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Volodymyr Kharchenko[1]
Ruslan Pechevysty[2]
Oleh Alexeiev[3]
Serob Karapetyan[4]

SELECTION OF A SYSTEM OF INDICATORS CHARACTERIZING THE EFFECTIVENESS OF THE FLIGHT SAFETY MANAGEMENT SYSTEM

[1,2,3,4] National Aviation University, 1, Lubomyr Husar ave., Kyiv, 03058, Ukraine
E-mails: [1]kharch@nau.edu.ua; [2]rick999@ukr.net; [3]oalexeiev@yahoo.com; [4]s.karapetyan@ukr.net

Abstract

The article poses the task of evaluating the system of indicators itself with such a mathematical apparatus that would allow expressing by number the overall efficiency of the SMS for the required period of time or its potential capabilities in a form suitable for use in managing the relationship between production activities and the system of indicators, i.e., required development of a specialized mathematical apparatus for evaluating the effectiveness and a specialized environment in the form of a software product - information monitoring of SMS

Keywords: safety management system; information monitoring; flight safety

1. Introduction

Since the Safety Management System (SMS) is constantly evolving, the designated system of indicators changes at each new step. The main threats, sources and factors of danger and risk are formed as a result of the restructuring of state supervision bodies and their formation, a complex, underdeveloped mechanism of legal and economic relations, a system for monitoring and localizing consequences, rising energy prices, falling professional aviation discipline, uncertainty of the risks of modern technologies [1].

We consider the efficiency of SMS operation in two aspects:

- efficiency as a characteristic of achieving results;
- efficiency as a characteristic of the internal activities of the SMS, reflecting the relationship between its inputs and outputs.

The process of choosing a system of indicators by which it is possible to evaluate the effectiveness of the functioning of any system is a problem that is not new in science. In this regard, the literature contains a large number of recommendations. Thus, most researchers form a system of performance indicators for separately taken functional areas of activity (personnel, organizational structure, etc.), while it is indicated that all indicators should characterize the state of affairs both in the present and in the future [2].

2. Analysis of the research and publications

The study is mainly based on the scientific works of the following authors, who made the most significant contribution to the search for solutions to the problem under consideration [2,3].

Despite the active research of this problem, the scientific problem associated with the development of effective methods, algorithms and programs for conducting a predictive study of the process of functioning of the flight safety management system of aviation enterprises and the industry as a whole, based on modern computational methodologies, is still of considerable interest [4,6].

The tasks will allow us to form a list of the main measures and rules of the flight safety management in the studied aviation enterprise and in the industry as a whole for the foreseeable forecasting period.

3. Problem statement

The problem under study belongs to the sphere of improving and developing complex anthropocentric systems. It is generated by the practical need for predictive estimates of the main measures and rules of the management to ensure the safety of flights in civil aviation and their theoretical justification for the foreseeable period of forecasting. Based on the implementation of monitoring and predictive assessments of the state of flight safety in the form of a graph, the object of the dissertation research is the structure of the monitoring system of the civil aviation system, the subject of the research is methods for assessing and predicting the level of risks of aviation enterprises that affect flight safety and the industry as a whole in terms of the characteristics of aviation events.

4. Problem Solution

We represent the effectiveness of the SMS in the form of an organizational structure:

$$SMS = \{Objectives, Resources\}.$$

Based on the system methodology [5], decomposition of the set, the objectives are:

$$Objectives = \{External, Internal\},$$

where *External* is a set containing global SMS objectives to ensure the required level of flight safety;
Internal – a set containing the goal of improving the structure of the SMS.

The composition of the set of *Resources* can be different and depends on the goals and on other systems interconnected with the SMS [7]. Therefore, within the framework of the airline's SMS, we will include the following components in the set of Resources, which are cumulatively, the ability to achieve SMS objectives:

$$Resources = \{T, Tch, K, F, M, O, I, SU, NP\},$$

where *T* is a technological resource, *Tch* is a technical resource, *K* is a human resource, *F* is a financial resource, *M* is a material resource, *O* is an organizational resource, *I* is an information resource, *SU* is a management system resources, *NP* is a regulatory resource.

In SMS, some types of resources act as nodal elements in the organizational structure of relationships, while other types of resources define flows of events.

Such types of resources as technological, financial, material play the role of intermediate connecting nodes, since they characterize the way of connecting human and technical resources.

The human resource is air personnel, that is, a set of specialists sorted by structural divisions, functional responsibilities, services, etc.

Technical resources represent a variety of aircraft operation and maintenance tools, tools and test equipment.

The technological resource provides the main activity of the SMS and includes:
- many technological processes of operation;
- many indicators of personnel qualifications reflecting the level of technological culture and compliance with the conditions and requirements of technological processes of aircraft preparation for flights.

Material resources are a variety of SMS material assets:
- a lot of spare parts and materials, including group kits, technical kits and spare parts in bulk;
- aviation technical property;
- movable and immovable property.

Financial resources represent many elements and many technological processes of SMS as a financial environment.

The resources of the management system represent a variety of processes for managing human and technical resources (personnel work, etc.).
The normative and legal resource is a set of documents of title and a system of accreditation, licensing and certification.

In order to ensure the possibility of identifying the cause-and-effect mechanism of the occurrence of an AU and / or another state of the SMS, we select indicators that characterize the effectiveness of the functioning of the SMS and reflect the relationship between the elements of the SMS, the processes occurring in it and the environment, both external and internal. These requirements are most fully met by such "systemic" indicators as [4,5,8]:
- economic indicators;
- indicators characterizing the quality of customer service;
- indicators of production activity;
- the quality of staff work;
- flight safety in relation to aviation enterprises;
- industry-wide aviation safety.

Thus, we have a system of indicators consisting of 6 groups. System indicators are intended to characterize the effectiveness of the functioning of an SMS on a scale of the industry, and specific indicators are intended to characterize individual elements of an SMS and to identify the cause and the investigative mechanism of the occurrence of an aviation event and the reason for one or another SMS state.

Economic indicators contain:
– Financial effectiveness of the route network;
– Financial effectiveness of a single route;
– Cost Effectiveness of Route Network Planning;
– Financial efficiency of planning individual routes;
– Total income, average income;

– Financial efficiency of opening a new route.

Indicators characterizing the quality of customer service are:

– Share of the total transportation market;
– The number of transported passengers (cargo);
– Share of business class passengers;
– Regularity of flights;
– Customer satisfaction with services.

Indicators of production activity are:

– Aircraft load factor;
– Efficiency of ticket sales;
– Efficiency of advertising activities;
– Prompt implementation of new technologies;
– Optimization of the route network structure;
– Efficiency of maintenance, repair and restoration.

Staff work quality indicators are:

– Staff turnover rate;
– The effectiveness of incentive programs;
– Personnel qualification level;
– Ratio of financial costs for personnel training.

Flight safety indicators:

– Average flight time for an aviation event (catastrophe, aircraft accident, incident);
– Number of aviation events (catastrophe, aviation accident, incident) per conditional number of flight hours;
– Average flight time per incident per accident;
– Loss factor;
– Risk of an aviation event;

Industry-wide aviation safety indicators are:

– Number of accidents per 100 thousand flight hours;
– Fatalities per million flights;
– Number of fatalities per million passengers carried.

The monitoring system, according to the methodology of the theory of system security, studies the risk of aviation events, such as a catastrophe, accident or serious incident and an aviation accident associated with the destruction of vehicles, tracks, berths, airports, etc., with harm or damage. people - passengers, aviation personnel or bystanders [1,4,7].

Risk is an integral characteristic or measure of hazard. Using the "risk" value, we measure the necessary indicators of the safety of an activity or hazard through other indicators of a lower system level. As a result, it is necessary to define a risk measurement tool.

6. Conclusions

Thus, the purpose of the study is to improve the level of flight safety in civil aviation enterprises based on the formation in the monitoring system of reliable predictive assessments of the level of flight safety in aviation enterprises and the industry as a whole in the short, medium and long term.

Based on this goal, the following interrelated scientific tasks have been identified:

- conducting a general analysis of the sets of aviation events, methods of their identification and forecasting;
- development of a methodology for identifying aviation events by causality based on the use of hyper- and ultragraphs as a formalized description of aviation events;
- development of a system of initial data with a user-friendly interface with automated operation;
- development of algorithms for the functioning of the aviation safety monitoring system in the form of logical, semantic and arithmetic structures of the lexicographic type and programs that make up the knowledge base;
- development of a model for monitoring the activities of an aviation enterprise;
- substantiation and formation of the characteristics of the monitoring system, allowing it to function in order to control the state of the SMS and determine the cause-and-effect mechanism of aviation events;
- development of a methodology for assessing system indicators of the monitoring system;
- implementation of a computational experiment to identify predictive estimates of the dynamics of indicators and identify the main factors affecting the level of flight safety [6,8].

The identification of the sets of indicators of the activities of aviation enterprises and aviation events by the methods of graph theory is a difficult task and faces a number of fundamental problems. One of them arises due to the fact that a lot of aviation events is a reflection of a real system, namely, a flight safety management system, the mathematical model of which is a priori unknown, and at the same time its dimension (the number of variables or independent coordinates of the system state) is unknown.

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В.П.Харченко[1], Р.П. Печевистий[2], О.М. Алексеев[3], С.С. Карапетян[4]

Вибір системи показників, характеристичних ефективності системи управління безпекою польоту

[1,2,3,4]Національний авіаційний університет, просп. Любомира Гузара, 1, Київ, Україна, 03058

Стаття ставить завдання оцінити саму систему показників за допомогою такого математичного апарату, який би дозволив виразити за допомогою числа загальну ефективність системи управління безпекою за необхідний проміжок часу або його потенційні можливості у формі, придатній для використання у відносинах між виробничою діяльністю та системою показників, тобто необхідна розробка спеціалізованого математичного апарату для оцінки ефективності та спеціалізованого середовища у вигляді програмного продукту - інформаційний моніторинг системи управління безпекою.

Ключові слова: система управління безпекою; інформаційний моніторинг; безпека польоту

В.П.Харченко[1], Р.П. Печевистый[2], О.Н. Алексеев[3], С.С. Карапетян[4]

Выбор системы показателей, характеристических эффективности системы управления безопасностью полета

[1,2,3,4]Национальный авиационный университет, просп. Любомира Гузара, 1, Киев, Украина, 03058

Статья ставит задачу оценить саму систему показателей с помощью такого математического аппарата, который бы позволил выразить с помощью числа общую эффективность системы управления безопасностью необходимого промежуток времени или его потенциальные возможности в форме, пригодной для использования в отношениях между производственной деятельностью и системой показателей, то есть необходима разработка специализированного математического аппарата для оценки эффективности и специализированного среды в виде программного продукта - информационный мониторинг системы управления безопасностью

Ключевые слова: система управления безопасностью; информационный мониторинг; безопасность полета

Volodymyr Kharchenko. Doctor of Technical Sciences (Ph.D.), Professor,
Vice-Rector for scientific work of National Aviation University.
Education: National Aviation University.
Research area: management of complex socio-technical systems, air navigation systems and automatic decision-making systems aimed at avoidance conflict situations, space information technology design, air navigation services in Ukraine provided by CNS/ATM systems.
Publications: 540.
E-mail: kharch@nau.edu.ua

Ruslan Pechevisty (1983). Postgraduate.
Department of Aeronavigation system
Education: Kirovohrad flight academy of Ukraine (2003).
Research area: safety management system, human error, flight safety
Publications: 6
E-mail: rick999@ukr.net

Oleh Alexeiev (1978). Candidate of Engineering.
Department of Aeronavigation system
Education: Kirovohrad flight academy of Ukraine (2000).
Research area: safety management system, human error, flight safety
Publications: 62
E-mail: oalexeiev@yahoo.com

Serob Karapetian (1964). Postgraduate.
Department of Aeronavigation system
Education: Kyiv International University of Civil Aviation, Ukraine (1984).
Research area: safety management system, human error, flight safety
Publications: 5
E-mail: s.karapetyan@ukr.net