ANALYTICAL MODEL OF PARALLEL COMPLEX SYSTEM OF MACHINERY OF PLANTING

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Abstract. *Optimization methods of parallel complexes occupy a significant place in the complex of quantitative methods for optimization of parameters of objects of standardization. Examples are parallel complex parallel manufacturing lines, parallel connected elements, schemes, etc. Parallel the complex production machinery of plant is a set of several products of partial interchangeability.*

Optimal parallel set of products should be chosen, taking into account future changes in the conditions of production and use

(operation) of the products. Thus, the standardization arise because dynamic optimization models, not static. Using these dynamic models to address issues related to optimal points of production statement on manufacture, changes of modifications or withdrawal of production and operation, etc. These issues should be resolved simultaneously with the selection of the optimal parameters of the products. Static optimization models appear as a result of simplifying the original dynamic model. Static models are used to obtain approximate results. They are used because they are easier to obtain this necessary and easier to build computational procedure. However, this complicated interpretation of the concepts representing the basis of the model, as these concepts can be interpreted differently depending on the way information of the original dynamic optimization model to static. Moreover, for the application of statistical models is necessary to build complex, adapted to the specific conditions of the procedures for determining the source data.

Key words: ***method, optimization, parameter, object, standardization, system of machines, planting***

Formulation of problem. Optimization methods of parallel complexes occupy a significant place in the complex of quantitative methods for optimization of parameters of objects of standardization. Examples are parallel complex parallel manufacturing lines, parallel connected elements, schemes, etc. Parallel set of products is a set of several products of partial interchangeability. In other words, it is sometimes possible instead of the i-th product to get around the j-th species, but it may change the magnitude of the effects and costs.

Analysis of recent research results. If the effects and costs associated with i-th element of the complex differ from the effects and costs associated with j-th element of the complex only in magnitude, but not the item in the vectors of effects and costs, no zero component), we have the case of parametric next [1]. Thus, the parallel set of homogeneous products is close to the parametric [2]. Elements of parametric range can be distinguished by the value of one (main) parameter, for example, motors of the same type vary in power or in the case of multidimensional parametric number may vary according to the value of the set of parameters [3].

Optimal parallel set of products should be chosen, taking into account future changes in the conditions of production and use (operation) of the products [4]. Thus, in standardization there is a dynamic optimization model instead of a static [5]. Using these dynamic models to address issues related to optimal points of production statement on manufacture, changes of modifications or withdrawal of production and operation, etc [6]. These issues should be resolved simultaneously with the choice of optimum parameters of products [7]. Static optimization models appear as a result of simplifying the original dynamic model [8]. Static models are used to obtain approximate results. They primenyaya because they find it easier to obtain this necessary and easier to build computational procedure [9]. However, this complicated interpretation of the concepts representing the basis of the model, as these concepts can be interpreted differently depending on the way information of the original dynamic model to a static optimization [10]. Moreover, for the application of statistical models is necessary to build complex, adapted to the specific conditions of the procedures for determining the source data [11].

Purpose of researches is to formulate an analytical approach to static models of parallel optimization of complex systems of machinery crop production.

Results of researches. Here sequential complexity of the simplest model of optimization of the parametric series introduces the main subject of interpretation in the application of the model concepts. The result is a model that generalizes the model.

The product is defined by a set of characteristics. In this set, of course, are the optimizable parameters. Parallel set consists of a finite set of elements u_i, $i = 1, \dots, n$, and uniquely determined by them:

$$W = (u_1, \dots, u_n).$$

With the help of the optimization is to determine the number of types of products and their optimal parameters, i.e. n and u_i, $i = 1, \ldots, n$. To optimize parallel set, it is necessary to form the objective function and constraints. The objective function is constructed as a function of effects n costs incurred for the selected complex.

In particular, accounted for total costs product development costs for the readjustment of the production costs PA production, costs, and effects – meet the needs in production, perform certain types of work, improving certain technical characteristics, etc.

Effects and costs arising from the use of products, it is possible to determine, knowing the conditions of its use and purpose, as well as the volume of products used.

Specific condition of use of the product and its intended use conform to the required parameters of products x, i.e., the parameters that are optimal for the consumer, are not taken into account when certain types of effects and costs, particularly production costs.

These are the required parameters of the products, in some cases, accurately determine the magnitude of the effects and costs arising from the use of products in the conditions in the appointment, the relevant x.

In the simplest optimization model of the parallel complexes specified volumes of production in the conditions of the relevant required parameters of products $x: \varphi(x)$. The function $\varphi(x)$ is called the demand function. When different formulations of the problem it is interpreted differently, it could be average or total production volumes for a certain period, extreme volumes, etc. to define it, often it is necessary to apply appropriate methods. The assumption that demand is fully met, means that with the possibility of replacement of products with required parameters to x one of the types of products will be achieved specified volume of demand $\varphi(x)$.

Let us dwell on the case of one-parametric number $u_i \in [a, b]$. Suppose that instead of products with parameter $x \in [a, b]$ can be used only products with the next highest parameter u_i:

$$u_{i-1} < x \leq u_i,\ u_1 < u_2 < \ldots < u_n.$$

For example, if for the carriage of containers necessary cars of a certain capacity x ***and operating costs grow with increasing load, it is natural that there will be used cars capacity*** u_i, $u_{i-1} < x \leq u_i$.

If such a change use the same quantities of products, it is possible to determine the total volumes of products with parameter u_i:

$$V^{(i)} = \int_{u_{i-1}}^{u_i} \varphi(x)dx,\ u_0 = a.$$

The total volume of products $V^{(i)}$***,*** $i = 1, \ldots, n$ ***it is necessary to know to estimate production costs for a given parametric range. Note that the interpretation of*** $V^{(i)}$ ***(average, total, maximum volumes, etc.) to the interpretation of*** $\varphi(x)$***.***

If we the cost per unit of production parameter u***, produced in the volume*** V***, we denote*** $c(u; V)$ ***is the total production cost will be:***

$$Z^{(n)}(W) = \sum_{i=1}^{n} c\left(u_i, V^{(i)}\right) \cdot V^{(i)}.$$

Consider the case when operating cost is proportional to the amount of used products. We denote the cost of operation of the unit volume production settings u ***used in conditions characterized by required parameters,*** $x - g(u, x)$***. Then the total operating costs are:***

$$Z^{(n)}(W) = \sum_{i=1}^{n} \int_{u_{i-1}}^{u_i} \varphi(x) g(u_i, x).$$

Note that the function $g(u, x)$ ***is interpreted according to*** $\varphi(x)$***as the total cost for a certain period, medium, etc.***

As the target functions often take the total cost:

$$Z(W) = Z^{(z)}(W) + Z^{(n)}(W).$$

The assumption that is the product with the x ***option can be used only to produce the product with the next highest parameter*** u_i***, often does not correspond to reality. To reflect a wide range of applications, introduce features of applicability of*** $\xi^{(i)}(x, W)$***. A function of*** $\xi^{(i)}(x, W)$ ***is the proportion of the total volume of products used in the conditions corresponding to the parameter x, satisfy produce parameter*** $u_i \epsilon W$***. Obviously:***

$$\sum_{i=1}^{n} \xi^{(i)}(x, W) = 1.$$

If the demand is fully met, there is the following relationship between the volumes and functions of the application:

$$V^{(i)} = \int_a^b \varphi(x)\, \xi^{(i)}(x, W) dx.$$

The value of the objective function in this case will depend not only on optimized neighborhood of W***, but also the functions of applicability. If the functions of applicability is specified, the optimized number*** W***. only Possible formulation of the problem, when along with the optimization of the range*** W ***can be optimized the functions of applicability. Function of applicability reflect the distribution of products according to the conditions of its use, in particular, the distribution of output between consumers.***

Influence of character of distribution of products between consumers on the value of the total cost until recently in the problems of optimal choice of production parameters was not analyzed. The

work assumes the existence of an optimal distribution, this fact should be taken into account when using models. Sometimes the distribution of production is quite close to the optimum, this condition must be checked. Note that best meet the needs of each consumer does not always correspond to the optimum from the point of view of the total cost distribution.

It is possible to consider the two in a sense the opposite of the mechanism of distribution of products. One is a direct appointment by the consumer of a particular product. In this case, together with optimal production parameters must be determined and the optimal assignment, i.e. a function of applicability should be arguments to the target function. There are often some restrictions regarding the nature of product distribution, for example, all consumers who require a product with a parameter x ***supplied the same products. Such restrictions must be recorded in the statement of the problem, and restrictions on the functions of applicability.***

Another mechanism of distribution of products – selling products. This mechanism is influenced by the prices of traded goods, the price change will change the distribution of products (even assuming that all manufactured products will be purchased and used). Distribution of products affects both the operational and production costs, then the same can be said about prices. The price of the product can be considered as one of the parameters, and technical parameters subject to optimization. Above, when determining the volume $V^{(i)}$***, it was assumed that instead of some a given level of output with the required parameter*** x ***uses the same amount of products with parameter*** u_i***. But it is possible that instead of the unit volume of products with the required parameter x can be used*** $\theta^{(i)}(x,W)$ ***units of production on the parameter*** $u_i \epsilon W$***. A function of*** $\theta^{(i)}(x,W)$ ***is a function of the substitutability and summarizes the coefficient of substitutability.***

Now in case of full satisfaction of demand:

$$V^{(i)} = \int_a^b \varphi(x) \cdot \xi^{(i)}(x,W) \cdot \theta^{(i)}(x,W) dx.$$

If $g(u_i,x)$ ***is the operating costs arising from the operation unit of production by parameter*** u_i ***to the conditions corresponding to the desired parameter x, the total operating costs:***

$$Z^{(z)}(W) = \int_a^b \varphi(x) \cdot \xi^{(i)}(x,W) \cdot \theta^{(i)}(x,W) \cdot g(u_i,x) dx.$$

The function of the applicability $\xi^{(i)}(x,W)$***, a function of substitutability*** $\theta^{(i)}(x,W)$ ***and a function*** $\varphi(x)$***, called the demand***

function, allow us to construct the optimization model of the parametric range of products. Function of unit costs $c(u;V)$ and $g(u_i,x)$ are used to construct the objective function in the optimization, or rather souls of determining the production and operating costs. Thus constructed the optimization model of one-dimensional parametric range needs to be extended in several directions.

First, it is necessary to optimize not only a one-dimensional parametric range, but also a parallel set of products, i.e. it is necessary to return to the interpretation of the u_i as a set of characteristics that determine the type of product, in particular, in the case of multidimensional parametric number $u_i = \left(u_i^{(1)}, \dots, u_i^{(m)}\right)$, m – dimensional vector.

Second, conditions may have not only the required values of the parameters (in the case of multi-dimensional series $\bar{x} = \left(x^{(1)}, \dots, x^{(m)}\right)$ but some other factors. For example, the effects and the costs arising from the operation of the machine, not only depend on its parameters $\bar{x}$, but also on the load factor τ°, the set of factors characterizing the operating conditions, in this case, $\tau = (x, \tau^{\circ})$.

The set of all possible required values of the parameters will denote by X. It can be a finite set, especially if the function $\varphi(\bar{x})$, $\bar{x} \in X$is determined by the poll:

$$X = (\bar{x}_1, \dots, \bar{x}_m).$$

The set X may be different, for example, be determined by the restrictions:

$$a^{(j)} \leq x^{(j)} \leq b^{(j)}.$$

Function of applicability $\xi^{(i)}(\bar{x}, W)$, the substitutability $\theta^{(i)}(\bar{x}, W)$, demand $\varphi(\bar{x})$ and the value of the unit operating costs $g(u_i, \bar{x})$ and specific production costs $c\left(u_i; V^{(i)}\right)$ can be defined in the same way, only $\bar{x} \in X$ is now a multidimensional quantity.

In the case of a full satisfaction survey total volumes:

$$V^{(i)} = \int_x \varphi(\bar{x}) \cdot \xi^{(i)}(\bar{x}, W) \cdot \theta^{(i)}(\bar{x}, W) d\bar{x}.$$

production costs:

$$Z^{(n)}(W) = \sum_{i=1}^{n} c\left(u_i; V^{(i)}\right) \cdot V^{(i)}.$$

and operating costs:

$$Z^{(z)}(W) = \int_x \varphi(\bar{x}) \cdot \xi^{(i)}(\bar{x}, W) \cdot \theta^{(i)}(\bar{x}, W) \cdot g(u_i, \bar{x}) d\bar{x}.$$

Note that if X is a finite set, then $\int_x \dots d\bar{x}$ becomes $\sum_{x_z \in X}$.

Thus, the transition from the models of one-dimensional parametric optimization of a number of parallel optimization model of the complex. But there was not yet taken into account the fact that the terms of use of the product can definitely not be characterized by the required parameters, $\bar{x}$. In principle, to characterize these terms of use, you can consider a number of factors $\tau \in \mathrm{T}$. For example, the conditions characterized by the kind of work you want to perform, and the demand function $\varphi(\tau)$ is the volume of work of the kind τ.

The function $\varphi(\tau)$, $\tau \in \mathrm{T}$ can be interpreted differently depending on the view factor τ. In particular, if the environment of the considered factors are the required values of parameters $\tau = (\bar{x}, \tau^{\circ})$, $\varphi(\tau)$ is the volume of production parameter x in conditions characterised by factors $\tau = (\bar{x}, \tau^{\circ})$. In the other case, $\varphi(\tau)$ is the value of a certain effect in conditions characterized by factors τ.

If the function $\varphi(\tau)$ interpreted one way or another, it is possible to define functions applicability $\xi^{(i)}(\tau, W)$, function of substitutability $\theta^{(i)}(\tau, W)$ and the value of specific operating costs $g(u_i, \tau)$ analogously as it was done above.

In this extended model, if you set function $\varphi(\tau)$, production volumes and production and maintenance costs are determined the same way as was done above:

$$V^{(i)} = \int_T \varphi(\tau) \cdot \xi^{(i)}(\tau, W) \cdot \theta^{(i)}(\tau, W) d\tau;$$

$$Z^{(n)}(W) = \sum_{i=1}^{n} c\left(u_i; V^{(i)}\right) \cdot V^{(i)};$$

$$Z^{(z)}(W) = \int_T \varphi(\tau) \cdot \xi^{(i)}(\tau, W) \cdot \theta^{(i)}(\tau, W) \cdot g(u_i, \tau) d\tau.$$

Conclusion. If $\varphi(\tau)$ is not set, i.e. is subject to optimization, then turn to the General scheme of optimization of parameters of objects of standardization, namely to determine the effects and the costs incurred. from the use of products in conditions characterized by factors τ, form the objective function and constraints and solve the corresponding formal mathematical optimization problem. The objective function in this approach, there may be some technical specifications that reflect the operation of parallel complex W as restrictions there may be restrictions on the total cost.