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TECHNICAL AND SOCIO-TECHNICAL DEPENDABILITY

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ABSTRACT

The paper presents the dependability concept for technical and socio-technical systems. There are presented their components and their characteristics. It is also presented the human in the context of dependability of technical systems and a human errors classification. Finally it is given a technical system representation highlighting the parameters that could be influenced by the human errors.

Keywords: Dependability, human errors, technical and socio-technical systems

1. INTRODUCTION

Dependability or safety in operation is a basic criterion in the study of behavior of the technical systems, considering the time [1]. The development of the engineering in the last decades allows us to distinguish today a technical dependability, which takes into account only the technical considerations and a socio-technical dependability, which takes into account the influence of human factor on the behavior of the technical systems. Corresponding it is defined a "reliability engineering" and a "socio-technical reliability" [2, 3].

2. TECHNICAL AND SOCIO-TECHNICAL DEPENDABILITY

Technical dependability includes: designing, technological and operational execution that determines the availability, security, reliability, integrity and privateness of a technical system. (fig. 1).

Note that the parameter "reliability" widely used in the study of behavior of technical systems, is a component of the dependability concept. The availability, integrity, privateness are defining the technical security of the system.

The socio-technical dependability take into account the presence of human element participating in the design and technological process phases but mostly in the management, maintenance and working stage. Literature in the field of the human reliability [5] contains very interesting data in the field of technical socio-technical dependability.

Figure 2 shows the structure of the socio-technical dependability concept.

The participation of human factor influences the quality of a technical system, because he is involved in the quality of its three components: design, manufacturing, using. (fig. 3).

Fig. 3. The components of the total quality [11]
Fig. 1. The structure of the technical dependability concept [4]

Fig. 2. The structure of the socio-technical dependability concept
After [6], human reliability has as its object the predicting and preventing of the human error in order to optimize overall system reliability and productivity.

The socio-technical system is defined as a whole made up of people and machines that interact, based on an information network within a given physical and social environment in order to achieve a common goal (or more) within a given time limit.

In [7], quoted in [6], it is outlined a definition of human reliability, similar to the definition of the technical reliability by specifying working conditions and time. According to the authors human reliability is "the ability of an individual to achieve a set of required functions, in given working conditions for a given time."

The definition is broadening for the team or human organization in [8], quoted in [6]. After them human reliability is "the probability of an individual, a team or human organization to accomplish a mission within the limits of acceptable conditions, for a certain period of time".

In [9], quoted in [6], it is inserted into the total reliability of a technical system the “human performance in space and on Earth”

In terms of classification errors, in [10], quoted in [6], there are mentioned five types:
- general (errors through omission, errors during work, delay errors, etc);
- specific and composite, related to the nature of the specific activity where they toke place;
- specific to a domain (computer operating, programming, etc);
- reported to a specific task or particular subtask ("in this case the error is related to a particular task and/or particular subtask and is specific to the considered task structure, but is independent of the subject");
- related to the phases of the task and types of error, in this case "it can highlight more exactly the crucial moments of the work and provide an initial diagnosis of difficulties."

Technical and socio-technical dependability technique are finally defined by the quality of the design, manufacturing and service processes represented by the three spheres in (fig. 3). The intersection of the spheres determines a common area which is the "total quality" of the optimal properties. The dimensions of the area require research in all the three components of the quality.

To study the reliability from technical point of view it is used the concept of "technical system."

The concept of technical system forms the basis of the "machine" one that involves the presence of mechanical energy (fig. 4).

The machine type is determined by the sense of transformation of mechanical power. The machine is the "engine" when it converts a type of energy W (electrical, chemical, wind, etc.) into mechanical energy "M.E" and "generator" to reverse the transformation of mechanical energy into another form of energy "W" (electrical generator, etc).

Transformation of mechanical energy "M.E" into useful mechanical work “U.M.W.” denotes a working machine.

In practice there are systems that are based on other types of energy (electromagnetic) and other fields (biology, social, economic, and so on).

In general it is understand through technical system a complex of functional mechanical units or constructive elements between there are liaison energetically relationships, materials flux or deformations for performing a function. Technical systems can refer to [13]:
- Simple systems, with linear structure and small number of components with given functions (stiffening, assembling and others).
- Complex systems with spatial structures and internal mobile links, with a given number of base elements. In this category are included the systems based on tribological processes, called tribosystems (transmission of movements or mechanical energy).
- Ultra complex or large systems with spatial arrangement and with remote connections (technological lines, etc).

From the constructive point of view the structure of complex and ultra complex technical systems contains components that are static (static systems) and dynamically component (dynamic systems) with given functions.

In general, scientific and technical progress is dependent upon the intervention of the human element. It requires a high preparedness to achieve technical systems with new, exciting performance. Thus the human element must to detect the defects,
to oversee the functioning of the system and to design automatic security devices.

In the most general form, the structure of a technical system (simple or complex) has as input-output quantities: materials, energy and information (fig. 5).

**Fig. 5.** The general structure of a mechanical system [13]

For a complex technical system structure has the form:

\[ S = \{ I, P, C \} \]

where:

- \( I = \{ i_1, i_2, ..., i_n \} \) - number of elements;
- \( P = \{ P(i_j) \} \) – characteristics of the elements;
- \( C = \{ C(i_i, i_j) \} \) - correlation or interaction between the components.

General interaction into system is based on the transformation of the input quantities \( X \) into output ones \( Y \).

**CONCLUSIONS**

In addition to understanding the internal functioning of a technical system is necessary to know the factors that make its interaction with the environment.

Man, being the one who decide on the input, command and control parameters, the error caused by it influences the socio-technical system operation with repercussions on the human and system.

Quality of human activity has a decisive influence on the socio-technical system.

Ignoring the human component of socio-technical systems is one of the major causes of loss of system security.

Human errors cannot be removed, this fact implying reduction measures of its and their consequences.

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