Fig. 3) takes into account the basic data, which are drafts of products, structure of the process or service, specificity of application, as well as analogues and the prototype, means of achieving the purpose set, and the output data. The method presupposes an employment of the four basic functions, viz. determination of indices for the quality of product, process or service, concomitant costs, profit and the price of sale. On the basis of the input data, taking into account the influence of external environment, fundamental indices of quality are determined. Simultaneously, these indices are determined on the basis of operating requirements with due account of the

analogical ones in the prototype, which are supposed to be more optimal. **Next step is** a calculation of production, extra-production and operating concomitant costs, followed by determining the income and the price of sale. By the well-known formulas [6] necessary data are calculated and comparison is made with the analogous ones in the prototype, which provides a basis for determining the integral level of the object's competitiveness. If the level appears to be somewhat lower **yet** can be made higher, the product, process or service are sent to revision or are, reversely, rejected.

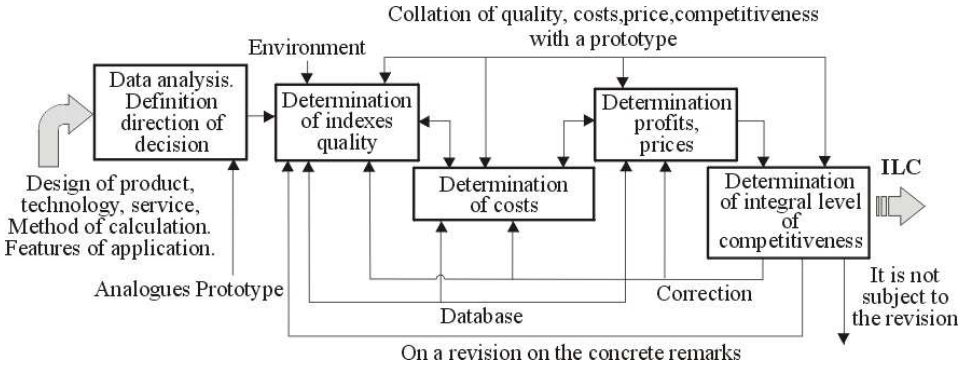

Fig. 3. SADT – diagram of the initial stage for determining the level of competitiveness (I LC)

5. Conclusions

The universally accepted method for determining the level of competitiveness envisages an obligatory taking into account of the indices of quality, development costs, introduction and exploitation, technological prime-cost of the products made on its application in comparison with the prototype. Managing the competitiveness of products, technologies and equipment particularly in the conditions of crisis except for marketing and application of the mechanism of directed forming envisages a reorganization in conducting designer, technological and production operations aimed at improving the quality indexes with a reduction of production costs due to the optimization of all links of the production chain, co-operation and specialization. The same goes for the reduction of operating costs. Acceptability of the price of products in the time of crisis must be provided due to marketing, management and diminishing of the profit expected. Nonproductive costs can be reduced by reorganizing the infrastructure, deliveries, advertising etc., esp. by eliminating unplanned expenses in the form of bribery, recoiling etc. Special significance is attached to legal enterprise, tax-reduction, profit regulation, legal assistance, inflation, sponsorship etc.

In this connection one can profit from the experience of the huge China and small Switzerland successfully reorganizing productions, diminishing concomitant costs, reducing release prices, combating corruption, creating favourable conditions for production and business.

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