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About Philosophical Sense of the Category “Reliability”

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Abstract—The study of the philosophical significance of the category reliability is necessary due to the fact that without this category dialectical analysis of reality is impossible. The solving the fundamental problem of reliability goes beyond the management of technical - economic (cybernetics) world of humans on planet Earth. The article focuses these problems.

Index Terms— Reliability, Cybernetics Management.

I. INTRODUCTION

The term, “reliability” is deeply connected with the human lexicon. It is used by people in their daily circulation. It is used in literature as well as in research. Using this word people talk about the reliability of this or that property or subject, reliability of the materials obtained in the course of production, reliability of the cyber system, rocket or space station, reliability of work of the person or community.

In one of the most representative dictionaries, The Oxford English Dictionary the term reliability is explained as „the quality of existence of reliable and hope” [24]. If we lookup in the computer dictionary Google [26] we find in the free encyclopedia Wikipedia that the reliability of engineering systems means the following, “Probability to keep the system with certain quality characteristics during the relevant time period and under the conditions of functioning”.

In the Dictionary of the modern Russian language the term „Probability” is defined as follow: Reliability – this is a property of the reliable [15] and in the fundamental work of Georg Wilhelm Friedrich Hegel “Encyclopedia of the philosophical Sciences” it is recorded as “The nature-philosophy (Physics) is explored in the nature concept, it is subject to the same general, for itself, and consider it in its own immanent need according to the self-determination of the notion of reliability” [10].

Under the „trustworthy person” all reasonable people understand the man, who we can trust, i.e. suggesting respect, faith and even love to the people. There are definitions and art definitions for a trustworthy person, related the presence of “goodness”, “beauty” and “honesty” [1, 3, 4, 6, 10, 22].

In terms of modern scientific and technical progress the term reliability acquires mathematical, logical and technical aspects. Thanks to that it is possible to connect it with some quantitative characteristics of reflected in it philosophical phenomenon “reliability”. As laid down in the above definition for reliability of engineering systems like “likely to keep the system from certain quality specifications over the relevant interval of time and at such local operating conditions” is used as a general definition [8, 9].

In the technical sciences the language of the theory of reliability and the mathematical statistics is used. Because of that the category reliability has a specific meaning. It is determined by so-called Basic Law of the Reliability that defines the probability function of fail-safe operation $P_{BP}(\Delta t)$ of a system in the monitoring interval $\Delta t = t_2 - t_1$ according the equation [3, 8, 9, 20 - 22]:

$$P_{BP}(t_1, t_2) = e^{-\int_{t_1}^{t_2} \omega(t) dt} = \exp\left[-\int_{t_1}^{t_2} \omega(t) dt\right], \quad (1)$$

where $\omega(\Delta t)$ is the intensity of the stream of rejections in the scene interval from time $\Delta t = t_2 - t_1$.

It is important for us to note that the main contribution to the development of reliability concept of as a "category" in the Bulgarian engineering is this, which is formulated by Prof. Dr. Sc. Eugene Gindev. He defines and extends the meaning and importance of reliability as the key indicator for improvement and technical development while systems and technology [8].

Thanks to the strong technical sound of reliability, the majority of the specialists as well as some modern philosophers consider that this concept, in principle, purely technical, is related to the natural sciences and philosophy. The role of the phenomenon “reliability” for contemporary natural sciences is determined its heuristic



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value. In this sense, this role involves basic theoretical and philosophical analyses. Reliability problem is the study subject of a number of sciences as well as cybernetics, bionics, technical theory of reliability, mathematical theory of reliability, information theory, automatic theory, neuro-physiology, engineering psychology, etc.

For its successful resolution it is necessary to develop new methods and quantitative theories about the reliability of complex systems and automatic systems with the bio-social structure. The analysis of the reliability has a connection with the analysis of the functionality, system design, hardware and software design, production testing, maintenance services, transportation, provision of spare parts, technical documentation and qualitative human factor [19, 20].

It is important to point out that reliability is an essential component of social systems. We can't imagine the public being, beyond the sphere of information relationships. In a more specific plan it is necessary to analyze the reliability of the system "man-machine". From the special features of this system follow the controversies which take part in the formation of the spiritual world of a person. These special features represent the factor that leads to the need of a concept analysis of the term "moral credibility of the individual and the society" and related technical and economic risks.

In this context the utmost importance is the development of a number of different concepts and strategies for risk assessment and management of a scientist by Republic Bulgaria Acad. Prof. Dr.Sc. Ivan Popchev, and research in this area [16-18]. Therefore the phenomenon reliability is up-to-date both systems of living nature and the socio-economic, technical and the humanitarian sciences.

II. THE PHILOSOPHICAL DIRECTION OF THE PROBLEM OF RELIABILITY

Phenomenon reliability occurs at many levels of the structural organization of matter. It reflects the essential properties of the real artificial and natural systems, as it contains important ontological aspect. The presentation of this concept in mathematical form by formula (1) allows its analysis in the process of use (operation) of the technical, economic, social, biological, and other systems. From a qualitative point of view we can introduce the following definition for reliability in the ontological sense: Reliability is a property of systems, manifested in their ability to operate effectively. This efficiency is expressed by stability of the basic parameters of the system regarding the relevant monitored time interval" [12, 13, 19, 22]. The reliability has philosophical meaning characteristic for the sphere of gnoseology. This follows from the definition: "Reliability of the systems is characterized according to the gynecological aspect. The degree of understanding of this term, depending on very real factors determines the level of coverage of controversial trends in the reality. Scientists dealing with natural sciences, turning to questions of gnoseology and methodology of science, sometimes they use categories that have not yet found a place and recognition in the social sciences. This particularly considers the term "reliability" [22]. Very interesting is the following statement by Albert Einstein: "Scientific truth is distinguished from waste fantasizing only by the degree of reliability, by which can be made relevant research. In this statement of the great scientist we can notice the use of the term "reliability" to solve the gnoseological problem of the scientific truth.

III. GENERALITY OF THE RELIABILITY

Generality is the first feature of the philosophical concepts and categories. However, as noted by Prof. P. Kopnin scientist of Ukraina, we must remember that „the dissemination of the contents of any concept on the phenomena, belonging to different fields (natural, social, etc.) is not a sufficient indication of a philosophical category [13]. In order to be a philosophical category the term "reliability" must satisfy following conditions [22]:

Presence of the reflection of matter or reality;

Presence of the second category, which is inflected with the first (in this case the reliability is the first category);

Relationship rank between both categories must be connected with a special dialectical law.

The implementation of the first condition for the philosophical category is ensured by the ontological definition of the phenomenon reliability that was shown above. The confirmation of the second sign for a category is done by the following claims. For all physical and chemical interactions in the nature there are two trends expressed by the characteristic dialectical terms – reliability and violation (failure). In purely philosophical aspect these terms are analogy of the duality – truth and untruth.

It should be noted that the reliability is associated in our mind with the terms "efficiency", "sophistication", "beauty", "stability", "noise immunity", etc. But there are no ideal objects or features in the world. For this reason as a result of aging caused by internal and external factors the abnormalities appear in the structure of the systems. They are expressed in the events of failures, faults, mistakes, injuries, diseases, fluctuations, mutations, noises.



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In living biological organisms, in general, the ideal conditions do not exist. The disease of all living organisms is the manifestation of a trend towards violation of a certain way of functioning [12]. However, it should be borne in mind that the problem "reliability" which exists in technical systems is not analogous to biological reality (humans, animals and plants). For this reason biological systems are capable of restoring the non-relevant features and even they have the ability to report about the trend of dangerous diseases. For example, if some brain neurons are "blocked" by the onset of the disease, the nerve fibers form new compounds which fully or partially reimbursed dysfunction of control and communication. This function for communication establishment is called "adaptation" and it is the most important property of the neurons and their networks [25].

As it is well known the humans constantly monitor the existence of trends for reliability and violations in the systems of the living nature. It is too important to clarify in what respect are those trends in natural self-organizing systems. In the field of life as well as in any other area of reality these opposing trends are in respect of intransigence and fight (to verify the law of unity and struggle of opposites).

A similar interaction of reliability and violation (the refusal) is observed in qualitatively different systems, in particular in the artificial cybernetic and economic systems. Therefore, the reliability and the violence exist in a dialectic relationship. It can be argued that the trend of existence of reliable state is impossible without the trend for the occurrence of the violation (failure).

The main equation of reliability of systems follows, i.e., the sum of the probability of reliable (fail safe) job (state) $P_{EP}(\Delta t)$ and the likelihood of a violation (the refusal) $Q_0(\Delta t)$ is equal to the entity in the interim interval of observation Δt [3, 8, 20]:

$$P_{EP}(\Delta t) + Q_0(\Delta t) = 1 \quad (2)$$

On the basis of this short philosophical analysis we identified following lemmas:

Lemma 1: Reliability is the first major philosophical category of all kinds of forms of matter, its material and ideal shapes and their interaction. The second category that is conjugated with it is the category "violation" (destruction, failure and its consequences).

Lemma 2: The nature and interaction of the reliability (right) and violation (the refusal) are in accordance with the Hegel's "Law of unity and struggle of opposites". The interaction of these two categories leads to universal "Law of quantitative and qualitative changes in the nature of planet Earth and in the Universe".

IV. ABSOLUTENESS AND RELATIVITY OF THE RELIABILITY

Aristotle wrote the following: "... it is difficulty, in what regards the matter, in this or that form, stand as mutually opposing categories. For example, if the human body is tight (in terms of disease), and we all know the health is the opposite of the diseases the possible states of the body and his soul are two - healthy or sick! [1].

Dialectic of "this or the other", "health or illness" is characteristic of the interaction between the reliability and the violence. Therefore, "It is not possible the existence of absolute reliability of the forms of matter".

Reliability is relative and it is best seen from the fundamental work of Georg-Wilhelm Friedrich Hegel "Encyclopedia of the philosophical Sciences", part 1 and 2. Hegel wrote: "Actually, everything is relative (for example, positive and negative, body and soul). They have sense only in their relationship, not any of them considered it "[10]. Such reflections there are even in the writings of the Chinese philosopher Confucius and ancient Indian philosopher Kapila, the creator of the doctrine "Sankhya".

Notable philosophical productions there are in the work of Prof. Dr.Sc. Eugene Gindev [8, 9]. In these works, it is shown that "It is possible in the technological practice from relatively little reliable elements to construct relatively reliable systems that have greater reliability than the component parts [3]. This is proved by the "boom of modern industry" of the most developed and organized state in the economic and spiritual aspects at the moment, the Republic of China [11].

Reliability issues are relevant to the social sciences that explore the social systems, including "the man". According to E. Dimova, "Any society through the processes of communication is able to self-regulate the interaction between persons. People interact functionally in the society, they always play one or the other role connected with their social position and this way their behavior is understandable, predictable, or reliable "[6].

All my reflections, caused by the works of scientists and art authors give me reason to pin down the following:

Theorem about the relativity of hope for reliability:

"Under the hope in general philosophical and mathematical aspect we can understand the mathematical expectation



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of the values of the main parameters of the objects (tangible and intangible) and systems of objects. In this sense, the need to speak, calculate and analyze reliability arises from the existing opposite ("alien") reliability – a tendency to breach or self-destroy. Without the violation (the unreliability) we had no idea about the existing in nature of phenomenon "RELIABILITY".

Reliability is unthinkable without the occasional infractions committed by people working with machines. Its rating is between 0 for "non reliability" (State of denial or dangerous violation), till 1 for completely reliable (sturdy) object or system of objects — the latter exists only in the theory. Therefore, we should strive to achieve reliability of functioning systems which prevails over the violations (the failures) in them.

V. CONCLUSION

- The reliability of a system is philosophically abstract concept.
- This abstractness can be seen in the system of individual objects of nature on the planet Earth.
- Regardless of this abstractness the concept „reliability” holds a significant degree of concreteness when people consider the conversion of engineering practice (design, testing and operation of the devices).
- Engineering practice is the scientific area that is able to provide organic synthesis of universality and concreteness.

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On 29 September 2009 he is chosen for Professor in Technical University, Sofia. Professor Petrov has been taking part in many scientific congresses and conferences, for example in Miami (USA), Vienna (Austria), Petersburg (Russia), Athens (Greece), Brno (Czech), Lvov (Ukraine), Istanbul (Turkey), Lodz (Poland) and others.

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