Suggestions for improved dependability-related terminology

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Abstract. Aim. *This article aims to eliminate the shortcomings associated with the application of the conventional, yet insufficiently substantiated terms in the GOST 27.002-2015 interstate standard. Correct understanding and use of terms are of great significance for the activities of dependability experts.* **Methods.** *Shortcomings in terminology are eliminated by clarifying the definitions of the used terms. Several terms used in this standard were submitted to logical and terminological analysis that is based on statutory requirements and the semantic meanings of such terms. The premises were set forth in [8].* **Findings and conclusions.** *Definitions of several new terms, as well as those that do not meet the identified requirements are suggested: "dependability theory", "dependability estimation", "dependability calculation", etc. The expressed considerations could provide the foundation for the adoption of agreed (compromise) solutions.*

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Introduction

The paper aims to formulate substantiated suggestions for clarifying certain terms and concepts of the standard [1]. The paper substantiates the definitions of a number of terms and concepts that, in the author's opinion, could provide the foundation for the adoption of agreed (compromise) solutions.

Source overview

In [10], the author correctly observed that technical standards require preliminary elaboration in terms of humanities. As the result, a set of agreed and consistent terms should be substantiated.

In [11], unorthodox approaches are set forth to the matters of technical item dependability in terms of design and development.

In [8], the requirements are defined for the used terminology in terms of internal logical consistency and specific terms are identified, whose use violates such requirements. Such terms include: "methods of dependability definition", "dependability estimation", "state of item".

In [8], the concepts are defined that are referred to in the name of the standard [1]: term, definition, dependability.

Term, a word or phrase that clearly designates a certain concept used in the field of dependability.

Definition, a wording that clarifies the meaning, content, essence, primary characteristic features of the terms using known and meaningful words.

Dependability is the property of an item to maintain in time the ability to perform the required functions in the specified modes and conditions of operation, maintenance, storage and transportation.

The definition of the term "dependability" is according to the standard [1]. It defines the essence of the term and its content as a property. This definition is unambiguous. No other interpretations, methods, variants, varieties of the definition of the term "dependability" must exist.

Methods

Besides the requirements of [8], the definitions of terms should include features that reveal the substance of the terms.

A new term – "dependability theory" – should be added to the basic concepts. This term is well-established and generally accepted. There is a number of monographs and textbooks entitled "Dependability theory". This term should also be used to define other dependability-related terms. Therefore, the term "dependability theory" should be included in the state standard.

Dependability theory: a set of scientific provisions that describe, substantiate and explain the principles, laws and correlations of phenomena in the field of dependability.

In [8], it was noted that the term "State" was used in the title of Section "3.2 States", yet it was not defined. Additionally, the term "State of item" is not defined either. The most appropriate terms associated with the states of items is "Technical state of item". The term and its definition are given in standard [2]:

Technical state of item (technical state, state of item, state): a set of properties of an item that is subject to changes in the course of its manufacture, operation, transportation and storage, characterized by parameter values and/or qualitative characteristics defined in the documentation.

In the author's opinion, the term "Technical state of item" should be made a basic concept and – along with its abbreviated forms – used in other sections of the standard.

Important terms are those that are associated with dependability calculation and its methods. The terms "dependability calculation" and "methods of dependability calculation" are used in reference and research literature, but they are not defined in the fundamental dependability-related standards. Let us definite those terms as follows:

Dependability calculation: mathematical calculations for the purpose of obtaining numerical values of dependability indicators of an item according to the rules established in the dependability theory.

Method of dependability calculation: a special technique or system of techniques for dependability calculation based on the laws substantiated in the dependability theory.

In accordance with standard [3], the terms are divided into two types, i.e., probabilistic and statistical. That means that dependability calculations can be based on the methods of the probability theory or mathematical statistics. Hence, the methods of dependability calculation are divided into two main classes, probabilistic and statistical. On the basis of the probability theory, the values of dependability indicators are calculated in terms of the properties of the entire assembly, while based on mathematical statistics, they are estimated according to sample observations of a certain set. Naturally, this does not rule out joint use of the probabilistic and statistical methods.

So, two classes of dependability calculation methods should be identified.

Probabilistic methods of dependability calculation: the methods of calculating dependability indicators based on the probability theory.

Statistical methods of dependability calculation: the methods of calculating dependability indicators on the basis of mathematical statistics.

Note 1. Those terms can be formulated differently, for example: methods of dependability calculation based on the probability theory/mathematical statistics.

Note 2. Those terms can replace the terms in [1]: the computational method for determining dependability, the computational and experimental method for determining dependability, the experimental method for determining dependability.

Note 3. The probabilistic and statistical methods can be used to calculate not only dependability indicators, but also various characteristics of random events and random values used in the field of dependability.

It should be noted that the term "statistical methods of dependability calculation" is used in [11].

Probabilistic methods are used to calculate the probability of random events and numerical values of dependability indicators that are numerical characteristics of random values. The dependability theory provides various probabilistic methods of dependability calculation that are set forth in monographs, manuals, textbooks and research papers. The standard [4] is dedicated to methods of dependability analysis (calculation). The specificity of methods based on the event tree and flow chart analysis have been examined, the Markovian, Petri net and other methods have been considered. The application of the Markovian methods is described in the standard [6], including the conditions of application, construction of state-transition diagrams, formulas for calculating the dependability of specific circuits. The standard [5] sets forth block diagrams on whose basis dependability is calculated, considers Boolean methods, the reduction method, etc. The subject matter of the author's research activities is the development of matrix methods of dependability calculation [9].

The standard [4] identifies statistical methods of assessing the probability of no-failure, defines the areas of their application and advantages. The statistical methods include Bayesian, Monte Carlo and others. The general terms associated with the statistical methods are set forth in standard [3]. The statistical methods are used for dependability indicator estimation.

The primary statistical terms include "estimate" and "estimation of dependability indicators".

Estimate of dependability indicator: the numerical value of a dependability indicator calculated from sample data.

Note: an estimate of dependability indicator is random and can take different values from sample to sample.

Estimation of dependability indicators: an operation that consists in obtaining (calculating) the numerical values of the dependability indicator from sample data.

Note 1. A dependability indicator is estimated based on statistical methods of dependability calculation.

Note 2. The purpose of an estimation is to obtain an estimate of a dependability indicator.

Discussion and conclusions

The paper sets forth specific suggestions for improving the dependability-related terminology. The author only considered a limited number of terms. The primary terms should include "dependability theory", "dependability calculation", "dependability calculation method". The definitions of the terms "technical state of item", "dependability estimate", "dependability estimation" were clarified.

The author hopes that the publication and discussion of the above suggestions will enable a stricter approach to the wordings of the dependability-related terminology standard.

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The author's contribution

The author conducted a terminological analysis of the fundamental dependability-related terminology standard and defined certain terms. The expressed considerations could provide the foundation for the adoption of agreed solutions in this area.

Conflict of interests

The authors declare the absence of a conflict of interests.