THE INVESTIGATIONS AID IN EXPLOITATION

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Summary

Exploitation systems are constantly improved by management methods and information techniques. Machines in operation are subject to degradation controlled by diagnostic methods. Obtaining information on the condition and its processing for the purposes of legitimate exploitation decisions is elaborated on in many aspects, considered as new herein. This involves information selection, dedicated diagnostic systems, the system of agreeing on decisions and cause-effect modelling. Selected aspects of this subject were discussed in this publication.

Keywords: management, exploitation, diagnostics, redundancy, product life cycle.

WSPOMAGANIE BADAŃ EKSPLOATACYJNYCH

Streszczenie

Systemy eksploatacji są ciągle doskonalone metodami zarządzania i technikami informacyjnymi. Maszyny w eksploatacji podlegają degradacji nadzorowanej metodami diagnozowania. Pozyskiwanie informacji o stanie i jej przetwarzanie dla potrzeb uzasadnionych decyzji eksploatacyjnych jest rozwijane wieloma zagadnieniami, rozwijanymi jako nowe w tej pracy. Dotyczy to selekcji informacji, dedykowanych systemów diagnostycznych, systemu uzgadniania decyzji oraz modelowania przyczynowo - skutkowego. Wybrane aspekty tej problematyki omówiono, z konieczności skrótowo, w tym artykule.

Słowa kluczowe*:* zarządzanie, eksploatacja, diagnostyka, redundancja, cykl życia produktu.

1. INTRODUCTION

The necessity of the technical state estimation is conditioned the possibility of making decisions connected with object exploitation and the procedure of next advance with object. The present development of automation and computer science in range of technical equipment and software creates new possibilities of realization of diagnosing systems and monitoring technical condition of more folded mechanical constructions.

Production system constitutes a deliberately designed and organized arrangement of material, energy and information used by men, for the purpose of manufacturing specific products – in order to meet diverse needs of consumers. Its proper functioning, in the light of production computerization and application of flexible production systems, almost starts a revolution in the methods of factory management. The practice of exploiting increasingly complex machinery shows that engineering knowledge, on a par with economic and organizational knowledge, becomes a necessity in market economy.

Detecting, measuring, recording and evaluating selected information and data on the condition of a particular system (organization, management, product quality, safety, environment, machinery exploitation) are used for the purpose of organization functioning, management and quality assessment (product, safety, environment, machinery) in terms of assumed task classification. The particularization of such decisions in the area of machinery degradation examination (task usefulness) at the stage of their exploitation is constituted by methods, procedures and measures of technical diagnostics, enabling a particularized (structural) assessment of system condition, generating a basis for further diagnostic - exploitation decisions [1, 2, 3, 4, 30, 32].

2. MANAGEMENT OF EXPLOITATION

The processes of technical system destruction extort the need to supervise the changes of their state, particularly at the stage of exploitation. Methods and means of modern technical diagnostics are tool diagnosing their technical state, which enables their rational and safe maintenance.

The present development of automation and computer science in the field of hardware and software gives way to new possibilities of realization of diagnosing and monitoring systems of more and more complex mechatronic constructions. These new possibilities are connected with new constructions of intelligent sensors, modular

software and modules of communication and data exchange.

Any company operating in a competitive free market economy should choose an appropriate management method ensuring a strategic advantage. This includes an analysis of description and relevance of management methods with reference to enterprise specificity, with their brief characteristics, principles of functioning and possible benefits. In view of a large number of established management methods (more than 130 according to various sources), such as: management by objectives (MBO), management by communication (MBC), management by innovation (MBI), management by delegation (MBD), management by results (MBR), management by quality (MBQ), strategic management (SM), management by motivation (MBM), management by participation (MBP), with different: property forms, locations, branches and employment size – an analysis of the distribution of their use frequency indicates that management by objectives (MBO) and management by quality (MBQ are the most frequently used methods (fig.1).

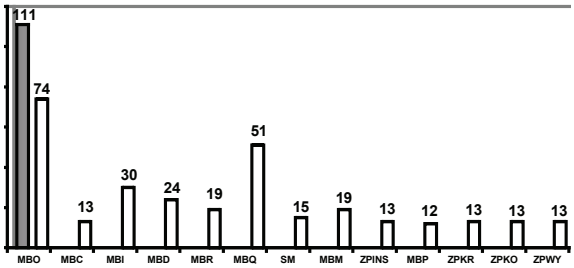

Fig. 1. The use frequency of management methods applied in organizations

Quality supported by information techniques has become the central problem of modern management. It is the whole of product characteristics and services affecting their ability to meet identified and potential needs.

Available commercial "product lifecycle" programs include a description and principles of managing the lifecycle of a machine at the stages of evaluation, design and construction, manufacturing and operation.

At the stage of design, the following are used: Autodesk, AutoCad, CAD, CAE (MES, FLUENT, ADAMS), PDM (documentation management), MICROSTATTION, CATIA, SOLIDWORKS, SOLIDEDGE, INVENTOR and ANSYS. In manufacturing, the following are available: CAM, IRIS, UIC. For exploitation description, the following programs can be used: ARETICS, CMMS Machine, TPM, AGILITY, MAXIMO, SUR-FBD, EUROTRONIC, THETA-CONSTELLATION, PREKION, PLAN-9000, "MACHINE" SYSTEM, PLAN9000 SYSTEM, REPAIRING SYSTEM API PRO, IMPACT XP 217 SYSTEM, IFS SYSTEM, ISA SYSTEM – BPCS. Product lifecycle integration is described by PLM, LCM, engineering knowledge management – KM, CATIA.

Hence, intelligent converters have adaptive proprieties, enabling to choose an algorithm of measurement appropriate for an investigated issue on the basis of conditions of measurement, item properties, requirements and limitations. Converter memory includes software with a certain set of algorithms and a programme of their choice. The choice is conditioned suitably to the realized function, accumulated knowledge, as well as information on conditions of measurement.

Presently, some initiatives relating to software and the selection of instrument structure are under development, enabling to automatically adjust to a realized task, which was partly presented below. The success of different conceptions of acquisition and diagnostic information processing is connected with improvement in the methods of obtaining symptoms of state, objective modelling and building self-diagnosing items [1-32].

3. INITIAL DATA PROCESSING

The observation of progress in wear and tear of an object is based on measuring various symptoms of the technical condition and comparing them with allowed values established earlier – for a specific symptom and in a particular application. The process of object wear and tear is usually not one-dimensional, and the dimension of damage degree increases with the degree of machinery construction complexity. This radically improves the dimensionality of condition vectors, signal and interference vectors. Diagnostic information available in the check-up becomes redundant, dimensionally complex and difficult to process.

This study presents the problems of information redundancy, assessment of individual measurements of diagnostic signal and multi-dimensional processing of diagnostic information in program research as key issues.

A set of signal diagnostic parameters stands out against the set of output parameters accompanying machine operation. Most frequently the criteria distinguishing these symptoms include conditions of their independence, unambiguousness and measurability.

Marking a set of failure-sensitive diagnostic parameters should include:

- the ability to imitate state changes during maintenance,
- information on the technical state of the transmission,
- parameter value sensitivity during maintenance.

The methods of marking diagnostic signals are as follows:

- the method of maximal parameter sensitivity to technical state change.
- the method of maximal relative value of diagnostic parameter change.
- the method of maximal information capacity of a diagnostic parameter.
- the method of maximal changeability of a diagnostic parameter.

The aforementioned methods enable to choose single - and multi-element sets of diagnostic parameters out of a set of output parameters, which is a significant advantage.

The criteria for the optimization of a set of diagnostic parameters are as follows:

- parameters should characterize the process of item destruction, and they should be closely linked with this process,
- parameters should be sensitive to the changes in the on-going process of capability deterioration,
- the number of parameters cannot be too big due to the fact that it hinders and sometimes makes impossible the familiarization and definition of the process of deterioration of item state,
- diagnostic parameters should be measureable,
- there have to exist reliable statistical and analytical data regarding tested parameters.

In practical applications, the pre-treatment of measurement data is an essential step in data classification, having impact on both the effectiveness of distinguishing between conditions, speed and construction simplicity, as well as learning the cause-effect model and its subsequent generalization. A recorded time signal of the tested process moved to an Excel spread sheet is the basis for further processing, for example in the field of time, frequency and amplitude, giving many measurements enabling the decomposition of the output signal to signals of growing individual disruptions.

The decision-making process consists of a series of operations starting with obtaining information on machinery status, its gathering and processing, until selecting and forwarding a fixed decision for implementation. At the beginning, however, three types of initial data processing need to be distinguished: data transformations, filling in the missing values and dimensionality reduction.

4. INFORMATION SYSTEM OF IDENTIFICATION TESTS

The possibility of rapid identification of damage while diagnosing the elements affecting the functioning of objects was the basis for the creation of SIBI program shown in fig.2. This program is an attempt of software implementation for the following purposes: acquisition of vibration processes, their processing, testing co-dependencies of vibration processes, testing symptom sensitivity, statistical inference, and visualization of analysis results.

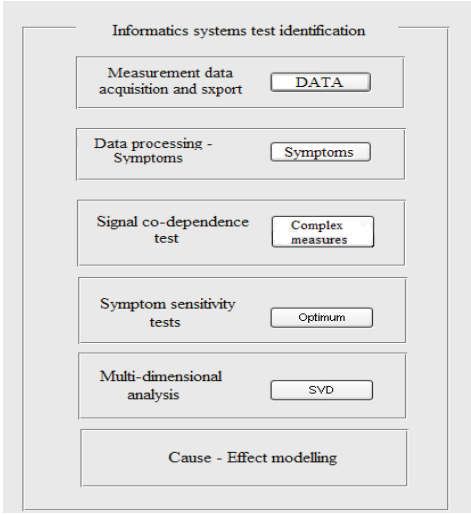

Fig. 2. Main dialog window of SIBI program

5. MANAGING PRODUCT LIFECYCLE

The procedures of rational exploitation can be characterized socially, environmentally and economically – fig. 3.

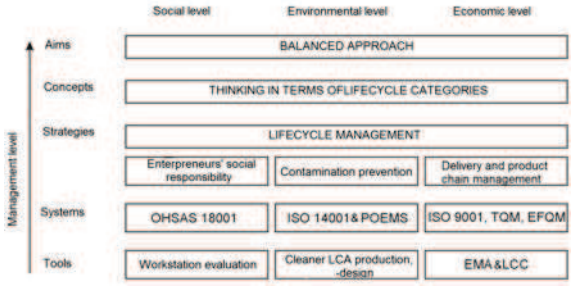

Fig. 3. LCM (Life Cycle Management) [21]

The explanation of shortcuts: OHSAS - safety and professional hygiene, POEMS - The system of the environmental management be well-versed about the product, TQM - the total management of the quality, FFQM - European Foundation for Quality Management, LCA - life-cycle analysis, EMA - Employers and Manufacturers Association., LCC - opinion of the costs of the life cycle.

On the market there are many CMMS systems (Computerised Maintenance Management Systems) in a wide range of prices and possibilities. An important issue for enterprise decision-makers is the choice of proper system supporting motion maintenance services. The analysis of methods of evaluation and selection of systems of this type and the subjective-scoring method of the assessment of the environmental usability of commercially available computer programs are shown in fig.4.

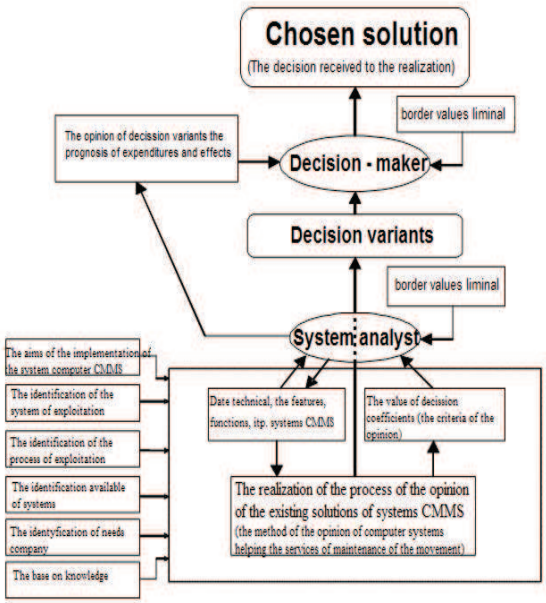

Fig.4. The algorithm of information system selection for exploitation monitoring [9]

6. CONCLUSION

The issues related to diagnosing complex technological items are constantly developed, and the procedures of obtaining and processing diagnostic information constantly improved. This paper deals with reduction redundancy for single state symbols and a multi-dimensional state test.

Selecting a method for the specificity of enterprise business depends on a number of internal or external factors. It is impossible, however, for an organization to survive without adopting any of the methods reducing the chaos and randomness of decision-making rules to a minimum. The methods should be well identified before implementation, and the decision on their implementation should be fully deliberate.

A new, simple and effective method of sensitivity assessment for individual measurements of condition was proposed – the OPTIMUM method; moreover, the essence of the SVD method, SIBI program and guidelines for the selection of rational commercial programs in the field of machinery exploitation were explained.

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