**Mechanical Testing and Diagnosis**
**ISSN 2247 – 9635, 2012 (II), Volume 3, 39-43**

# TECHNICAL AND SOCIO-TECHNICAL DEPENDABILITY

**Ion CRUDU, Constantin SPÂNU, Claudiu TELETIN**

University "Dunarea de Jos"of Galati, ROMANIA

constantin.spanu@ugal.ro

**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, a technical system representation is given, 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 for the technical systems, considering the time [1].

The development of the engineering in the last decades allows us to distinguish 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

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

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

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

Figure 1 (see next page) shows the structure of the socio- technical dependability concept.

After [6], the human reliability has as its objective 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 a 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 the human reliability similar to the definition of the technical reliability by specifying the working conditions and the 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 a team or a human organization in [8], quoted in [6]. After these references, the human reliability is "the probability of an individual, a team or a human organization to accomplish a mission within the limits of acceptable conditions, for a certain period of time".

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

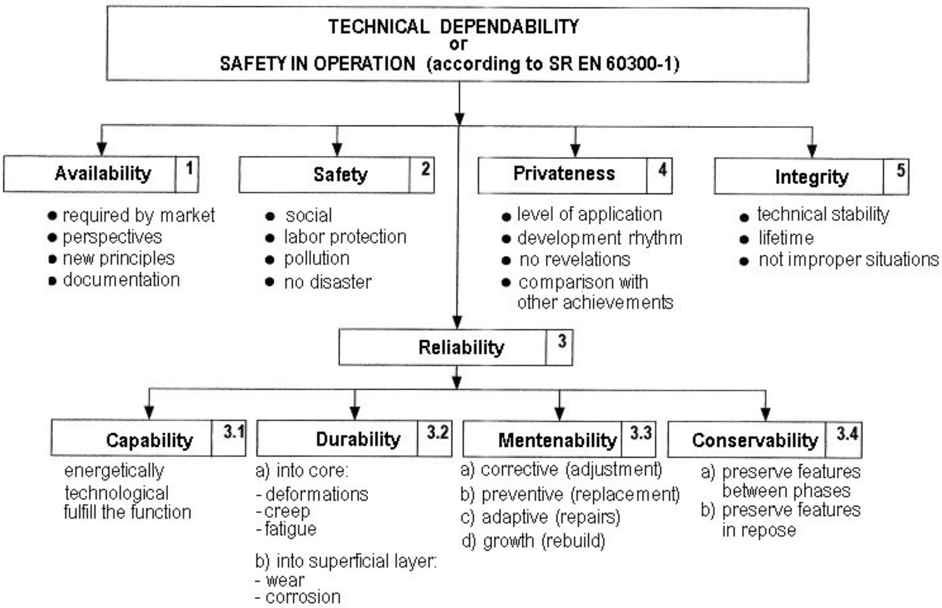


**Fig. 1.** The structure of the technical dependability concept [4]

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

In terms of the errors' classification, in [10], quoted in [6], five types of errors are mentioned:

- general (errors through omissions, errors during work, delay errors, etc.);
- specific and composite, related to the nature of the specific activity where they take place;
- specific to a domain (computer operating, programming, etc.);

Mechanical Testing and Diagnosis, ISSN 2247 – 9635, 2012 (II), Volume 3, 39-43

-reported to a specific task or a 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."

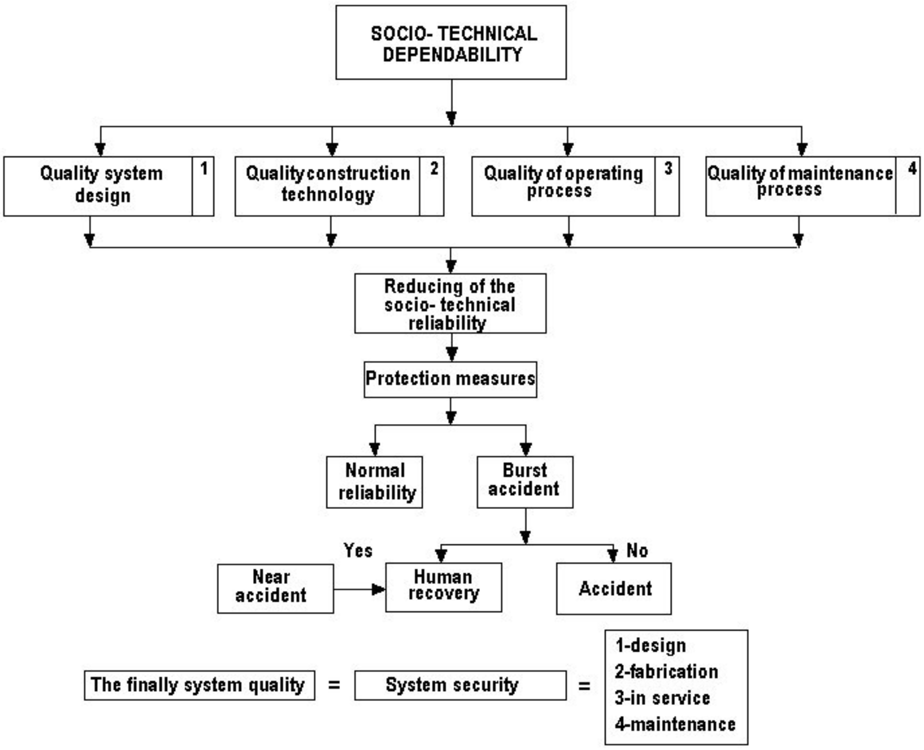


**Fig. 2.** The structure of the socio-technical dependability concept

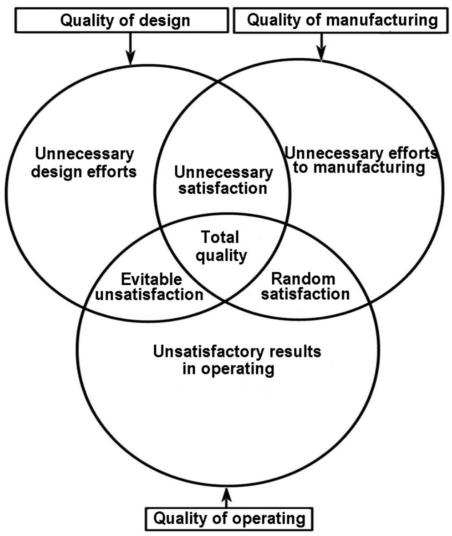


**Fig. 3**. The components of the total quality [11]

Technical and socio-technical dependability techniques 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 ask for research in all the three components of the quality.

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

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

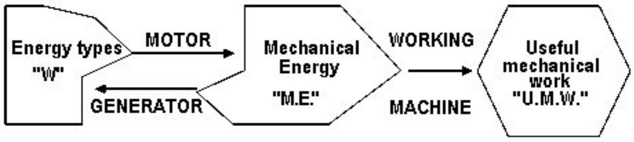


**Fig. 4.** The machine definition [12]

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

The transformation of the mechanical energy, "M.E", into the useful mechanical work, “U.M.W.”, denotes a working machine.

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

In general, it is understand that a technical system is a complex of functional mechanical units or constructive elements, among which there are energetic relationships, materials flux or deformations for performing a function. A 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).

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).

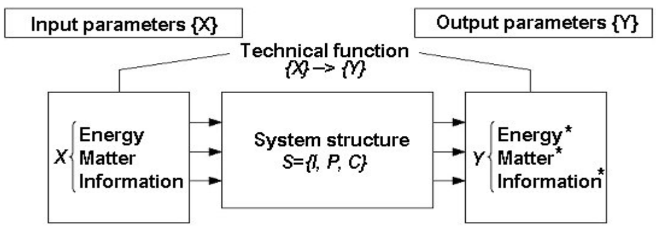


**Fig. 5.** The general structure of a mechanical- system [13]

From the constructive point of view, the structure of the complex and ultra complex technical systems contains components that are static (static systems) and dynamical (dynamic systems), with imposed functions.

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

A complex technical system structure has the form:

$$S = \{ I, P, C \}$$

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

General interaction into system is based on the transformation of the input quantities {X} into output ones{Y}.

## CONCLUSIONS

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

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

The quality of the 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 losing of the system security.

Human errors cannot be avoided, this fact implying measures for reducing their frequencies and their consequences.

## REFERENCES


1. ******* SR EN 60300-1:2006 Dependability management Part 1: Dependability management systems.
2. **Rognin L., Salembier P., Zouinar M.,** 2000, Cooperation, reliability of socio-technical systems and allocation of function, *Int. J. Human-Computer Studies*, vol. 52, pp 357-379.
3. **Rognin L., Salembier P., Zouinar M.,** 1997, Latent Organizational Reliability, in E. Fallon, M. Hogan, L. Bannon. & J. McCarthy (Eds.), *ALLFN'97, Revisiting the Allocation of Functions Issue,* Ireland, October 1-3, pp. 63-71.
4. **Crudu I.,** 2011, Dependabilitatea ca bază în studiul sistemelor mecanice (in Romanian), *Al XXXI-lea Seminar Naţional de Organe de Maşini "Ioan Drăghici" SNOM' 11*, „POLITEHNICA" University of Bucharest, Faculty of Mechanical Engineering and Mechatronics, Department of Machie Design and Tribology.
5. **Afrazeh A., Bartsch H.,** 2007, Human reliability and flight safety, In*ternational Journal of Reliability, Quality and Safety Engineering (IJRQSE)*, vol. 14, Issue 5, pp. 501-516.
6. **Iosif, Gh.,** 2007, Psihologia fiabilităţii umane (in Romanian), Editura Victor, Bucureşti.
7. **Terssac G., de, Chabaud C.,** 1990, Referentiel operatif commun et fiabilité, in J. Leplat et G. De Terssac (eds.). Les facteurs humains de la fiabilité dans les systèmes complexes, Marseille, Octares.
8. **Nicolet J. L., Celier J.,** 1985, La fiabilité humain dans l 'entreprise, Paris, Mason.
9. **Chandler F.,** 2005, Human error and risk management, *NASA Risk Managemenet Conference (RMC VI)*, December 7.
10. **Leplat J.,** 1985, Erreur humaine, fiabilité humaine dans le travail, Paris, Armand Colin.
11. **Crudu I.,** 2003, Fiabilitatea şi calitatea sistemelor mecanice (in Romanian), S.C. F&F International S.R.L., Gheorgheni.
12. **Crudu I.,** 2011, Tribomodelarea (in Romanian), Editura AGIR., Bucureşti.
13. **Angheloiu I., Mincu I., Győrfi E., Ghiţă A.,** 1980, Introducere în sisteme tehnice mari (in Romanian), Ed. Militară, Bucureşti.
14. **Czichos H., Habig K. H.,** 2003, Tribologie Handbuch, Ed. Friedr Vieweg & Sohn Verlag GWV Fachverlage Gmb H. Wiesbaden.