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Improving the reliability of an operational product quality management system

One of the most important tasks of development of countries is the development of production on the basis of scientific and technological progress with the effective use of materials and raw materials, reducing their prime cost, improving the quality of manufactured products and increasing the number of automated processes. The level of development of the country is characterized not so much by quantitative (output and price of manufactured products), but by qualitative indicators (quality and assortment of these products). To improve the quality of products, manufacturers must invest in the technical control of production or use additional personnel for this. The constant increase in the requirements imposed on the quality of products leads to the need to develop (create) models and tools for automated diagnostics and quality control of products.

At the same time, for the production of high-quality high-tech products, the study of physicochemical materials, the application of the newest methods of their control and research acquire special significance. So, at the present stage there are a number of methods that can be conditionally classified as follows:

1. Using human resources;
2. Hardware (automated quality management systems);
3. Chip or digital (specialized software).

The scientific and technical problems of research into the reliability of automated control systems (hereinafter - ACS) remain relevant at the present stage of the development of science and technology, which is characterized by a significant penetration of information technologies into all branches of production.

Practice shows that the problems of reliability of the automated control system are given insufficient attention. Such studies do not keep up with the growing complexity of production systems, their components and links, which can lead to failures, as well as interruptions and breakdowns of planned production schedules or provision of services to enterprise customers. At the present stage, the efficiency and reliability of managing production systems directly depends on the accuracy and timeliness of the information received. The facts of the occurrence of software and hardware failures, as well as hardware damage during the operation of the automated control system, lead to failure or deterioration of management efficiency, which proves the urgency of research of the software and hardware complex of the automated control system for reliability, namely, determination of quantitative

parameters of reliability and search for ways to improve them.

Thus, the task of increasing the reliability of the automated control system for its full or partial solution requires an integrated approach that takes into account the features of the structure and functioning of both hardware and software mathematics.

In case of abnormal situations, the production process can be either partially or completely stopped for a certain or indefinite period of time, which will result in a loss of cash. In the process of technical systems, there are bound to be times when they work in an abnormal mode. In this case, abnormal situations can arise either because of hardware, or because of software problems.

In practice, during the adjustment of the automated control system, a significant number of errors are detected (about 5% of the total number of commands in the program). At the same time, the costs of identifying and correcting them are comparable to the costs of software design. Errors are classified as follows [1]:

1. System (errors in the formulation of the task and the conditions for its implementation);
2. Algorithmic (incorrect formulation and implementation of algorithms);
3. Software (algorithms encoding errors);
4. Technological (arise in the process of preparing documentation for the program).

The process of debugging and implementing programs is divided into the following main stages:

1. Software debugging - for individual testing of individual programs on test model data, in the course of which the various algorithmic, software and technological errors are manifested and eliminated;
2. System debugging - to check the correctness of the operation of a complex of programs using real information arrays of incomplete volume. In the process of system adjustment, the equivalence of the logical scheme of the program complex to its functional purpose is verified. This eliminates most of the complex algorithmic and system errors;
3. Experimental operation - to verify the functioning of the system using real-world full-size data arrays and in real time.

Nevertheless, the situation when the hardware part of the control system goes out of order is problematic. Such problems can be classified as follows [2]:

- Failure of equipment due to exhaustion of the equipment operating period;
- Hardware failures due to a defect in the manufacture of equipment;
- Hardware failures due to changes in operating conditions;
- Damage caused by external factors;
- Hardware failures or damage are caused by a violation of the order of performance of routine maintenance.

All these situations require the immediate intervention of maintenance

personnel to perform diagnostics and eliminate problems in the operation of the automated control system in order to return the system to its normal operating mode. This can lead to a violation of the operational and calendar production plans, which leads to a decrease in the profitability of the entire enterprise.

In this case, the diagnostics system is an integral component of any system for which a reliability study is carried out in order to apply its methods, increase when emergencies arise in the system.

To solve the problem of diagnosing non-receipt (loss) of data on the state of the production process, the necessary step is the design of a technical diagnostics system that includes, according to [1], the following three steps:

1. Analysis of the diagnosed object, the purpose of which is to determine possible states;
2. Limitation of the list of these states and selection of observable parameters;
3. Development of an algorithm for determining the operability of an object and localizing a defect.

This implies the problem of diagnosing losses and obtaining inauthentic data in the control system. To combat unreliable data, preventive methods are used - routine checks and tests, and to identify them during the course of the production process, separating the fact of the sensor failure from the fact of equipment failure, information about the progress of which the sensor collects, is almost impossible.

However, there is another situation, characterized by a complete failure of the sensor. Such cases can theoretically be separated from the breakdown of production equipment, since they lead to complete losses (lack of fixation of information) of data on the progress of the production process.

References

[1] https://www.ncbi.nlm.nih.gov/pmc/articles/PMC2998599/
[2] Richard E. Barlow, Frank Proschan. Classics in Applied Mathematics. Mathematical Theory of Reliability