Diagnostic of Trans-Boundary Environmental Security

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Abstract. **This paper explains and presents an integrated methodology of technogenic risk management, which is a system of scientific knowledge on methods, means, laws, regularities, rules and procedures of their application, which aims at preventing and reducing the risk of production systems. The basic stages of the methodology are: I. Formalizing dangers; II. Analysis of dangers; III. Classification and rating of dangers; IV. Synthesis of safety; V. Information assurance.**

Keywords: technology risk, safety analysis, method.

I. INTRODUCTION

Danger is a criterion of environmental safety. It is a distinguishing mark, a property of the quality of production systems. It changes in the course of time and has accidental character. The risk is an indicator of dangers.

II. EXPOSITION

The logic presented in this research shows that in order to manage risk it is necessary to exert an influence on dangers. It is necessary to seek solutions to minimize dangers, respectively critical situations. Therefore risk is not only a criterion of safety, but also an object of management.

The presented widely accepted methodological grounds make it necessary to define and create a scientific field, and we think that it is appropriately to name it ”technology of risk management” in ergonomic systems.

Based on the general and private interpretations of the term “technology”, as well as on the base of knowledge for value, assessment and criteria, developed by us [3,4,6,10], we make the following definition of safety of production systems.

Technology of risk management in ergonomic systems is a system of scientific knowledge for methods, means, laws, regularities, rules and procedures for their application, which aims to prevent, reduce and compensate the ergo- and eco-criticalities of work process in production ergonomic systems.

We would mention the following basic arguments for the term so formulated:

1. The problem is the safety, examined as a property, determining the quality of functioning of production systems;

2. The system of scientific knowledge is examined due to the necessity of applying systematic scientific approach for the problem solution.

It directs us to the way in which knowledge about risk and safety can be obtained. In cases of obtaining knowledge only as a result of the influence of the outside world, without any purposeful actions to establish and analyze the cause-and-effect links between phenomena and consequences, such knowledge is limited and will not contribute to objective research.

Science is the field of human activities, the functions of which are to create and to systematize theoretically the objective knowledge and the reality, one of the forms of public awareness. For that reason it is necessary to create scientific knowledge, which requires defined use of a specific complex of theoretical and experimental actions to establish the above cause-and-effect links;

3. The methods, because they are the ways or operations for practical or theoretical knowledge and assimilation of reality, subject to the solution of the problem of safety;

4. The means are "the tools" for applying the created methods.

5. Laws and regularities.

Laws reflect objective relations, on which the examined phenomena are based. Regularities are included in the formulated term, because they are permanently inherent property of the reality, reflecting the variety and the variation of examined objects.

6. Rules, because they are the canons and the prescriptions, according to which specific activities are performed.

7. Procedures, i.e. the compulsory order of successive operations for application of methods, means, laws, regularities and rules for creation of safety.

8. Dangers are included in the content of the term “technology of safety”, because they are the criteria, the signs according to which safety and criticalities are determined;

9. Criticality, in its both forms – differential and integral and defining – critical situations and critical events, because it determines fatality, heaviness and danger of a specific ergonomic system, including in the form of perception and experience of people.

10. The labor production process (according to BDS 30.101-88), i.e. that part of the production process, which is performed with the immediate participation of people.

11. Prevention and reduction are included as the main purpose of technology, leading to the maximum safety. However there are a number of cases when prevention is impossible for objective reasons, and in this case forms and methods are searched for reduction, for decrease, which can be interpreted as partial prevention, corresponding to a specific degree, or a specific level of existing dangers.

We think that the mentioned arguments provide enough proof of logical truthfulness and value of the defined term “technology of technogenic risk management ".

The subject of this technology is dangers of subjective and objective type, occurring in man-machine systems. They characterize the problem of this technology – risk and common relations between components of ergonomic systems and surrounding environment.

The object of the technology are the production systems, which have exactly specified functions and in which the man-operator is the active control subsystem, the labor of which is the purposeful activity for satisfaction of its needs.

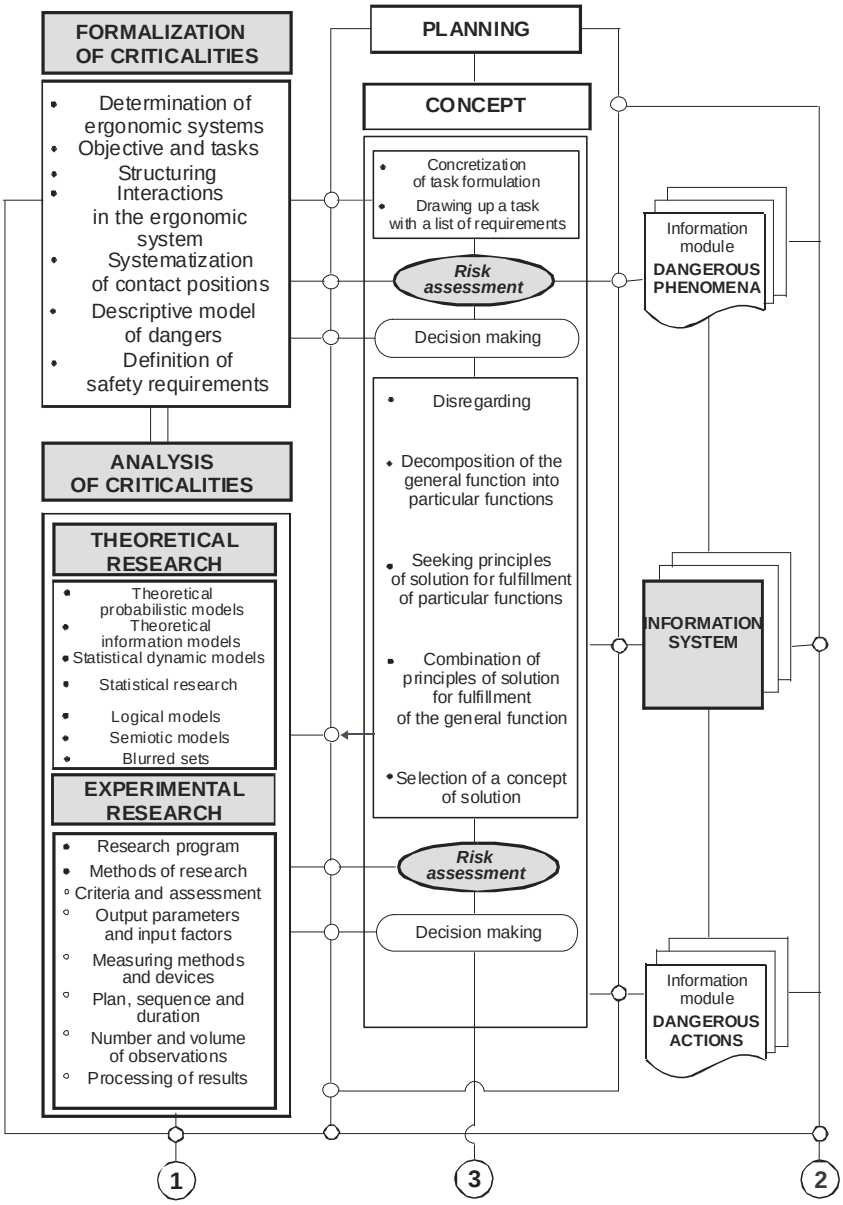

Fig.1. Integration of technology for risk management and process of design of production systems

The basic requirements, which can be formulated for that technology, are:

- objectivity;
- pragmatics;
- universality regarding its application in various systems;
- implementation in different phases of production processes and the life cycle of products;
- coordination with the state-of-the-art achievements in safety and known natural laws;
- experimental check ability and provability;
- limitation and reality of assumptions;
- logic.

The well-argued and adopted morphological model of criticality [1,2,6,8,11,12] of production systems treats it as an accidental process in the course of time. Variation of each characteristic of its components predetermines different value, which requires adequate form of control.

To achieve its basic aim, the technology of safety shall have such totality of logical and transforming rules, which shall allow influencing the process of ergo and eco-dangers, running in production systems. Therefore a logical and transforming procedure is necessary.

Because the number of possible actions on dangers is final, then the set of possible critical situations and events shall be divided into n-classes. To each class of critical situation – differential danger, respectively dangerous events, corresponds a specific solution or class of solutions [5,7].

The above means that it is necessary to have appropriate technological operation, which shall classify criticalities in such a way that they will form such number and such kind of classes that correspond to the possible actions for prevention, reduction and compensation [9]. This procedure shall be called a procedure of classification. When a criticality is not examined enough and is not known in details, then it may be

included in a close class, for which the action and the solution is known.

Some classes of criticalities may be identical to some extent. Then the problem occurs with the selection of one

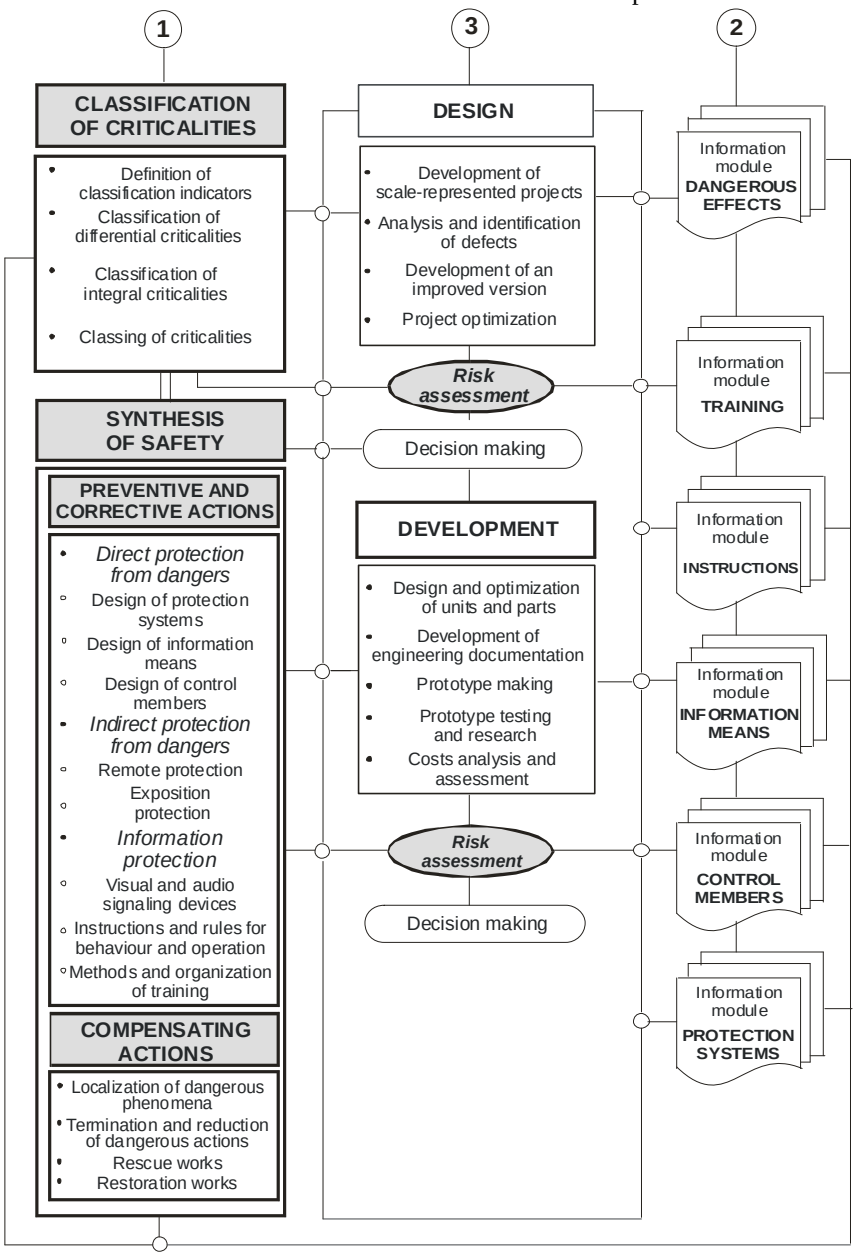

Fig.2. Integration of technology for risk management and process of design of production systems - continuation

solution or another of all possible solutions. For that reason another technological operation is introduced – procedure of extrapolation, in the wide sense of the word, i.e. summarized conclusion based on partial, fragmented data. The application of the procedure leads to assessment of the results from application of a selected action and comparison of obtained forecasts for all possible actions and solutions for a specific complete situation.

When describing the specified procedures it is necessary to specify that an operation shall be introduced for description of current critical situations and critical events. This operation is called as a formalized description.

The results of this procedure shall be analyzed, which should be done by an analysis procedure. By this procedure the necessity of making a specific solution for influencing the criticalities is assessed. If this is not necessary, it means that safety of examined production systems is obtained.

In the opposite case the formalized description of the current situation is subject to a classification procedure. Based on the existing information, the current information is referred to one or several classes of tasks, which shall be solved.

This information is processed through logical-transforming operation. When there is only one class of actions and solutions, then influencing on criticalities follows. In case if there are several logical-transforming rules, the procedure of extrapolation is applied. The decision of logical-transforming procedure is made based on the results of it.

In case if the decision cannot be made using the last two procedures, the information about the current situation is subject to a procedure of random selection. Its application leads to the selection of such a protective action, which may be an individual subjective solution, solution that is not efficient enough or protective action may not be applied at all. The use of this procedure shows that the technology of safety does not have the required information and protecting ability regarding a specific critical situation.

The basic stages of the technology are:

I. Formalizing dangers;

II. Analysis of dangers;

III. Classification and rating of dangers;

IV. Synthesis of safety;

V. Information assurance.

Stage I- Formalizing dangers aims at describing dangers completely enough. It is a basis for developing and undertaking protective actions and for establishing information system. Therefore the following tasks shall be solved:

1. Determination of the production system, formulation of system borders, input factors and output parameters, having influence on controllable and uncontrollable parameters;

2. Defining goals and tasks, specifying structure, common and private functions of production equipment;

3. Structuring of technological machines, apparatuses and equipment, decomposition and reporting of material, power and informational interaction between components on the one side and the interaction with a man-operator, with people, elements of nature, etc. on the other side.

4. Systematization of contact positions of objects of influence with the sources of dangerous factors, respectively their immissions and emmissions. It shall be done on the basis of signs, which describe completely the interactions. Such signs are:

a) Interacting couples “man-machine”, “man-work environment”, “man-workable object”, “work environment – nature”, “man-nature”, etc.;

b) Functions:

- management,
- transformation,
- connection,
- accumulation;

c) Workable object:

- substance,
- energy,
- information,
- space;

d) Phase of functioning of the production system:

- intended use,
- technical service,
- repair,
- recycling,
- destruction and other phases of life cycle of products;
- e) Field of interactions:
- management,
- information,
- protection.

5.Descriptive model of dangers.

The model is built on the basis of the morphological structure, created by us – the unity of dangerous events, dangerous actions, and dangerous effects. Each of them shall be adequately described by means of semantic categories, which precisely specify their characteristics;

6. Formulation of safety requirements.

It is expressed as a summary, which complies with either legal and normative requirements and requirements, resulting from previous actions for formalizing dangers. We should mention here the connection of formalizing with the first stage of the design methods – the planning. It ends with concrete definition of goals, tasks, requirements to construction of machines. Thus, for the sake of clarity a common block has been included for assessment and decision-making, for further operation with direct connections and feedback.

Stage II. Analysis of dangers aims at establishing the characteristics of danger indicators, respectively current dangerous situations.

To achieve that aim the technology applies empirical researches and modeling of dangers.

Empirical researches shall be carried out according to preliminary established:

- Research program – type of research; specification of indicators; principles, methods and approaches to performance; place, term and order; required means and personnel; rules for selection, approval and preparation of experiments; normative documentation; compiling, reporting forms, responsibilities and liabilities;
- Research methods – purpose; assessment and condition criteria; input factors and output parameters; methods of measuring; equipment and furnishing; research plan; sequence of performance; normative level; duration; number of observations and volume of sample; methods of processing of results and presentation form.

Modelling is a proven method of danger research. Based on the world experience, as well as on our experience, we explain and create practical tatistical models; theoretical information models; logical models; models of subjective danger; physical models; semiotic models.

Results of analysis serve for formation of information database, which is a basis for approval of a reasonable concept for making the production systems safe. For that reason it is connected with the conceptual phase of design and also with a united block for risk assessment and decision-making.

Stage III – Classification of dangers aims at determining the class of the task that should be solved. Thus classification signs are defined, based on which dangers are classified and rated by events, actions and damages..

Stage IV – Synthesis of safety includes three groups of methods – protective, corrective and compensating actions.

Protective methods aim at preventing and reducing dangerous events – sources, risk factors and their emissions.

Corrective actions aim at limiting immissions of risk factors along the channels of distribution, of space and time co-existence of the objects of influence and immissions.

Compensating actions apply in order to limit damages that already have occurred – physical, chemical, biological.

Applied technology allows designing of new protective actions, as well as using the existing actions that have proven their efficiency in practice. It corresponds with an information system, which provides information for all specific signs of situational danger management.

Risk assessment at this stage is final and is accompanied by the application of the method “costs-benefits”, which is the basic principle of the universally adopted approach ARAL. The conclusion for the optimal solution is based on it.

III.CONCLUSIONS

In general the technology of safety has the cyclic character. It allows for the operational and stage-by-stage return to the previous solutions and for the iterative search of improved solutions. Combining the technology with the methods of design of production processes allows applying constructive solutions and complete technological design of production ergonomic systems.

The application of the presented technology in different productions [1,2] has proven its efficiency.

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