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METHODS OF SOFTWARE RELIABILITY RESEARCH

O.I. SCHEPOTYEV, ***Ph.D.***
A.V. ZHILTSOV, ***PhD***
V.V. VASYUK, ***postgraduate****

The question of the reliability of the results obtained at each stage of the study.

Reliability, research, research object, the object of research, the method of observation, comparison, experiment.

Scientific research – the process of development of new scientific knowledge, a type of cognitive activity. Conducting research certainly makes it necessary to solving the question of their truth, ie as confidence in their results accuracy.

The aim – disclosure of the concept of reliability research, establishment of proof methods and ways to ensure it at every stage of research.

Materials and methods research. *Reliability* research property - research results objectively reflect the actual behavior of the object of research.

It is determined by a variety of factors that reflect the actual state of the object of their research early to get results during both theoretical and experimental studies.

Methods proof of authenticity can be grouped into three categories:

- policy;
- experimental;
- verification practices.

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* Supervisor – PhD A.V. Zhiltsov

Analytical methods are the most "powerful", their essence - the dissemination of results (theorems, lemmas, formulas, laws) through mathematical transformation. These methods are used when constructing mathematical models of the phenomena under study.

The essence of the experimental methods of validation is playing on a physical model of the phenomenon and comparison of theoretical and experimental results.

The reliability of scientific research results provided by:

• consideration of a reasonable number of factors that influence the solution of scientific tasks;

• the use of reliable baseline data that was collected from theoretical and experimental studies;

• reasonable choice of basic assumptions and constraints in the formulation of scientific problems productions;

• the use of modern, proven scientific methods (mathematical) system;

• justified correct choice of used general and partial indicators and criteria mathematical models;

• coincidence of theoretical and experimental studies.

The reliability of scientific research results confirmed:

• the results of mathematical, physical modeling, experimental data, physical tests;

• high similarity of the theoretical (analytical) results with the experimental data with the results of physical tests and practical implementation;

• similarity of simulation results with experimental data;

• receipt of an overall research results known partial results;

• the results of research and design development, experience of practical implementation of proposals;

• the results of experimental tests of technical and organizational solutions offered;

• availability of clear physical interpretation of the results.

In general, it is determined reliability of the results obtained at each stage of the study. Any scientific study can be represented by the following logic [4]:

• justify the relevance of the theme;

• setting goals and specific objectives of the study;

• definition of the object and subject of study;

• selection methods (methods) of the study;

• description of the study;

• Formation of results and discussion;

• report writing and evaluation of the results.

Justification topicality begins with coverage problems is controversial situation in science, which requires a solution [2].

Previous issues of formation begins with a detailed study of the system, information flow, check symptoms in documentary form.

Regardless of the nature of the research goal always belong to two categories - the stabilization and development.

The purpose of stabilization to maintain or support existing resources (time, energy, equipment) or conditions, such as security. Thus, they can be called inputs solutions. The purpose of the acquisition is aimed at obtaining resources or conditions to be achieved. Actually - it outputs thereof. Thus, the purpose of research can always be expressed in terms of maximizing the difference between the output and the input, ie profits in general.

The implementation of possible solutions of results in different outcomes. For comparative assessment of the quality of each possible solution should justify the choice of appropriate indicators or performance criteria (criteria of optimality).

Index – qualitative or quantitative characteristics necessary for evaluating individual properties or set object properties.

Criterion – a necessary and (or) sufficient indication, based on which the assessment (classification or the selection of the values of a criterion index (simple criterion) or more parameters (complex criterion)).

The scientific problem can be formulated as follows: for a given fixed values and characteristics of uncontrollable factors $A_1,\ldots,A_p,Y_1,\ldots,Y_q$ taking into account the uncertain factors $Z_1,\ldots,Z_r$ find the optimal values of controlled factors $X_1,\ldots,X_l$ з областей $\Omega_{x1},\ldots,\Omega_{xl}$ their valid values that provide the opportunity for maximum (minimum) value of the indicator (criterion) optimality *F*.

If possible use a single indicator (criterion) problem called odnokryterialnoyi or single-purpose. In other cases, there are Multicriteria (Multipurpose) problem. Optimality criteria often are called of criteria or objective function. When choosing the appropriate method for solving problems using separate classification features:

• the number of goals that are pursued in solving problems, and appropriate criteria optimization;

• depending on the presence or absence optimality criterion disciplining and conditions from time to time;

• presence of random and uncertain factors that influence the outcome of the solution (a sign of "certainty-uncertainty risk").

For the *first task of classification* criteria are divided into two major classes: odnotsilovi (singlecriterion) and multi (multicriteria) problem.

In the *second task classification* criteria are divided into static and dynamic. Static tasks by criteria function and function restrictions are independent of time. In dynamic problems, on the one hand, as the optimality criterion is certainly not a function of time and functionality, which describes the behavior of some dynamic objects. On the other hand consisting of disciplining conditions present differential relations as a function of the behavior of dynamic objects in time.

A *third problem of classification* criteria are divided into three major classes:

• determination decisions under certainty, that determined the problem;

• identifying solutions at risk, ie stochastic problem;

• determination decisions under uncertainty.

In the first case, there is a clear connection between deterministic solution adopted and its outcome. This optimality criterion and disciplining conditions depend only on fixed deterministic factors are not controlled, but fully known to the operator.

In the case of risk (stochastic problem) every solution can lead to one of a plurality of possible outcomes defined probability, which are known in advance.

To justify Quantitative research is always necessary to build a model of the object. Of course the model used three types of graphic (geometric similarity model), analog and symbolic (mathematical).

In figurative models are essential properties of the original by these properties are usually only a different scale.

In analog models set some properties used to display completely different properties.

In symbolic models display variables and relationships between them by using letters, numbers and other characters (characters). These models have the form of mathematical expressions (equations or nerivnyan) that describe the structure of objects modeled.

Depending on the complexity of the system using various principles of models: direct analysis of the system, the use of analog data analysis, experiment on the system, the use of "artificial reality".

To implement multilateral describe the research object must perform the procedure of fixing his subject the parties and synthesis of these parties into a single image of the object of research.

The object of study is the subject areas (subject) or some of the science subject area, a process or phenomenon that creates a problematic situation and selected for the study.

Subject of investigation – this side of the object in question in the survey, it is contained within the object. The object and purpose of the study, as a category of scientific process, relate to each other as total and partial. Multilateral description of the object of study can not only determine the place and role of the research subject in house research and establish relationships with other parts of the facility as a whole.

Method – a set of methods or operations of practical or theoretical understanding of reality, subordinate to solving a particular problem. This is carried

out comparative evaluation of existing methods that can be used for research under conditions that are considered to reflect the new (additional) factors and indicators (criteria).

The methods of theoretical studies [3] include abstraction, analysis and synthesis, induction and deduction, modeling, system approach, decomposition, historical method, analytical research (linear programming, dynamic programming, analysis of input and output signals, statistics and probability theory, theory queuing, game theory, the theory of Monte Carlo, etc.). The methods of empirical research - observation, comparison, measurement, experiment.

Observation – a systematic study focused research facility. As a method of knowledge, it allows you to get information leading to a set of empirical claims. In applying the method of observation is determined by the source object of scientific study.

Comparison – the process of establishing similarities or differences of objects and phenomena. This may find general differences inherent in two or more objects. Comparisons can be made directly or indirectly through the evaluation of any other object (standard). In the first case, of course, get quality results (more - less above - below), the second is the possibility to obtain quantitative characteristics.

Measurement – the definition of the numerical value of a certain size using units. It requires a measurement object, reference, instrumentation, measurement methods.

Experiment – a method of studying the object on which the researcher actively and purposefully affect it by creating artificial conditions or use of natural conditions necessary to identify the properties.

To ensure reliability [5] experimental results must solve a number of important questions: • set the number of objects trials;

- set the duration of the experiment;
- establishing the conditions of the experiment;
- the scope, content and plan the experiment;
- determination of the evaluation of the experiment;

• determination of the similarity of the experimental results and theoretical research;

• develop a set of measures to improve the object of research and others.

The measure of reliability is the probability that the report on the state of the system (product), after control is true. It consists of a methodology and tool reliability. Articles reliability mainly depends on the completeness and reliability of the control object control. Completeness control - methodological component reliability, which is characterized by the ability to bounce expression of this product with the selected method of control of its technical condition. Size completeness of control can be defined as the ratio of the amount of information In_k, which is obtained as a result of control n_k parameters to control the object a priori entropy $H_0(M)$.

$$\mathrm{H}_0\ M_H = -\prod_{i\in M_H} P_i \log_2 \prod_{i\in M_H} P_i - \left(1-\prod_{i\in M_H} P_i\right)\log_2\left(1-\prod_{i\in M_H} p_i\right) \qquad (1)$$

– entropy set M_H функціональних object elements that are not under the control of n_k options; P_i – probability of the i-th element; M_H – set of elements that are under the control parameters.

Instrumental reliability depends on the error (precision) of measurement parameters and reflects the degree of objectivity display the results of measurements of actual technical condition of the product.

As a result, errors measuring tools to obtain test results "normal" is possible when the true value of the parameter is "normal" (event X, X^*), and if the actual value of the parameter is "not normal" (event $\overline{X}, X^*$).

Similarly, getting test results "not normal" may in the exercise of events $\overline{X}, \overline{X}^*$ or events $X, \overline{X}^*$.

Therefore, we can write:

$$P(X,X^*)+P(\overline{X},X^*)+P(\overline{X},\overline{X}^*)+P(X,\overline{X}^*)=1, \qquad (2)$$

where $P(X,X^*)$ – probability of a correct conclusion on the results of system performance monitoring; $P(\overline{X},X^*)$ – probability "skip" failure (error "first order"); $P(X,\overline{X}^*)$ – probability of false rejection (error "second kind"); $P(\overline{X},\overline{X}^*)$ – probability of a correct conclusion disability system.

As a result of measurement of the parameter in the control of possible significant variations in results. In this case, the approximation using the following methods: Method selected points method medium, the method of least squares.

If on the basis of statistical data necessary to test the hypothesis of the involvement of a random variable (ie uptime engine) any specified distribution law, using as differences characterizing the degree of difference between the values of the theoretical and statistical distributions. In practice, the most commonly used criteria for approval Pearson «criterion X^2» Kolmogorov and criteria.

To ensure the reliability necessary justification and proof-of each section of research methodology.

Methodology – serial reasonable description of the method of targeting research facility to obtain the desired result [5]. The main elements of research methodology include: composition and performance criteria for scientific problem solving under review methods of the indicators in question and verification criteria, methods of obtaining baseline data for the study of technical implementation, simulation and calculation, processing and filing received results and methods of experimental verification of research results [1].

To specify each element method and sequencing of actions to produce the desired result developed algorithm of targeting research.

Algorithm – focused strictly defined sequence of rules, which provides the solution to all problems of this class.

Evaluation of the results of scientific analysis covers the subject of studies using the selected methods study (synthesis) based on the results of the analysis of practical conclusions and recommendations, methods and results of experimental verification of the conclusions and recommendations of the object with its efficiency studies using established methods.

To test the accuracy of the results is carried out:

• evaluation of the accuracy applied the scientific method;

• assessment of the assumptions and limitations imposed by development (selection) models, methodologies algorithm;

• estimation errors of computation in the implementation of the algorithm;

• comparison of the obtained solution with the results obtained by alternative methods, algorithms;

• comparison of the obtained solution with known scientific results described in the scientific literature.

The final step is the research findings that contain something new and significant, which is scientific and practical research results.

Scientific results – this knowledge, the appropriate requirements of novelty, validity and practical value. Scientific results are divided into two types: theoretical and methodological (methods, techniques, other elements of scientific and analytical tools) and factual (scientific facts, scientific advice, research findings). The best form of scientific result is a law or rule.

Conclusions and evaluation of results from scientific includes analysis of the subject studies using selected methods of research, study practical conclusions and recommendations, analysis of the importance and novelty of the conclusions and recommendations, assess the completeness of the solution of the task, the assessment of the reliability of the results and their comparison with the results local papers, the grounds for further research, evaluate the effectiveness of the proposed new guidelines.

Results. The resulting new scientific results should meet the requirement of novelty, a valid scientific significance and netryvialnosti, the possibility of obtaining this result using known scientific and analytical tools. Scientific novelty of the results is formed as a brief abstract for a new contribution to the study of relevant scientific task. It should show their difference from the known scientific results, and describe the degree of novelty. The reliability of scientific innovation can be confirmed information about the fact that the ideas that made the author received copyright

certificates and patents. This confirms unfair world novelty of the proposals of the author, which officially recorded state patent examination.

In revealing the presence of scientific significance of the results should be separated, which is a contribution to the science and practice, and the results are a contribution to the practice. The first of them focused on the use of outcome researchers and practitioners, the second - only for use practices.

The requirement netryvialnosti new scientific result needs a complex process of creative research, which is associated with overcoming stereotypes, with the rejection of the usual schemes and concepts that impede the achievement of the given scientific problem. In conducting this search and study a set of selected elements proposed by the authors of scientific and analytical tools in their logical interrelationship and interdependence defines a separate scientific method as a tool to perform research and concrete way the study is found in a particular procedure.

Conclusions

All the new provisions, conclusions and recommendations are derived in sections and work as a whole, must be reasonable and reliable. This is largely determined by the selected mathematical tools.

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Рассмотрены вопросы достоверности результатов, полученных на каждом этапе проведения исследования.

Достоверность, научные исследования, объект исследования, предмет исследования, метод наблюдения, сравнение, эксперимент.

The problems of reliability of the results obtained at each stage of the study.

Accuracy, research, research object, the object of study, observation method, comparison, and experiment.