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I.I. Kovalenko, L.S. Chernova

**AN APPROACH TO THE FORECAST OF THE KEY PERFORMANCE INDICATORS
OF THE HIGH TECHNOLOGY ENTERPRISE'S OPERATIONS**

The article deals with the process of providing management control system at the machine-building enterprise. Employment of management control system models and approaches for managing is observed. Importance of management control system for feedback mechanism implementation has been studied. The choice of adjustment measures of managerial impact is provided. The adjustment measures of management impact must be implemented in such a manner as to incorporate into the system of internal accounting for the optimization of management solution through information and economy system of planning procedure.

Keywords: *management control system, machine-building enterprise, labor cost, investment projects, work target cost, earned value technique.*

У статті розглянуто процес забезпечення системи контролінгу на машинобудівних підприємствах і використання його моделей і методів в управлінні. Досліджено роль контролінгу в реалізації механізмів зворотнього зв'язку, обґрунтування вибору коригувальних заходів управлінського впливу таким чином, щоб інтегрувати в себе через інформаційно-економічні системи методики планування, обліку, контролю, аналізу систему побудови внутрішньої звітності для оптимізації ефективних управлінських рішень.

Ключові слова: *система контролінгу, машинобудівне підприємство, трудові витрати, планова вартість робіт, метод освоєного обсягу.*

В статье рассмотрен процесс моделирования основных показателей деятельности наукоемких предприятий, основанный на количественном и качественном прогнозировании, осуществляемом путем построения и анализа сценариев. Рассмотрен алгоритм, иллюстрирующий построение одной из возможных технологий комплексного применения методов количественного и качественного прогнозирования.

Ключевые слова: *показатели деятельности, сценарный анализ, количественное прогнозирование, качественное прогнозирование, временные ряды, множество альтернатив.*

Analysis of recent researches and publications. Modern market economy conditions in which high technology enterprises operate require constant monitoring of various indicators of their activities. For example, in report documents of the enterprise financial plan implementation there are indicators: profit, returns, costs, investments, reserve funds and others.

These indicators control is reached by monitoring, estimation and forecasting. Currently, the methodology of program-target planning and forecasting is more and more prevalent, it is seen as a means of reasonable allocation of limited resources to achieve certain goals. At the same time until recently the main «instrumental» methods to solve such problems are quantitative forecasting methods aimed at approximate determination of the future behavior of certain variables which is as a variety of technical and economic parameters. As the mathematical models that describe such indicators behavior the time series (random processes) are used which are analyzed by a number of forecasting methods [4] (a moving average and its variations, a moving median, exponential smoothing, etc.) (Fig. 1).

In spite of the widest practice of using these methods their practical application is fundamentally limited by processing the historical quantitative data of monotonically varying processes. Here, it should be pointed out the fact that modern economic development of society has received an innovative direction and the creation of various innovative products is characterized by a variety of precipitous changes, disruptions of the process monotony, deficit of information provision, so that there are different kinds of uncertainty. All that laid the preconditions for appearance of a new scientific field over the past 15-20 years that is based on the methods of qualitative forecasting (foresight), which is called scenario analysis [2; 3].

Development and analysis of scenarios is a creative process executed by the commands (teams) of professional specialists (analysts, experts, consultants, and others.) which is hard formalized. At the present time the basic mathematical models for the scenario development and analysis are objectives trees, decision trees, a predication graph, hierarchical decision-making structure, analytical networks and others (Fig. 1).

The considered directions of the program-oriented planning and forecasting are developed and used independently. However, to solve a number of problems their complex application seems promising.

It is primarily determined by the presence of so-called semi-structured problems which are characterized by the presence of quantitative and qualitative factors. The analysis of such problems is reduced, as a rule, to the formulation and solution of problems of multicriterian alternatives that allow to achieve the intended objectives.

The purpose of the article consists in development and justification of the approach which is implemented through the technology of complex application of qualitative and quantitative forecasting methods.

Statement of the base material. The financial indicator «PROFIT» (Fig. 2) is choose as the analyzed indicator of the enterprise activity. A basis for use of short-term quantitative forecasting methods of this indicator is the availability of historical data in the accounting documents which are the numerical series of dynamics. As forecasting methods the moving average method and its variations and the method of moving median can be used that received wide practical application.

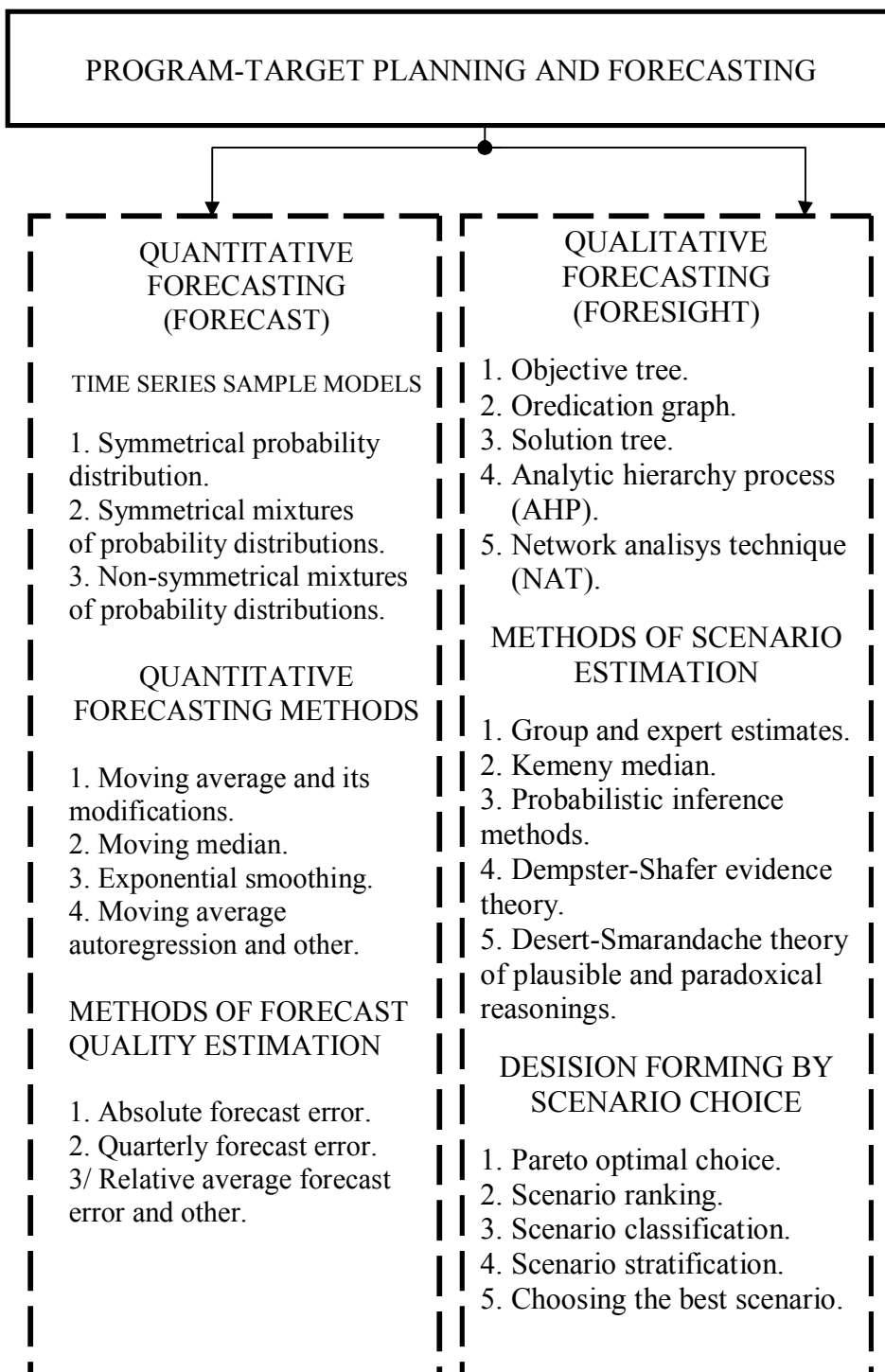


Fig.1. Structure of models and methods of program-target planning and forecasting

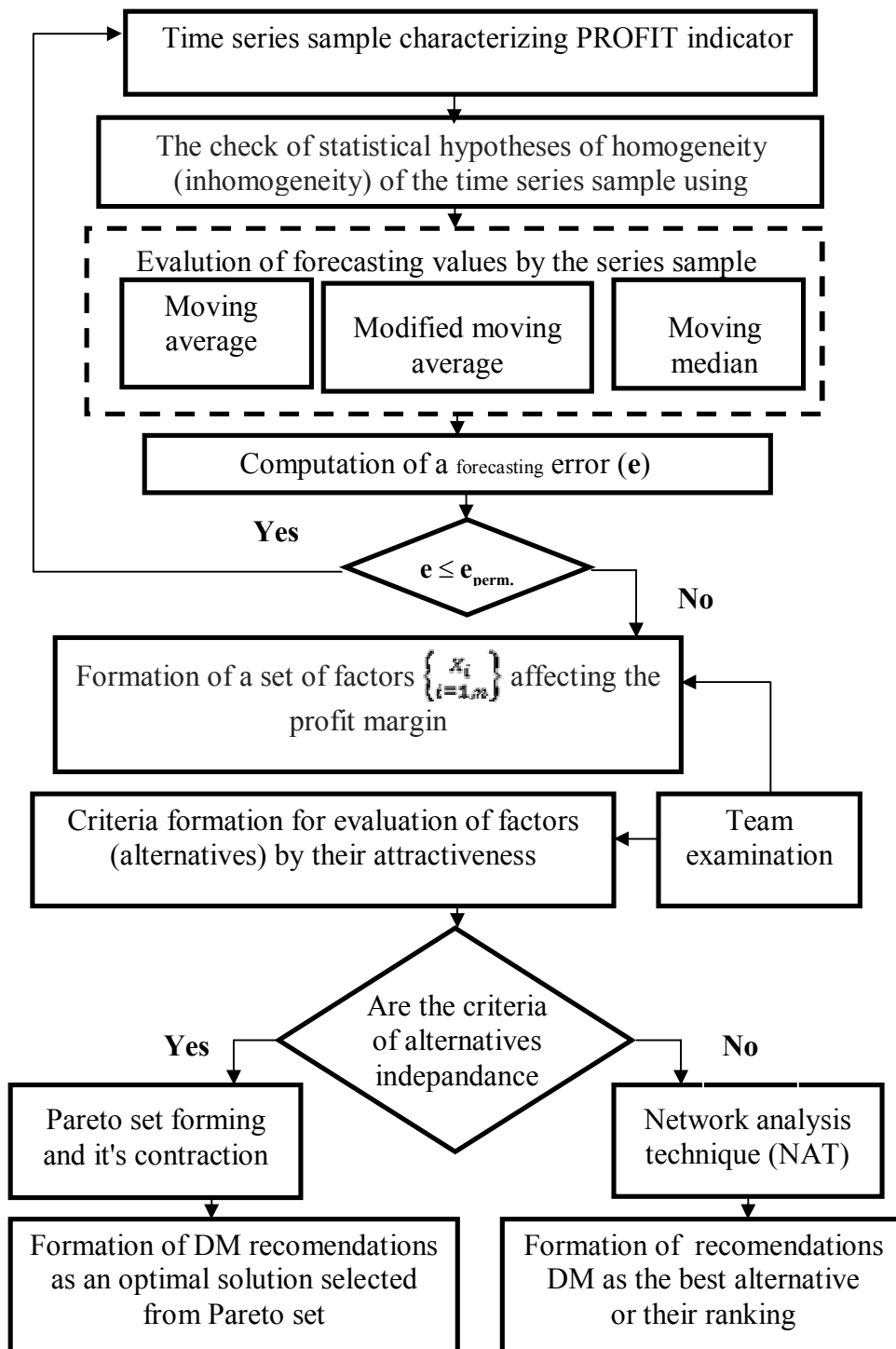


Fig. 2. Structure of integrated use technology of quantitative and qualitative forecasting method of the enterprise activity indicator

For effective application of these methods the mathematical models are constructed that reflect the features of time series samples: homogeneity, local inhomogeneity, inhomogeneity. Using such models a check of statistical hypotheses of homogeneity (inhomogeneity) or local inhomogeneity of the values composing the time series sample is performed. Further, using these methods of short-term forecasting the predicted time series values are calculated, and the errors of prediction ϵ are determined. If ϵ does not exceed a permitted value ϵ_{permit} of forecasting, the following predicted value of the series is calculated.

Otherwise the procedure of formation of a certain set of factors $\{X_i\}$, $i = 1, n$ affecting the profit margin is performed. For high technology enterprises they obviously can be as follows:

$$X = \langle X_1, X_2, X_3, X_4, X_5, X_6 \rangle, \quad (1)$$

where X_1 is investment activities (acquisition of new technologies and equipment);

X_2 – the cost value for research and development (R & D);

X_3 – direct costs (purchase of materials and components);

X_4 – maintenance of fixed assets;

X_5 – booking and its financing;

X_6 – core products sales.

The next stage which is implemented in the considered technology is the use of qualitative planning and forecasting methods that leads to problems of decision support in conditions of multicriteriality and multialternativity.

However, the considered factors play a role of alternatives (solutions), and as the criteria a risk of enterprise profits reduction, which can be introduced by alternative factors and their attractiveness in terms of profit growth can be considered.

Preliminary check of the criteria and the alternatives for independence (dependance) allows to realize the following procedures of recommendations formation for the decision-maker.

In the first case, the recommendations for decision-makers may be formed by Pareto set forming (a set of non-dominated alternatives where none of the alternatives is uniquely more advantageous for decision-makers than others), if necessary by its contraction and the choice of the decision-maker of single optimal solution [5].

The general scheme of alternatives set contraction is shown in Fig. 3 [1].

In the second case, the recommendations for decision-makers may be presented by presentation of the best alternative or by rankings of a set of alternatives. To solve this problem it is appropriate to use the network analysis method (network analysis technique) NAT, which allows to perform forecasting of situations (including risk situations) based on subjective evaluation of experts or decision-makers [6].

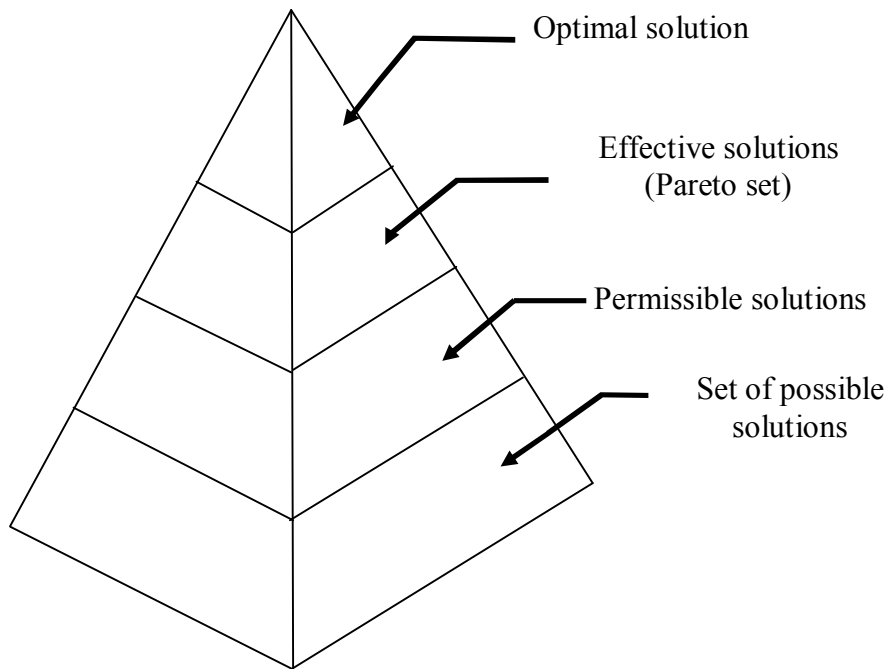


Fig. 3. Sequential creation a set of alternatives [1]

This method is an extension of the analytic hierarchy process (AHP) and allows to analyze situations that are characterized by mutual influences and feedbacks between the criteria and alternatives.

In addition the forecasting problem elements unite into clusters: a cluster of objectives, a cluster of factors, a criteria cluster, a cluster of enterprise economic risk gradation, etc. (Fig. 4), between which there may be different relations.

For example, a cluster of risk level **R** can be represented by the following gradations:

R₁ is very low risk that may correspond to short-term loss of the effective functioning of the enterprise (reduced labour efficiency, slight loss of profits, dynamics discrepancy of the capacity and market share, and others.);

R₃ is an average level of risk that may be associated with nondurable disturbances of production cycle.

R₅ is very high risk which corresponds to catastrophic nature threats: heavy financial losses comparable with the value of economic resources, deficiency of R & D, and others.

R₂ and **R₄** are low and high risk level that are intermediates and can be introduced to ensure the necessary flexibility in assigning estimations.

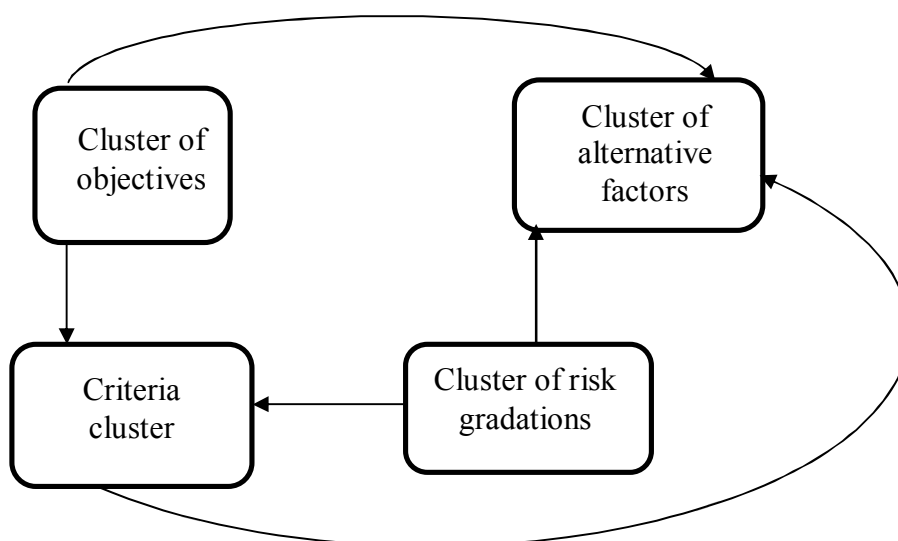


Fig. 4. Cluster network

Conclusions. In the paper there is considered one of the possible approaches to the development of the technology of planning and forecasting series of operating rates dynamics in high technology enterprises, which is based on the integrated use of quantitative and qualitative analysis methods.

This approach is advisable to apply for the analysis of semi-structured problems, in which there are qualitative elements along with quantitative variables. First of all it describes the enterprises involved in innovation activities.

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Рецензент – доктор технічних наук, професор, директор ІКІТН
К.В. Кошкін