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THE CREATIVITY STARTERS OF RATIONAL EXPLOITATION OF MACHINES

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K e y w o r d s: management, creativity starters, operation, diagnostics, redundancy, the life of the product.

A b s t r a c t

Today's knowledge-based companies requires for their proper functioning to develop primers of creativity in every branch of the organization and structure. In this study presented high the rank problems of organization and machines of exploitation, showing the need, and possibilities of creative activities of the crew. Operating systems are constantly improved by management methods, and techniques of information. Operating machines are the subject of degradation supervised diagnosis methods. Obtaining information about the state and its processing for legitimate operational decisions is developed in many issues, being developed as new in this work. This applies to the selection of the information for dedicated diagnostic system, modeling system of decisions, cause and effect. Selected aspects of the issues discussed in this publication.

Introduction

The production system is purposely designed and organized and includes systems of material, energy and information used by humans and used for manufacturing certain products of – in order to meet the diverse needs of consumers. Its correct functioning in the light of production computerization and the use of flexible manufacturing systems and it is almost a revolution in the methods of corporate management. Practice operation of increasingly complex machinery indicates that the engineering knowledge on a par with economic and organization is necessary in a market economy is the knowledge engineering on a par with economic and organizational (GRIFFIN 1997, WEBBER 1996, HAMROL, MANTURA 1998, DURLIK 1995). Detection, measurement,

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recording and evaluation of selected information and data on the state of a particular system (organization, management, goods quality, safety, environment, operation of machinery) is used to assess the functioning of the organization, management and quality (product supply, safety, the environment, machines) in terms of assumed task classification. Detailed description of such decisions in the area of testing machine degradation (suitability task) at the stage of their operation are the methods and means of technical diagnostics, allowing particularized (structural) assessing the state of the system, generating a basis for further diagnostic and operational decision (ŻÓŁTOWSKI, TYLICKI 2004, ŻÓŁTOWSKI, NIZIŃSKI 2010, ŻÓŁTOWSKI, ŁUKASIEWICZ 2012, ŻÓŁTOWSKI et al. 2012a, 2012b, ŻÓŁTOWSKI, KWIATKOWSKI 2012, ŻÓŁTOWSKI B. 2012).

Assessment of technical machines condition using generated physical processes do not require obtaining relevant information about the state and the proper combination of functional parameters evaluated object with a set of measures and assessments of output processes. The development of virtual enables many new solutions for modeling, simulation, and processing diagnostic information. Some of these opportunities informative presented in this article, and this applies to the signal processing, optimization, statistical results and diagnostic reasoning in decision-making supplies.

The whole creative activity involves creative thinking that allows to solve problems, thinking creatively to provide early notice of problems and innovation (product, technology, management) treated, as an idea, practice or product – perceived as a new user (STONER 1992, ŻÓŁTOWSKI, TYLICKI 2004, ŻÓŁTOWSKI M. 2010). Creativity, creatively and innovations in the development of civilizations trigger the need to solve new problems: scientific, technical, organizational and social. Creative, innovative actions – are the result of creative activity the existing state-changing for the better. Every man has creative ability, thinking, knowledge and skills can be taught. The whole creative activity involves creative thinking that allows you to solve problems, think creatively to provide early notice of problems and innovation (product, technology, management) is considered as an idea, practice or product perceived as new by users (HAMROL, MANTURA 1998, ŻÓŁTOWSKI M. 2011). Creative design innovation in the exploitation strategy funds include: principles of creativity, innovative service structures, the algorithm problems innovative of enterprises, the primers of creativity in the organization and functioning of the company in the research system operation (with criteria of efficiency, condition assessment, safety and environment), development of innovative assumptions a dedicated system operating company (according to the state and tolerated failures), the development of creative quality system operation means, organization and maintenance of the enterprise, develop-

ment of information technology in the field of virtualization business. The end result of the creative treatment of the above challenges is the need to develop innovative primers effectively functioning enterprise, taking into account the creative principle of rational and creative thinking, using virtual technology.

Innovative company based on knowledge

Decisive role in the enterprise begins to play: quality construction, manufacturing and maintenance of the products of machines and vehicles converted to economic efficiency, safety of use and the risk to the environment (ŻÓŁTOWSKI M. 2011, 2014b, 2014c, ŻÓŁTOWSKI, ŻÓŁTOWSKI 2014c).

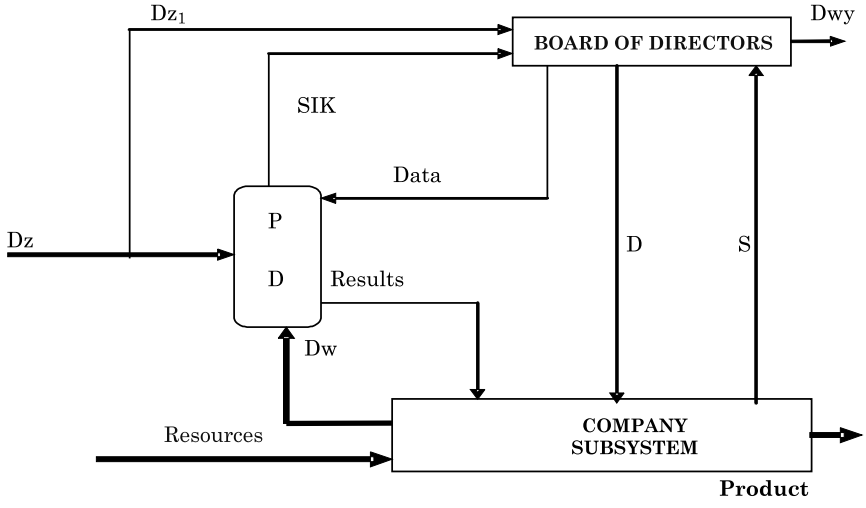
Creativity, innovation, economic and technical economy market appoint a number of new trends, where the main objective is „to develop innovative creativity primers based enterprise knowledge".

Knowledge – based economy – using product innovations, technological, process, organization and market capabilities – defining areas of primers creativity needs. Innovation: technology, technical, managerial, organizational – based on information technology – gives a new economic order. Knowledge-based economy – it's the ability to create knowledge and to acquire information process – as a path to economic success. This requires a willingness and ability to make long-term social investment in skills, education, knowledge and infrastructure. Knowledge is the most powerful engine of production, and the organization is supporting knowledge. Changing markets, new technologies explode, competitors multiply and products age in the „over-night", so the company's success consistently create new knowledge, disseminate it quickly transformed into new technologies and products.

Knowledge management in the enterprise include: acquisition of knowledge, application of knowledge, develop knowledge and sales expertise (new products, services, technologies). System management of exploitation is part of the corporate management. Business management model stands – Figure 1 – company management, data processing system and subsystems of company.

Enterprise as an open system is powered by data from the environment (Dz). The main part of this stream feeds the processing node or nodes, and some enter directly to the board (DZ_1) and there they are machined. Transferred to the processing node are also data from subsystems (Dw) and the board of the company (data).

Creative design primers innovations concern the functioning and efficiency of companies in the study area mainly organizational structures, and strategies for technical measures. These include mainly the principle of creativity, innovative organizational structures and problems algorithmisation innova-



Dz – external data, Dz_1 – part of entering directly to the board of the company, PD – data processing, SIK – system of the management information, Dw – internal data, Dwy – output data
Fig. 1. Enterprise management

tive exploitation machinery companies. In this area it is necessary to develop primers creative organization and functioning of companies in the study of the system exploitation, the criteria of effectiveness, assessment of safety and the environment. This requires the development of primers dedicated exploitation system companies – as of and tolerated damage and the development of information technology primers for virtualization business.

The finished results should be able to develop innovative primers (detailed procedures) effectively functioning enterprise, taking into account the creative principle of rational and creative thinking, using virtual technology.

Starters of creativity

All known, the concept of creativity, innovation and the fact that progress is necessarily linked to the creative thinking of the community. We also know that every one has the making (skills) of creative thinking, but you need to use them, and educate. There are many techniques of creative thinking. It is believed, however, that read them and use them to solve problems is sufficient to start with. Most of the techniques of creative thinking, brainstorming can integrate the innovative activity of the organization. The more effective will be the effects of the use of these systems, the better will be integrated into knowledge there innovative thinking techniques.

Detailed considerations of developing creativity primers mainly relate to further technology and its exploitation strategy, in terms of economic efficiency, maintaining an airworthy condition, ensure the safety and protection of the environment from the technology impacts.

The tool for assessing the state of degradation, the level of safety and environmental risks from operating machines are the methods and means of technical diagnostics. They should be used already be at the stage of assessing the quality of design (prototype testing) and during operation (evolution study of state).

Correct issues use of diagnostic information to assess the state of degradation, security risks and threats to the environment are about the problems of capturing: study the dynamics of structure, recognizing the state and the evolution of its changes, to develop criteria for safety and environmental risks, optimization of available solutions and practical aspects of monitoring changes in modern strategies operation.

There is therefore a need to develop primers for creativity and research methodology in creating dedicated exploitation strategy and conduct research related to the development of procedures for monitoring the evolution of changes, risk and safety, depending on the limiting factors. Scientific indications and application solutions for the creativity of the primers are still little recognized, important and rarely undertaken.

Take the issue of developing wizards and environmental safety assessment in clinical state of the technical system the company due to the following reasons:

– the need to assess the dynamic state machine which is possible through of description and examination of the volume component of the dynamic model of the machine being an objective measure of their burdens;

– the need to meet the requirements state that: the machine must be designed and constructed so that the environmental risks associated with it caused by mechanical vibration, noise and emission of harmful exhaust gas components were limited to the lowest level taking account of technical progress and the means at the disposal of minimize vibrations, particularly at source.

Primers creativity in this area relate mainly to study the effectiveness of strategies for technical measures. It also includes innovative, creative research and analysis of selected aspects of diagnosing the degradation state, with particular emphasis on the use of modern information technology. It should be mentioned areas of needs and possible applications developed primers specific areas:

1. Primers creativity of innovative companies:

– an innovative company that based on knowledge,

– algorithmization problems of innovative enterprises,

– the primers creative organization and functioning of the company.

2. Assessment of the risks of safety and the environment from the technique:

– security, technical risks, effectiveness,
– degradation of state – modeling, description and research,
– evolution of technical systems,
– tools and means of testing the state of degradation.

3. Structure of the exploitation of technical measures:

– the creative organization and management in logistics operation,
– evaluation of the effectiveness of the exploitation strategy,
– the strategy according to the state and tolerated damage,
– the development of a dedicated exploitation system,
– the quality system exploitation resources, organization and maintenance company.

4. Means of transport:

– maintaining the suitability of means of transport,
– organization and management of maintenance,
– the virtual technology in operation of vehicles,
– information techniques in organization and management.

The result of the implementation of precisely formulated tasks should be able to develop a methodology for the construction of primers for dedicated creative strategies for technical measures, taking into account the proposals for a system monitoring and evaluation of degradation in the safety and environmental risks from the used resources and the development of virtual tools for these tasks.

Exploitation systems are constantly being improved by management methods and information technologies. Available commercial programs „product life" includes a description of life and principles of machines management state at the stages of evaluation, design and construction, manufacturing and service. The design used: Autodesk, AutoCAD, CAD, CAE (FEM, FLUENT, ADAMS), PDM (documents of management), CATIA, MICROSTATTION, SOLIDWORKS, SolidEdge, INVENTOR, ANSYSS. In the preparation of sector are: CAM, IRIS, UIC. In the description of the operation process can take advantage of programs: ARETICS, machine CMMS, TPM, AGILITY, MAXIMO, SUR-FBD, EUROTRONIC, TETA-CONSTELLATION, PREKION, PLAN-9000, SYSTEM „MACHINE", PLAN 9000 SYSTEM, SYSTEM REPAIR API PRO, SYSTEM IMPACT XP 217, IFS SYSTEM, SYSTEM ISA – BPCS. Integration of product lifecycles describes – PLM, LCM, knowledge management of engineering – HP, CATIA. Practical use of available plant programs requires a primer binding creativity techniques on the tasks of the plant (ŻÓŁTOWSKI et al. 2012a).

Machines in operation are degraded and the degradation is supervised by diagnosis methods. Obtaining information about the state and its processing for legitimate operational decisions is developed in many ways, and some of them are the contents of this work.

This applies particularly to the use of new methods of statistical analysis of test results, such as: OPTIMUM, SVD, the methods of determination of cause – effect of selected tools and methods of artificial intelligence (ŻÓŁTOWSKI, ŻÓŁTOWSKI 2014a, 2014b, ŻÓŁTOWSKI M. 2014a).

Creative design innovation of this work concerns the functioning and effectiveness study of companies in the area of strategy, productivity, highlighting the issues of exploitation resources and production structures including:

– principles of creativity, innovative organizational structures;
– algorithmization of problems of innovative production company;
– the primers creative organization and functioning of companies exploitation in the research system, with criteria of efficiency, evaluation of the safety and environmental risks;
– the development of a dedicated system for mining companies – as of and tolerated failures;
– development of creative quality of exploitation analysis system resources, organization and maintenance of the company;
– development of information technology in the field of virtualization business.

The result of such an approach should be to develop innovative primers effectively functioning enterprise, taking into account the creative principle of rational and creative thinking, using the technology of virtual machines to maintain fitness.

The problem of the submitted proposal is broad, modern and saturated by many proposals, worth taking to improve the efficiency of operating companies leading to the direction them on creative, creative and innovative thinking and action, particularly in the area of operation and proposed new strategies and methods of examination of the technical measures.

Starters innovation in supervising status degradation

One of the possible solutions to the implementation of the problems in modern organized enterprise may be the use of additional diagnostic methods used extensively CMMS systems, and more specifically to a system MAXIMO endearing productivity issues through the prism maintain the fitness machines. Development and integration of MAXIMO structure dedicated diagnostic

system based on the methods OPTIMUM, SVD and a methodology of building diagnostic models, representing a comprehensive set of data analysis tools working in MATLAB, greatly affects the accuracy of the results of examination of the fitness machines.

Observation of play fuel facility carried out by measuring the various symptoms of the technical condition and comparing them to predefined limit values – for the specific symptom and a specific application. The wear of the object is generally not one-dimensional, and the dimension of the damage increases with the complexity of the construction machine. This increases dramatically dimensionality state vectors, signals vectors and interference. Diagnostic information possible to obtain in clinical status becomes redundant dimensionally complicated and difficult to process. This paper presents as primers for creativity operated machine parts information redundancy issues, evaluation of individual measures of diagnostic signal processing and multi-dimensional diagnostic information in clinical programmable.

In practical applications, the preparation procedures (primers) for processing data obtained from the measurements is a very important step in the data classification affecting both the efficiency of distinguishing between states, speed and ease of construction and the learning model of cause – effect relationship, as well as its subsequent generalization. Registered test time is later taken to process in Excel spreadsheet, and it is the basis for further processing, eg. the time, frequency, and amplitude, providing measures to enable the decomposition of multiple output signals of each of developing defects. Decision-making process consists of sequence operations from date of obtaining information about the machine state, through its collections and processing until the selection and transfer of fixed decision for execution.

Ideal point method – OPTIMUM

Diagnostic signals measured in different ways reflect observation space, and, in an indirect way, damage development in a machine – Figure 2. With the use of optimization techniques, sensitivity of measured symptoms to condition changes can be characterized based on measuring the distance from the ideal point. Distinguishing the fault is possible – according to mathematical formalism – after projecting constituent symptoms on axes *x, y, z* respectively.

The following algorithm makes statistical assessment of individually-elaborated diagnostic symptoms possible, resulting in a final ranking of their sensitivity and relevance. The following steps of this procedure include:

1. Creating an observation matrix from measured symptoms: s_1, s_2, s_3...s_m.
2. Statistical assessment of symptoms with the use of various criteria, i.e.:

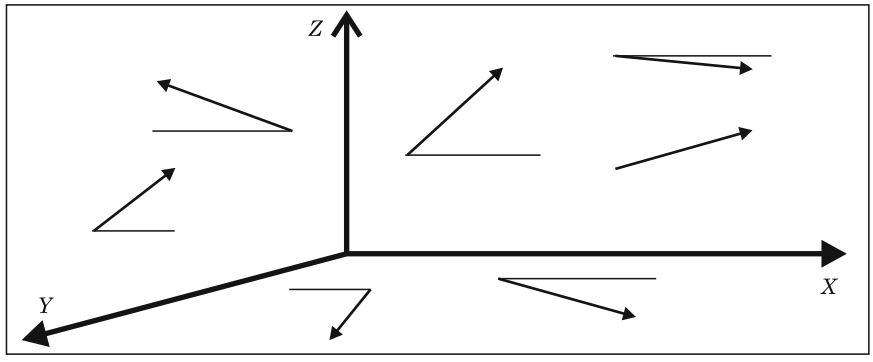


Fig. 2. Multi-dimensional observation space

– the symptoms change ability:

$$f_1 = \frac{s_j}{\bar{y}} \tag{1}$$

where:
S_j – standard deviation, $\bar{y}$ – average value;

– assessment of symptom sensitivity to condition changes:

$$w_i = \frac{x_{i\max} - x_{i\min}}{\bar{x}_i} \tag{2}$$

– correlation to the technical condition, run (determination of the correlation coefficient: symptom-condition):

$$f_2 = r\,(y,w); \qquad r_{xy} = \frac{1}{n-1}\frac{\sum_{i=1}^{n}(x_i - x_{sr})(y_i - y_{sr})}{\sigma_x\,\sigma_y} \tag{3}$$

To make considerations and the presentation of results on the surface easier, two selected indicators of quality are sufficient.

3. Making further maximization and normalization of adopted indicators of quality signals, we obtain statistical characteristics of their sensitivity (f_1^*, f_2^*) which further allows us to determine the coordinates of an ideal point. This allows distance determination of single signal measurements from an ideal point, according to the following relation:

$$L = \sqrt{(1 - f_1^*)^2 + (1 - f_2^*)^2} \tag{4}$$

4. General sensitivity coefficients (weights) for each tested signal are determined by relationship:

$$w_i = \frac{1}{\frac{1}{L_i} \cdot \sum_{i=1}^{n} L_i}, \qquad \text{where: } \sum w_i = 1 \tag{5}$$

The presented algorithm can be easily performed in Excel, obtaining a quality arrangement of measured symptoms. Figure 3 shows the final result of this procedure for sample measurement data. Distance points of each measurement from an ideal point (1,1) indicate the sensitivity of assessed signal measurements, with the points closest to (1,1) being the best symptoms.

Having highlighted statistically good symptoms, it is possible to build cause-effect models at the stage of inferring the condition. The quality of the model depends, however, on the number of measures taken into account, which, indirectly, in the simplest regression models, can be evaluated with the determination of coefficient R^2.

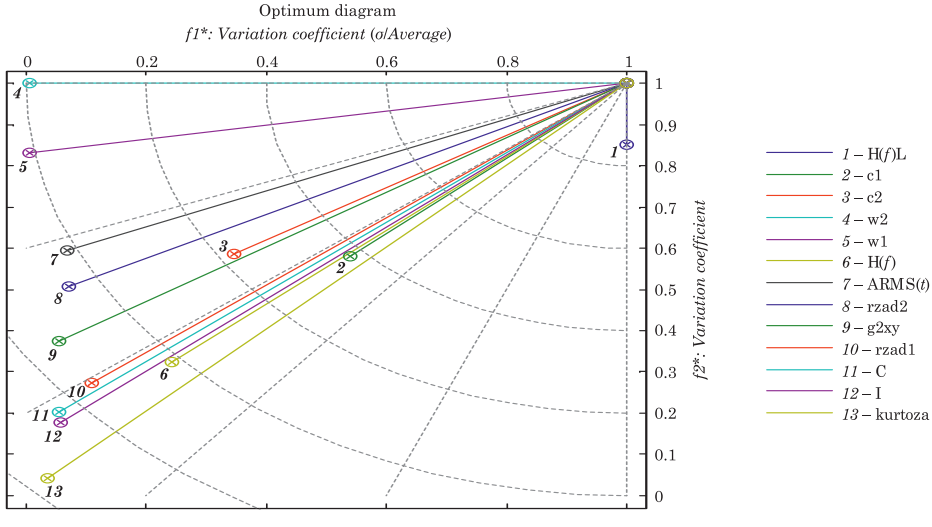


Fig. 3. Ideal point method outcome – OPTIMUM

Multi-dimensional system observation – SVD

SVD (Singular Value Decomposition) is a numeric procedure for the multi-dimensional tracking of changes of an object's condition. It detects developing damage and selects maximally informative condition symptoms in a given situation.

Let's take into account a complex mechanical object operating in time $0 < \theta < \theta_b$, where evolutionarily several independent defects are developing, $F_t(\theta)$, $t = 1, 2, ..., u$. Their development can be handled by observing the phenomenon field, creating a row vector of technical condition symptoms; $[s_m] = [s_1, ..., s_r]$, with a different physical nature. For the purpose of tracking changes in the technical condition of an object, one can perform dozens of equally-distant value readings of the vector in time; θ_n, $n = 1, ... p$, $\theta_p \leq \theta_0$. In this way, further rows of the symptom observation matrix (SOM) are obtained. We already know that the maximum diagnostic information can be obtained from the matrix if all the initial readings are centred (subtracted) and normalized to the original value $\mathbf{S}_m(0) = \mathbf{S}_{0m}$ of a given symptom. We thus obtain a non-dimensional symptom observation matrix:

$$\mathbf{O}_{pr} = [S_{nm}], \qquad S_{nm} = \frac{\mathbf{S}_{nm}}{\mathbf{S}_{0m}} - 1 \tag{6}$$

where:
bold markings represent the original dimensional symptom values.

For the purpose of describing system lifecycle, we hale a non-dimensional observation matrix $\mathbf{O}_{pr}$ of r – columns resulting from the number of observed symptoms and p lines resulting from the total number of consecutive observations. To the non-dimensional observation matrix, the procedure of distribution in relation to specific values is:

$$\mathbf{O}_{pr} = \mathbf{U}_{pp} \cdot \Sigma_{pr} \cdot \mathbf{V}_{rr}^{\mathrm{T}} \tag{7}$$

where:
T – transposition,
$\mathbf{U}_{pp}$ is a p – dimensional orthogonal matrix of specific left-sided vectors,
$\mathbf{V}_{rr}$ is an r – dimensional orthogonal matrix of specific right-sided vectors and in the middle – a diagonal matrix of specific values Σ_{pr} with the following properties:

$$\Sigma_{pr} = \text{diag}\ (\sigma_1, ..., \sigma_l), \text{ where: } \sigma_1 > \sigma_2 > ... > \sigma_u > 0 \tag{8}$$

$$\text{and: } \sigma_{u+1} = ... \ \sigma_l = 0, \text{l} = \max\ (p, r), \ u = \min\ (p, r).$$

This means that of r – measured symptoms, one can obtain only $u \leq r$ of independent information on growing damage. Such a decomposition of the SVD observation matrix can be conducted after each observation; $n = 1, ..., p$, and thus the evolution of defects $F_t(\theta_n)$ in an object can be monitored.

One damaged F can be described by a pair of new values; SD_t and θ_t. The first one is a generalised symptom of damage **t**, which could be called a discriminant of this damage and could be obtained as a right-sided product of observation matrix and vector $\mathbf{v_t}$ (HAMROL, MANTURA 1998):

$$SD_t = O_{pr} \cdot \mathbf{v_t} = \sigma_t \cdot \mathbf{u_t} \tag{9}$$

Since vectors $\mathbf{v_t}$ and $\mathbf{u_t}$ are normalized to unity, the length of vector SD is equal to its energetic norm and equals:

$$\text{Norm}\ (SD_t) \equiv ||SD_t|| = \sigma_t \tag{10}$$

Therefore, for a specified lifetime θ use advancement of damage, F_t can be reflected by a special value $\sigma_t(\theta)$, whereas its instantaneous evolution – by discriminant $SD_t\ (\theta)$. The equivalence of new measures of SVD is postulated to the characteristics of damaged areas, throughout the entire lifecycle θ of an object:

$$SD_t\ (\theta) \sim F_t(\theta), \text{ with the norm } |F_t(\theta)| \sim |SD_t(\theta| = \sigma_t(\theta) \tag{11}$$

$SD_t(\theta)$ can also be called a damage profile, whereas $\sigma_t(\theta)$ its advancement. Figure 4 shows the SVD idea.

The target of SVD is also to select maximally-informative symptoms measured in a given diagnostic observation. From the observation matrix $\mathbf{O}_{pr} = [S_{nm}]$, one can define two square r and p-dimensional covariance matrices, as below ($*^{\mathbf{T}}$ – the transposition of the matrix, vector):

$$W_1 = (\mathbf{O}_{pr})^{\mathbf{T}} \cdot \mathbf{O}_{\text{pr}}, \text{ and } W_2 = \mathbf{O}_{pr} \cdot (\mathbf{O}_{pr})^{\mathbf{T}} \tag{12}$$

Solving the issues of these matrices (EVD) shows that in this way the wanted specific vectors of the observation matrix SVD and squares of the specific values can be obtained:

$$W_1 \cdot v_v = \sigma_v^2 \cdot v_v, \ v = 1,... \ r; \text{ and } W_2 \cdot u_i = \sigma_i^2 \cdot u_i, \ i = 1,... \ p \tag{13}$$

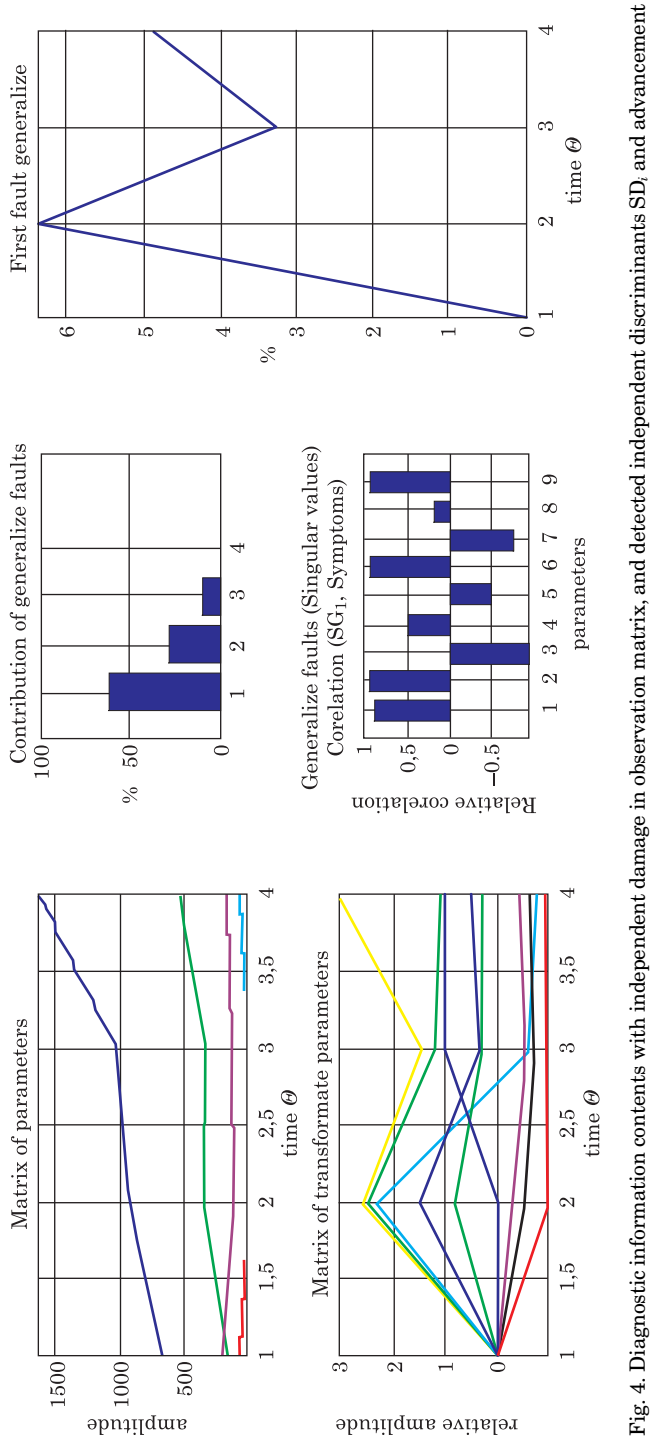


Fig. 4. Diagnostic information contents with independent damage in observation matrix, and detected independent discriminants SD_i and advancement measurements σ_i

Source: Żółtowski, Cempel (2004).

Thus, solving the two own issues (Eigen Value Decomposition – EVD) of both covariance matrix, defined in the observation matrix, we obtain the same result as in the SVD procedure; squares of specific values instead of their original values are the only difference.

An example of the application of these considerations is a diagnostic observation of a 12-cylinder traction diesel engine, and the results are shown in Figure 4. The image in the upper-left corner shows 12 measured symptoms creating a complexity of information, which, however, after being processed by SVD, is easy to decode into two main types of damage because σ_1 and σ_2 constitute ca 50% and 20% of all diagnostic information in the observation matrix (image in the upper-right corner) measured as a quotient of the values of a given σ_i to the sum of all specific values. Moreover, the first damaged SD_1 (lower-left corner) almost monotonically increases, while the second one is unstable and begins to grow only after the 20th measurement (200 thousand kilometres), which can also be seen in the course of the intensity of damage σ_2, in the lower-right corner.

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 Figure 5.

This program is a software implementation attempt 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.

Presented development issues are excerpts of works relating to the development needs of the primer creativity – supporting enterprise decision-makers in the analysis of existing solutions and selection of the best (innovative) systems supporting maintenance services.

It is worth remembering that the truth and danger existing in the implementation of innovation in the enterprise:

– „everything was good with great respect we put on the shelf meritorious solutions and stubbornly looking for new and better solutions, even for old problems";

– „the innovator has enemies all those who prosper under the old system, a faint support from those – who will benefit from the new".

Issues shaping the modern enterprise in terms of: knowledge, creativity, innovation, techniques and airworthy virtual machines designate the areas needs to develop of creativity primers.

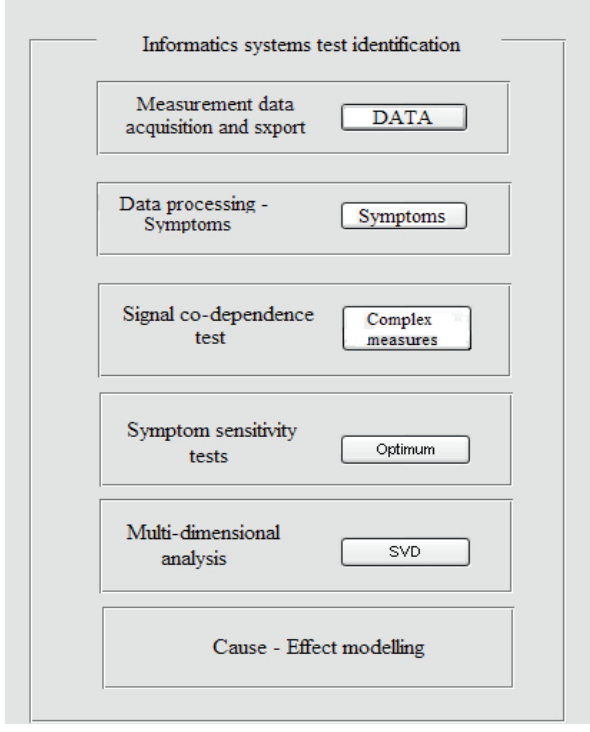


Fig. 5. Main dialog window of SIBI program
Source: ŻÓŁTOWSKI et al. (2014b).

Conclusion

The growing demands of the economy and the environment in terms of „quality" of newly constructed or upgraded machinery strategies for different objects are forcing manufacturers to introduce new methods and means of supervising the evolution of changes in objects and to facilitate decision-making supplies. The problems identification, of the dynamic machine state with the description of the model and the various research methods of these models is fixed in the design and operation of modern machinery and technical equipment. The resulting problems associated with the determination of the current facility state and its impact on the risk for man and the environment in the exploitation strategy are used for the substantive content of the creativity primers.

The scope of research methodologies for assessing the dynamic state machines currently covers issues such as: modeling the dynamic state, sources of information, signals and symptoms of the dynamic state, the rules of specific

methods of identification, diagnostic experiments, supporting research and information technology, organizational and economic aspects of maintenance of machines able to airworthiness. These areas need to delimit the primer creativity to improve the rational use in the enterprise.

The basic findings of this study include:

1. dominant role-based enterprise knowledge in creating innovation;
2. need to introduce modern management strategies for businesses;
3. primary role in the control of information abstracted undertaking;
4. award system management operation of machinery in the plant logistics system, and it will place the research operation of machines;
5. develop creativity primers rational functioning of the company.

In terms of the operation of machinery diagnostics problems are still being developed, and procedures for obtaining and processing diagnostic information are constantly being improved. This paper describes the reduction of redundancy for individual state symptoms, and for the examination of the multidimensional. Proposed a new simple and effective method of assessing the sensitivity of the individual measures of state – OPTIMUM method, discusses the essence of the SVD and the program SIBI. Any proposed procedures for the area of machines operation form are the basis of creativity starters.

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