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Ontological design of the concepts of the safety

Abstract: The safety of technosphere activity presupposes the existence of scientific grounds for research and development of an intellectual product in the form of technical regulation standards. The problem of identification of the subject and definitions of aviation safety notes contradictions and inconsistencies in the terms and definitions of existing practiced standards. The solution of the terminological problem is possible through the reduction of the meanings of the linguistic units of the word and the definition of the term. The method of ontological designing in this paper is considered as a scientific approach to reduce the uncertainty in the description of complex structural objects and events.

Keywords: ontological designing, logical analysis, air transport, regulation, safety definitions

Introduction

The ontological design of a subject consists in describing the totality of all concepts included in the object under study and establishing the relationship of these concepts. The concept of "relation" is the main category of the subject of danger. "The subject of research can be precisely safety relations, and from the position of relations it is possible to make a description of the subject area of research" [1].

Generic and specific differences of concepts are established on the basis of dividing the concept of the largest volume according to the signs of parts and are a condition for deriving the definition of the concept [2]. So, designing consists of: (1) establishing **relationships** of concepts, (2) establishing the **basis** of a generic concept, (3) deriving a **definition** of a concept.

Safety model. The subject of (security) is represented as a subset of the subject of danger. Security are objects of natural origin, are created artificially and respond to existing and emerging hazards. According to the concept theory, danger and safety are seen as inconsistent opposite concepts. Since safety is the complete absence of danger, the concept of security has zero volume. Consequently, the concept of security is postulated as identical to the concept of security, and the statements "observation, calculation, control" of safety and security are allowed. The ontological model of the danger space is structured as two spaces and four objects (figure 1).

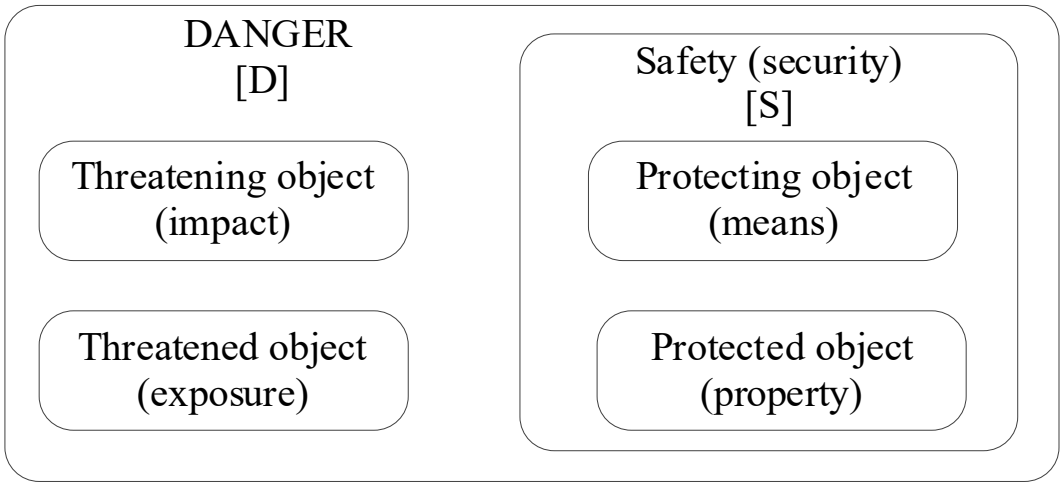

Figure 1 – Ontological model of the danger space

Relationships and Definitions of Safety. Objects enter into relationships that name the roles of the parties involved in the activity. The logical model of the danger space is structured as two subspaces and four objects. A glossary of the main terms of the hazard space is presented (table 1).

Table 1 – Glossary of key danger terms

Concepts		Objects	Relations
Danger [D]	d_1	threatening	$\langle d_1 \rightarrow d_2 \rangle$ impact
	d_2	threatened	$\langle d_2 \leftarrow d_1 \rangle$ exposure
Safety (security) [S]	s_1	protecting	$\langle s_1 \leftarrow d_1 \rangle$ protection
	s_2	protected	$\langle s_2 \rightarrow d_1 \rangle$ protectability

The following definitions are derived.

Danger impact $\langle d_1 \rightarrow d_2 \rangle$ is the ratio of the threatening object d_1, which has signs of the impact of damage to the threatened object d_2.

Danger exposure $\langle d_2 \leftarrow d_1 \rangle$ is the ratio of the threatened object d_2, which has signs of exposure (vulnerability) to the threat and damage from the impact of the threatening object d_1.

Protection from danger $\langle s_1 \leftarrow d_1 \rangle$ is the ratio of the protected object s_1, which has means of protection from damage and from the impact of a threatening object d_1.

Protectability from danger $\langle s_2 \rightarrow d_1 \rangle$ is the ratio of the protected object s_2, which has the property of counteracting and absorbing damage from the effects of the threatening object d_1.

Danger. The term (statement) of the subject "danger" [D] constitutes the semantic space of objects (Eq. 1):

$$[D]: \leftarrow (d_1 \cdot d_2), \ \forall d_i \subset D, \tag{1}$$

which have features (characterized) denoted by each of the terms: d_1 - threatening object that has the characteristics of a subject of threat and names the property of possible damage (harm, loss) to the threatened object d_2; d_2 - threatened object that has signs of exposure (vulnerability) to a threat and names the property of possible damage from the impact of a threatening object d_1.

Safety. The subject term "safety" [S] constitutes the semantic space of objects (Eq. 2):

$$[S]: \leftarrow (s_1 \cdot s_2), \ \forall s_i \subset S, \tag{2}$$

which have features denoted by each of the terms: s_1 - protecting object that has features of protection (means) from possible damage from the impact of a threatening object d_1; s_2 - protected object that has the property (protectability**)** of counteracting and absorbing possible damage from the impact of a threatening object d_1.

The universal danger space decomposes into a direct sum of subspaces (Eq. 3):

$$D = d_1 \oplus d_2 \oplus s_1 \oplus s_2, \tag{3}$$

where $(d_1 \cdot d_2 \cdot s_1 \cdot s_2)$ is the items denoted by each of the terms.

The structure of the danger space is a set of subspaces (Eq. 4):

$$D: \Leftarrow \{(d_1 \cdot d_2) \supset ((s_1 \cdot s_2) \supset S)\}. \tag{4}$$

Safety (security) management [SM] is the term is defined as counteraction the exposure to danger $\langle d_2 \leftarrow d_1 \rangle$ of the threatened object

d_2 to the threatened object to a threatening object d_1: means of protection $\langle s_1 \leftarrow d_1 \rangle$ of the protected object s_2; protectability properties $\langle s_2 \rightarrow d_1 \rangle$ of the protected object s_2 (Eq. 5):

$$[SM]: \Leftrightarrow \{d_2 \mid ((s_1 \cdot s_2) \vee (s_1 \vee s_2)) \geq |d_1|\}: \Leftrightarrow \neg D. \quad (5)$$

In this definition, the roles and relations of objects are logically substantiated, the transition of the threatened object d_2 from the danger space to the roles s_1 and/or s_2 of the security space. In the absence of a threatening object d_1 and/or a threatened object d_2, there is no danger D (Eq. 6):

$$\downarrow\{|D| \supset (d_1 \cdot d_2)\} \mid (\neg d_1 \vee \neg d_2) \rightarrow \neg D \quad (6)$$

The need for security for the threatened object d_2 arises in the space of relations $\langle s_1 \leftarrow d_1 \rangle$ and/or $\langle s_2 \rightarrow d_1 \rangle$. The type of relationship for the threatened object d_2 depends on the counteraction of d_1: means of protection and/or security properties. It is important to remember the difference that the means are understood as the external attributes (protection**)** of the threatened object, and the object itself has the safety properties **(**protectability).

Conclusion. Normative regulation in the development of standards begins with the derivation of definitions and terms of subject activity that meets the requirements of effective management [3]. The description of subject activity must begin with a humanitarian study of the subject. Abstract concepts such as danger and safety are extremely difficult to structure and classify. This paper proposes a method for overcoming this problem by means of ontological design and development of a model with a description of the name of the subject, objects of activity and relations of objects [4]. An ontological model of the object of danger, logically justified definitions of danger and safety, definitions of objects and relations of objects, definition of safety management have been developed.

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Чинакал В.О.

Проблемы обеспечения безопасности управления сложными промышленными объектами при модернизации производства в современных условиях

Аннотация: Рассматриваются основные проблемы совершенствования интегрированных систем контроля и управления сложными распределенными промышленными объектами (СРПО) при поэтапной модернизации в условиях санкций и импортозамещения. С учетом этих условий и требований повышения безопасности и эффективности управления СРПО анализируются возможности применения различных подходов на этапах проектирования и модернизации типовых АСУТП и АСОДУ на базе технологий усовершенствованного мониторинга и управления.

Ключевые слова: сложные технологические объекты, безопасность управления, усовершенствованный мониторинг, усовершенствованное управление, АСУТП, АСОДУ