

TRANSPORT SECURITY AND ECOLOGY. COMPATIBILITY ISSUES

Elisov L. N.¹, Ovchenkov N. I.², Fadeev R. S.¹

¹State Research Institute of Civil Aviation, Moscow, Russian Federation

²P.G.Demidov Yaroslavl State University, Yaroslavl, Russian Federation

Abstract

The work presents the author's view on one of the most important problems of civil aviation in modern conditions – the problem of aviation security support for civil aviation facilities. There is provided the authors' original approach to the functional and essential understanding of air transport safety. The approach is based on the analysis of fairly new terms: bodily security, unified security, and indivisible security. The authors propose a new term: integrated security of air transport, defining the concept of integrated security, structuring the concept, analyzing the functional relationships of the structure's elements. The article considers the problem of the human factor from the point of view of compatibility of transport and environmental safety. The work shows how the solution of aviation security problems using methods of human factor harmonization can be successfully applied in solving problems in the field of ecology. The approach's interface is the concept of bodily security.

Keywords: civil aviation, aviation security, environmental safety, human factor, harmonization of the human factor, bodily security

1. INTRODUCTION

In modern conditions of the human community's existence, the security of an individual or a social group of people becomes one of the main factors in human life, the dominant criterion for the functioning of complex systems that provide comfortable conditions for his life and professional activity.

Security is a multi-valued concept that characterizes the security and low level of risk for a person, society, or any other entities, objects, or their systems. This is a state of a complex system, when the action of external and internal factors does not lead to the deterioration of the system or the impossibility of its functioning and development [1].

Security in the transport sector and, in particular, in the field of air transport is of particular importance, since the lack of it or its insufficient level sharply reduces the demand for transport services and casts doubt on the existence and development of the industry. Therefore, the problem of ensuring the safety of air transport arose simultaneously with the formation of the civil air fleet as an industry that provides air transportation. At the same time, all civil aviation issues related to safety were considered within the framework of flight safety. Later on this concept has been transformed and new directions have emerged related to safety in various areas of industrial activity in civil aviation.

On the other hand, the opposite problem arises: the production activities of transport security facilities become a source of danger to the environment. In civil aviation, this influence is quite serious and manifests itself in various directions, such as noise exposure, chemical and technological effects associated with fuel and lubricants and aviation fuel, other pollutants, increased risk of man-made disasters, electromagnetic effects, and others. These impacts are located within the subject area of ecology, which is related to the concept of environmental safety.

Thus, it can be clearly stated that there is a direct link between the concepts of transport and environmental safety. This raises the question of the possibility of a comprehensive solution to transport and environmental safety problems, using developed and tested methods of solution, with the priority of transport security methods.

2. RESEARCH METHODS

At the present stage of civil aviation's development, security requirements have significantly increased and functionally transformed, which inevitably sets the task of fundamentally rethinking and reviewing problems, tasks and approaches to their solution in terms of compliance with new realities. Let's note a few important points.

In recent years, some works [1,2] discuss the concept of bodily security, which is understood as a state and conditions of life of the individual, in which its rights and freedoms are realized, first of all, the right to life and personal integrity. At the same time, the main threats to bodily security are: the negative state of security in various countries, the threat of criminalization of public relations, the growth of organized crime, the deterioration of the environmental situation and the risk of technical disasters.

In the international legal sphere, the concepts of "unified" and "indivisible" security are widely used, which are related to ensuring state security [3,4]. In this case, these concepts are used in relation to security actors, which are understood as different states, and determine their mutual conditionality.

On the other hand, today several types of security are used in the aviation transport system, which differ in terms of the conceptual apparatus, functional affiliation, subject area of applicability, methods, tools and research procedures. The main ones are: flight safety, aviation safety, transport safety, industrial safety, industrial safety, economic security, information security, environmental safety and some others (Pic.1).

Each of them is directly related to personal safety, but the paradox is that achieving an acceptable level, for example, flight safety, absolutely does not guarantee an acceptable level of personal safety, if, for example, it is not possible to achieve an acceptable level of environmental safety.

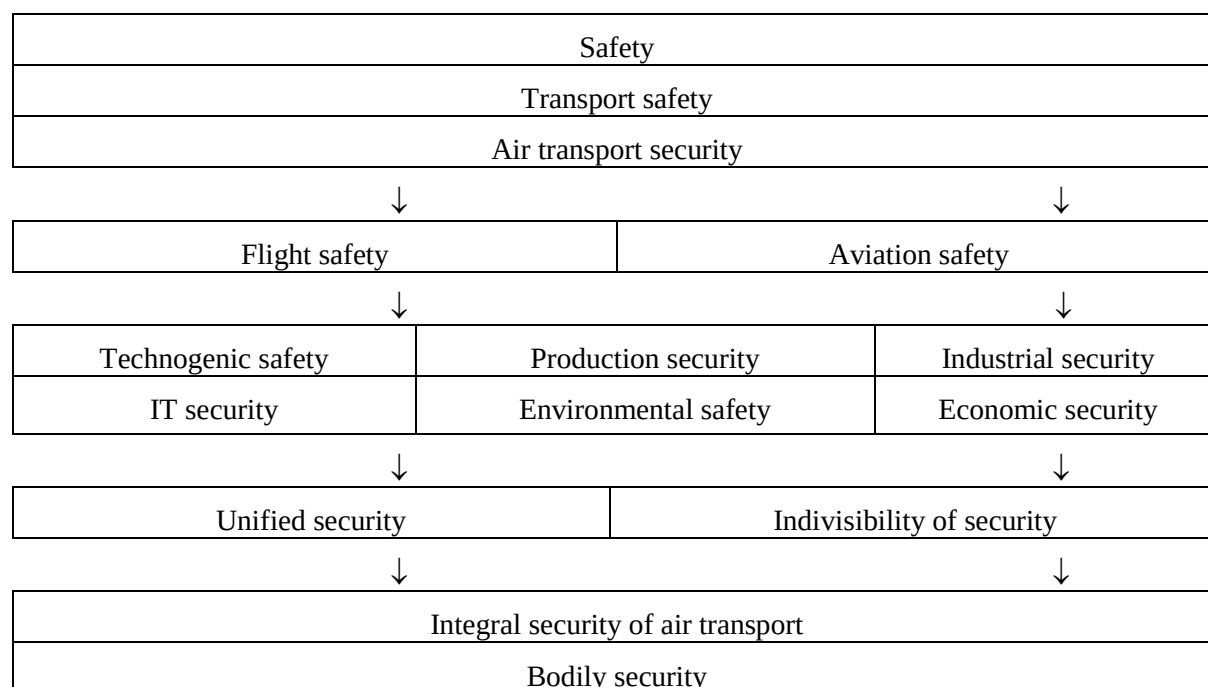


Fig. 1. To the question of the integration of air transport security

This is true in relation to any type of security, however, to varying degrees. In this case, the concept of "unified and indivisible security" becomes relevant.

At the time, the authors proposed to introduce a new concept of "integrated air transport security", which formed a new scientific direction, including a set of studies aimed at identifying a new concept and developing principles, strategies and methodologies for the study of a new subject area [5].

Integrated air transport security is a state of the aviation transport system that guarantees an acceptable level of personal security in the context of the implementation of an exhaustive list of aviation services and aviation works.

If we agree with the proposed interpretation of the integral security concept, then in order to further improve it and develop a new scientific direction, it is necessary to solve several fundamental issues.

1. If we agree with the concept of integral security, then the question arises as to what defines this concept, i.e. what threatens security. It is clear that for each type of security as part of the integral, there are threats and they require autonomous research. On the other hand, one of the most important factors in security is the human. In their works [1,5], the authors have shown that it is very effective for the study of the human factor to consider it as a threat.
2. The human factor in civil aviation is understood primarily as civil aviation personnel who are engaged in ensuring this security within the framework of their professional activities. Then the threat from the side should be considered as unauthorized interference in production activities.
3. The human factor as a threat has a very similar impact on safety, regardless of its type, including transport and environmental safety, i.e. it becomes a criterion of compatibility in the study of the factor and its use in the activities of personnel, which create a certain universality of methodological approaches in the study.
4. The human factor as a threat can be represented in relation to the object of protection by some external influence from the external environment, similar to conventional threats. Then the entire threat research tool that has been developed in civil aviation for security research can be used to study threats to personnel.
5. The problem of identifying the concept of security through a certain space of states of the hypothetical environment surrounding the object of protection is solved if we use the apparatus of field theory. The authors suggest identifying bodily security with a certain security field. In this case, you can enter hypothetical threat and protection fields. Then there is a triad of hypothetical fields whose interaction results in integral security.
6. The methodology for studying security is reduced to assessing the level of security and deciding whether it is acceptable, for which it is necessary to develop a methodology for evaluation procedures and solve the problems of formalization.
7. The authors believe that among the many methods offered by the field theory, the most adequate for formalization is the mathematical apparatus of the theory of boundary value problems, which is described by a system of partial differential equations.

The boundary value problem for partial differential equations is the problem of obtaining a solution in a given domain under given additional constraints at boundary points (boundary or boundary conditions) [6,7].

The boundary value problem for an n -th order linear equation has the form

$$L(y) = f(x), U_{\mu}(y) = \gamma_{\mu}, \mu = 1, 2, \dots, m,$$

Where

$$L(y) = \sum_{v=0}^n (v=0)^{n-m} [f_v(x) y^{(v)}(x)] .$$

The mathematical apparatus of the theory of boundary value problems contains an almost exhaustive list of mathematical models for the formal representation of various physical processes, including in field theory.

In most cases, analytical methods for solving boundary value problems are of limited use. In this case, numerical methods are used. Grid and neural network modeling should be considered the most effective method for solving boundary value problems at the present stage [8,9,10].

The history of the "human factor" concept began with the "personal factor" concept associated with the characteristics of a person (specialist) as a person. The imperfection of human nature, limited physiological and psychological capabilities and not always satisfactory personal characteristics of the individual led to the fact that the set of professionally important qualities did not provide adequate satisfaction of the requirements for professional activity, and was manifested in errors, failures, and in civil aviation in the form of aviation accidents of varying severity.

At a certain stage in the development of these studies in civil aviation, it became clear that the negative consequences are not always determined by a personal factor, but depend on a number of reasons related to the imperfection of the means of activity, unsatisfactory working conditions, and imperfection of the organization and content of work. In modern security systems, it is established that the reasons for erroneous actions of personnel are related not only to the level of professionally important personal qualities, but also to the imperfection of the means of activity and its organization.

In aviation security systems, everything is somewhat more complicated, since the procedures for professional activity of personnel are poorly formalized and algorithmized, are characterized by extreme manifestations, have a high degree of uncertainty, and the tasks being solved are poorly structured and poorly formalized.

From the point of view of aviation security, it is proposed to consider the human (personal) factor as an inevitable evil, excluding the useful component, and to classify all its negative manifestations as security threats.

The basis for this approach can be considered a conceptual framework. Indeed, a factor is a cause, the driving force of a process, determining its character or its individual features, where the cause is considered as the basis for some action. A threat implies a possible, probable danger, an intention to cause harm. In this case, the concept of factor can be replaced by the concept of threat, and the actions of aviation personnel in this part can be compared and equated to the actions of the violator, agreeing that these actions are not hostile, antagonistic, but are forced, random, often independent of the intentions of the personnel, and introduce the concept of threat of personnel.

The threat of personnel (UE) in aviation security is a state of inadequacy of the operator's professional readiness and the parameters of the situation in the security system, determined by the maximum level of psychophysiological parameters of the individual, allowing the appearance of a negative event.

The threat of personnel in the field of environmental safety is sufficiently consistent with the above definition, except for specific manifestations. However, according to the results of the impact on the environment and the population, the negative nature of the impact coincides. In this case, it is possible to talk about the compatibility of the two types of security according to the threat of personnel criterion.

3. RESULTS

Returning to the concept of indivisibility of security, which is one of the basic concepts of integral security, first of all, it is necessary to solve the problem of integrating certain types of security. It is intuitively clear that each security in the above list is uniquely related to the concept of integral security, but the nature of these relationships is far from being defined. Moreover, there are probably certain relationships between them, the nature of which also needs to be identified. Thus, there is a problem of in-depth research of the meaningful meaning of the selected security features and development of their adequate projection on the formal display of integrated security. The authors believe that the single platform here can be the human factor, and the methodology can be the SHEL model [1,5].

4. CONCLUSION

The authors' original approach to the issue of compatibility of two types of safety in civil aviation – transport (aviation) and environmental-is proposed and considered. The need for compatibility is caused by the increasing complexity in solving personal security problems in offline mode. It is shown that the compatibility criterion can be the human factor identified as a security threat. With this approach, the issue of methodology for solving security problems is related to modeling security processes in the format of a boundary value problem in field theory.

REFERENCES

1. Elisov L.N., Ovchenkov N.I., Fadeev R.S., 2016, «*Introduction to the theory of aviation security*», Filigran` Publ., Yaroslavl (In Russian), p. 320.
2. Elisov L.N. 2012, «*To the question of the accuracy of heuristic algorithms for solving optimization problems in operation*», Nauchnyi Vestnik MGTUGA=Scientific Bulletin of MSTU CA, (In Russian), no. 179, pp. 123-126.
3. Filippov V.L., Ovchenkov N. I., 2019, «*Some problems of automation of aviation security management procedures at the airport*», Scientific Bulletin of the State Research Institute of Civil aviation. no. 24. p. 66-74.
4. Elisov L.N., Ovchenkov N.I., 2013, «*To the question of structural modeling of transport security subjects*», Nauchnyi Vestnik MGTUGA=Scientific Bulletin of MSTU CA, (In Russian), no. 197, pp. 58-61.
5. Elisov L.N., Ovchenkov N.I., 2017, So. «*Integrated air transport security*». Scientific Bulletin of MGTUGA, volume 20.-M.: MGTUGA, № 6-p. 36-44.
6. Farlow S., 1985, «*Partial differential equations for scientists and engineers*» M.: Mir. p. 384.
7. Elisov L.N., Ovchenkov N.I., 2018, So. «*Numerical implementation of a heuristic model of threats to the security of a civil aviation facility*», Mechanics of solids HA №1(18). - St. Petersburg: St. Petersburg State University, p. 42-57.
8. Ovchenkov N.I., Elisov L.N., 2014, «*Assessment of vulnerability of objects of transport infrastructure and vehicles in civil aircraft*», Scientific Herald MGTUGA. no. 204. p. 65-68.
9. Elisov L. N., Gorbachenko V.I., Zhukov M. V. «*Learning Radial Basis Function Networks With The Trust Region Method for Boundary Problems*», 2018, Automation and Remote Control., Vol. 79. No. 9. P. 1621-1629.
10. Oleg A. Kartyshev, Michael O. Kartyshev , «*Using ecoflight building software suite for predictive assessment and development of compensation measures to mitigate impacts of aircraft noise in areas near airports*» . ICAO Environmental Report, 2016. pp. 56-59.