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**Principles of ensuring flight safety of civil aviation aircraft**

*An overview of the indicators of the quantitative assessment of the level of flight safety is proposed. It was found that the optimization and solution of flight safety issues requires the application of methods of comprehensive assessment of the degree of influence on the level of various factors.*

The National Transport Strategy of Ukraine for the period until 2030 emphasizes that transport is an integral component of the general state economic policy and ensuring the country's defense capability [1]. Accordingly, ensuring the flight safety of civil aviation aircraft is a complex technical and technological task, which is solved by an integrated approach with the participation of designers, manufacturers and operators of aviation equipment. It is worth noting that at the stage of design, manufacture and testing of aviation equipment, flight safety requirements are established and implemented in the design of the aircraft and technological processes of its manufacture.

Flight safety of civil aviation aircraft is characterized as a complex task, the purpose of which is to protect civil aviation from acts of illegal interference. Taking into account the above, the key task facing aviation enterprises is to ensure and guarantee the safety of passengers, crew members, ground handling personnel, the public, aircraft, facilities and services of airport and airfield services serving civil aviation on the ground and during flight . All of the factors are achieved through the interaction of a complex set of technical and technological processes with the direct participation of human and material resources.

It should be noted that aircraft flight safety is a dynamic characteristic of the aviation system, which makes it possible to predict risk factors to guarantee and ensure aircraft flight safety and has a tendency to decrease or become impossible.

The quality of passenger service, aircraft maintenance, and the operational condition of civil aviation airfields also play an important role in ensuring flight safety. To ensure flight safety, a set of IATA and ICAO Recommendations (procedures and rules) have been developed, which emphasize the principles of flight safety.

It is worth mentioning the technical complexity of the mechanism of interaction between consumers of aviation products and providers of passenger and baggage transportation services. This, in turn, implies the presence of clear requirements for ensuring the flight safety of civil aviation aircraft and an analysis of the mechanism of influence of numerous factors and interdependent components of the aviation industry.

Ensuring the safety of civil aviation aircraft flights should be considered from the point of view of theoretical risk analysis, which solves the problems associated with the identification of a set of safety factors as follows:

1. Analysis of risk factors;

2. Assessment of risk factors;
3. Management of risk factors.

It is proposed by authors to present the main information on flight safety data by a system consisting of five main principles (parameters), which are displayed in fig. 1.

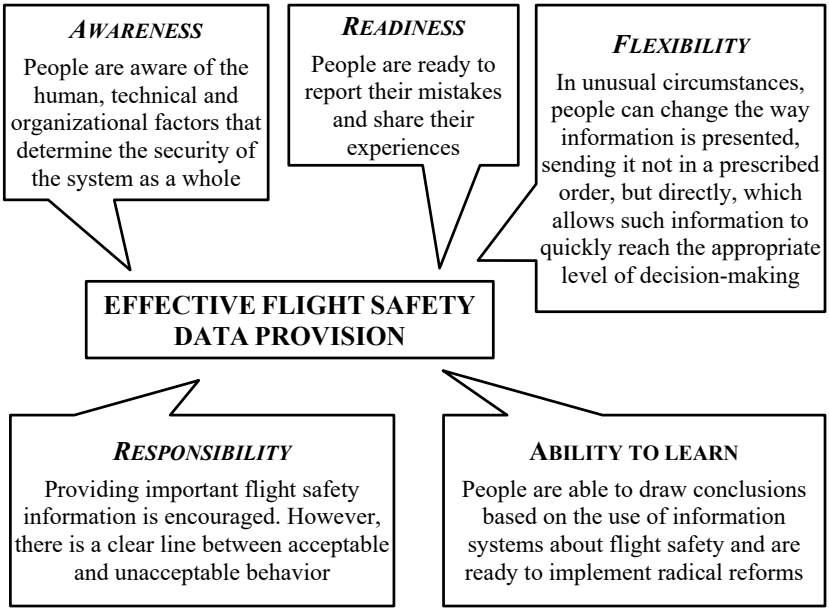


Fig. 1. Five basic principles of flight safety data presentation according to ICAO recommendations DOC 9859 (created by authors on the basis of [2])

It is worth noting that at aviation enterprises that provide services for the transportation of passengers and cargo, the labor productivity of the enterprise's organizational system and risk factors for flight safety are interrelated concepts.

To quantify the level of flight safety and determine its dependence on the properties of the aviation transport system and its operating conditions, two types of indicators are used - statistical and probabilistic. Statistical indicators obtained as a result of operational data processing are usually expressed as physical quantities or their ratio. Probability indicators are calculated by the methods of probability theory and are used not only for the analysis of the state of flight safety, but also for its forecasting and level optimization [3].

In accordance with the Methodological recommendations for the implementation of flight safety management systems, approved by the order of the State Aviation Service of Ukraine, the level of flight safety is a property of the system that characterizes its quality from the point of view of flight safety.

Accordingly, flight safety in the safety management system is a state in which the probability of harm to people or property is reduced to an acceptable level and is maintained at this or a lower level through a continuous process of identifying dangerous factors and managing risk factors for flight safety [4].

Mathematically, it is reasonable to define the level of flight safety as the probability of a catastrophic situation not occurring due to the occurrence of adverse factors:

$$R_{CS} = 1 - Q_{CS} \quad (1)$$

where: $Q_{CS}$ – the probability of a catastrophic situation.

Taking into account that it is advisable to define the normative values of $Q_{CS}$ as a practically impossible event, the use of statistical estimates under operating conditions often becomes practically impossible (unacceptable) [4]. Taking into account the influence of individual factors - failure of equipment, errors of aviation personnel, influence of the external environment - a combined approach using the dependence between probabilistic and statistical indicators of flight safety is possible [3].

This approach is based on the hypothesis of an exponential (exponential distribution – a completely continuous distribution that models the time between two consecutive completions of the same event) law of distribution of negative events due to their independence and relatively low frequency of repetition [5].

It should be highlighted that mathematical modeling of flight safety risk factors makes it possible to assess, warn and reduce (or prevent) risk factors in order to guarantee flight safety of civil aviation aircraft.

When estimating the risk factor Ri, the following equation is used:

$$R_i = q_i r_i \quad (2)$$

where: $q_i$ – the probability of the occurrence of the $i^{th}$ negative event in the field of flight safety;

$r_i$ – the danger of the $i^{th}$ negative event (the probability of an aviation disaster due to the $i^{th}$ negative event).

The risk assessment allows ranking the detected events for groups of the same type of events in order to reduce the risk level $R_i$, and, using the obtained series, to establish a priority order of actions to organize and ensure flight safety [3].

Optimizing and solving the issues of ensuring flight safety requires the application of methods of comprehensive assessment of the degree of influence on the level of various factors and their most dangerous combinations, taking into account the psychophysiological capabilities of a person, identifying the weak points of ATS elements and finding the most effective methods and means of preventing their occurrence or elimination, based on system principles of approach to problem solving. Forecasting and timely processing of information on the basis of mathematical modeling substantiates the correctness of the decision and consideration of recommendations to reduce or prevent the occurrence of flight safety factors of civil aviation aircraft.

## References


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