Energy Services and Rationing of Energy Resources Are the Basis of Energy Saving of Enterprises

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Abstract—Based on research regimes of power consumption of industrial enterprises provides construction algorithm and simulation of energy services. Submitted the mathematical model of the combined method of rationing of fuel and energy resources.

Keywords—algorithm, energy services, combined method, mathematical model, rationing of fuel and energy resources.

I. INTRODUCTION

Intensive development of technology, widespread adoption of automation in the field of management leads to the need for a scientific analysis of complex processes in terms of their structure and organization, to qualitative changes in approach to solve many practical problems. In the development of major energy, computing and other complex systems have to consider issues relating not only to the peculiarities of the functioning of individual devices, but also the properties of the whole system. Complex system feature is the presence of a large number of interrelating and interactive components. In this way many processes should be considered as complex systems. Therefore, at present more and more attention is paid to the problems of processes organization and management. In this case the need to verify to taken theoretical results, the best way is model, appears. You can use it to determine the amount of equipment for repair, prevention, or diagnosis, change the frequency and time of following equipment in the stream.

Constructive definition of the productive system is based on the highlighting of the system from its environment by any backbone indications, as the purpose of the system often acts. A good formulation of purpose itself contains the direction its achievement. However, setting a goal – is a difficult and controversial process. Difficulty in formulation of a goal is primarily due to the fact that the target can vary significantly depending on the progress of the technological process. Therefore, goals must be put only the most necessary and most actually at this stage, but at the same time real to fulfil.

There are scientifically validated methods to select a goal that can help in the identification and which can be used for a clear formulation their preferences and determine some goals to others. On the basis of all these methods is the analysis and usage of mathematical models [1].

Analysing with the help of mathematical methods provision, which emerge as a result of tasks such and such purpose, i.e. playing different situations on the models, you can find out the resource requirements, which are needed to achieve tasks, to explore the possibility of using different methods of process organization and obtain other information firstly, permit dismiss a goal, which is not real to realize and secondly, determine mutual preference of goals, i.e. ultimately make reasoned choice of target (Figure 1) [2, 3].

There are always several ways to achieve the goal but we can move only in one, we must choose the best option, i.e. the most successful way. Thus, another feature of management tasks - is the need to choose optimal version [4].

In recent years, the field of usage of mathematical methods of mass serves is constantly expanding.
Fig.1. Formulation target process by analyzing the mathematical model

Information systems, automated product systems, production lines and other technological processes - these are the systems for which nowadays this mathematical instrument can be used. Many problems that arise in the analysis of the reliability of technical devices, can also be attributed to tasks in the theory of mass service [5]. Many processes can also be described as the models of the mass service system (MSS) in energy service.

The purpose of the mass service system simulation consists in calculating indicator efficiency of the system through its characteristics. As the effectiveness of the mass service system rates uses the following:

- the absolute throughput capacity of the system (A), i.e. the average number of requests serviced in the time unit;
- the relative throughput capacity (Q), i.e. the average percentage of received applications served by the system;
- the probability of refusal \( P_{\text{отк}} \), i.e. the likelihood that the application leaves the mass service system unserved;
- the average number of busy channels \( \bar{K} \);
- the average number of requests in the MSS \( L_c \);
- the average time of arriving to the application system ();
- the average number of requests in the queue \( W_q \) - the length of the queue;
- the average number of requests in the system \( L_{ov} \);
- the average time of arriving in the application queue \( L_{\text{цер}} \);
- the average time of arriving in the application in system \( W_{ov} \);
- the degree of loading of the channel \( W_{\text{цер}} \), i.e. the likelihood that the channel is busy;
- the average number of applications under the service \( L_{\text{об}} \);
- the average number of requests serviced in the time unit;
- the average waiting time of service;
- the probability that the number of requests in the queue exceeds a certain value, etc.

For analysis of the formulated mathematical model with the help of computer require economical computing algorithms which permit obtaining the solution of the task for the allowed time. Such a requirement is particularly importance in relation to the multivariate nature of the computational experiment.

In the computer simulation of model primary interest is the observation received after the achievement system being studied stationary mode of operation, as in this case, dramatically decreasing the sample dispersion.

The time required to reach steady state operation of the system, determined by the values of its parameters and initial state.

As the main goal is to obtain observational data with the least possible error, to achieve this, you can:

1) to increase the length of time the simulation process of functioning of the system under study. In this case, not only the likelihood of achieving steady state operation of the system increases, but also the used number of n pseudorandom numbers increase, which also has a positive effect on the quality of the results obtained.

2) for a fixed length of time T hold N simulation computational experiments, also called the model runs, with different sets of pseudo-random numbers, each of which gives one observation. All runs start at the same initial state of the modulated system, but using different sets of pseudo-random numbers. The advantage of this method is the independence of the receiving observations \( x_k = \frac{1}{N} \sum x_k \), the effective system performance. If the number N of the model is sufficiently large, symmetrical boundaries of the confidence interval for the parameter X is defined as follows:

\[
-x - t_{\alpha/2} \frac{S}{\sqrt{N}} < x < x + t_{\alpha/2} \frac{S}{\sqrt{N}},
\]

Where - mathematical waiting (average meaning), is given by formula

\[
-x = \frac{1}{N} \sum_{k=1}^{N} x_k
\]
S – corrected dispersion, \( S^2 = \frac{1}{N - 1} \sum_{k=1}^{N} (x_k - \overline{x})^2 \), N – the number of runs of the program, \( \gamma \) – reliability, \( t_p = t(\gamma, N) \).

Stage 2. Building of modeling algorithm and the block diagram simulation. The technological process is written as a sequence of statements indicating the relationships between them. As operators of modeling algorithm is used: arithmetic operators, logical operators, operators of formation of random sequences, counters, operators input-output information.

Stage 3. Elaboration of software modeling resource simulation. Modeling algorithm presented in block diagram form, is implemented in a programming language [6,7].

A block diagram of the program that implements the above-described algorithm is shown in Fig.2. Here: \( T \) - time of the system; \( \lambda \) - flow rate of receipt of applications; \( \tau \) - flow rate of service requests; \( dt \) - time step; \( t \) - parameter tracking how much time the system worked; \( obz \) - the number of service requests; \( tob \) - the total time of service applications in the system; \( pz \) - the number of applications received by the QS; \( och \) - the length of the queue; \( otz \) - the number of applications that were refused service; \( ss \) - state of the system.

III. RATIONING OF ENERGY RESOURCES

The main purpose is to implement energy service actions aimed at energy conservation and energy efficiency use of energy resources [8].

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Production efficiency determined by the specific consumption of fuel and energy resources per unit of output. In this regard, a necessary condition for the efficiency of production is the development of progressive science-based rationing of consumption of fuel and energy resources per unit of output [9].

Establishment of evidence-based standards of fuel and energy allows evaluating the energy efficiency of production and enterprise as a whole, stimulates the growth of labor productivity, contributes to the improvement of the organization and operation of energy facilities, as well as improve the technical level and energy savings. Methods of rationing of fuel and energy - a set of ways to get their specific consumption rate based on the data presented. Today, the main methods of calculating the rationing of consumption of fuel and energy are experienced, reporting and statistical, computational and analytical and combined methods [10].

According to our research, the most reliable method for developing evidence-based rationings of consumption of fuel and energy resources is a combined method of valuation. Modern development of automated process control systems and systems of energy consumption allows the use of a combined method that takes into account energy relationship with the structure and mode of operation of production. This method consists in dividing the total energy consuming equipment in the group - energy profiles ($E_{pr}$) and processing of statistical data on the consumption of fuel and energy resources now in view of a factor (F).

$$E = \begin{cases} E_{pr1} & f_1(F_1, F_2, ..., F_m) \\ E_{pr2} & f_2(F_1, F_2, ..., F_m) \\ \vdots \\ E_{prN} & f_N(F_1, F_2, ..., F_m) \end{cases}$$

Where:
- $E$ - rationing of energy consumption;
- $E_{pr1}, E_{pr2}, ..., E_{prN}$ - rationing of energy consumption for energy profiles 1,2, ..., N;
- $f_i(F_1, F_2, ..., F_m), f_2(F_1, F_2, ..., F_m), ..., f_N(F_1, F_2, ..., F_m)$ - function of relationship between energy consumption equipment in the energy profiles and values influencing factors $F_1, F_2, ..., F_m$.

In such a way, modern development of automated process control systems and systems of energy consumption allows to apply perspective-combined method of rationing.

REFERENCES