UDC 351.735.814.2 (045)

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Peculiarities of the civil aviation flights safety system structure

The structural features of the security system in relation to the preparation, organization and execution of civil aviation flights, as well as its components: direct flight safety, aviation safety, environmental safety, economic safety and informational safety are considered. The results of the structural analysis of the system components are provided.

When we are considering the field of flight safety (FS) in civil aviation (CA) and analyzing its general structure, the following main components should be distinguished:

- health care in CA (its components: protection and life support of the population in emergency situations, labor safety (protection); safety engineering; fire safety; environmental safety);

- aviation security (AS). This term is considered in a "narrow sense" as a component of flight safety and as a state of aviation security from unlawful interference in its activities. And the aviation security system (ASS) is a complex of organizational and technical measures, as well as human and material resources designed to protect the activities of the civil aviation from acts of unlawful interference (terrorist attacks, hijackings, seizure of the aircraft, planting sabotage devices, bringing their components and weapons on board the aircraft, ammunition, etc.). Sometimes in ICAO documents the term "aviation security" is used in a "broad sense" - in the context of flight safety [1,5];

- flight safety (FS). The elements and processes associated with flight operations are usually associated with concepts such as “Safety control system” (SCS) and “safety management system” (SMS).

SCS can also be considered as the "Super system" to the aviation transport system (ATS).

For example, type design, aircraft manufacturing, certification, airworthiness requirements, many standards and recommended practices of international organizations (ICAO, IATA, EASA and ACI) are outside the framework of the ATS structure and refer to non-systemic factors [2]. That is, they manifest themselves for ATS in the form of the external environment, external factors and restrictions, but are closely related to ensuring flight safety.

The main functions (tasks) of the SCS include:

- creation and implementation of the State program for ensuring FS;

- establishing an acceptable level of FS which must be achieved within the specified program;

- implementation and maintenance of modern safety management practices;

- implementation of systems for collecting and analyzing information related to SCS, providing access to this information between civil aviation organizations and states, exchange of such information;

- investigation of aviation accidents and aviation incidents, investigation and analysis of their causes;

- development of preventive, adequate measures (recommendations) to prevent accidents and the implementation of such measures (implementation in practice);

- providing complex training of operational personnel in the field of Flight safety (including aspects of the human factor), educating civil aviation organizations in the formation

of a positive corporate safety culture;

- development (change, improvement) of regulatory documents and information support in the field of ensuring the Flight Safety of operators and civil aviation organizations;
- control of ensuring the Flight Safety at all stages of creation and operation of aircraft;
- FS propaganda.

Any increase in FS requires the combined efforts of all sectors of the aviation industry, including management, flight crews, manufacturers, etc., and even government agencies. Each of them has a vital role and the absence of any of them inevitably makes the task of increasing FS more difficult, and its solution less successful.

To achieve a high level of FS, it is necessary to have a firm legislation and regulatory framework consistent with international requirements. Compliance must be ensured.

An effective role, in this case, is played by a number of other important elements (factors):

- application of scientifically based methods of risk factor management;
- liability of senior flight safety department management;
- a positive corporate safety culture that promotes safe practices, encourages the communication of safety information, and actively influences safety management with the same focus on results as in financial management;
- effective compliance with standard operating procedures (SOPs), including the use of checklists and briefing;
- a non-punitive environment (or fair culture) conducive to effective reporting of incidents and hazards;
- systems designed to collect and analyze (safety-related) data obtained during normal flight operations and exchange such data;
- qualified investigation of aircraft accidents and serious incidents aimed at identifying systemic deficiencies in the ensuring the Flight safety (and not just at finding the culprit);
- providing comprehensive training of operational personnel in the field of FS (including aspects of the human factor);
- Sharing lessons learned from accidents and incidents and best practices through active exchange of FS-related information (between companies and states);
- systematic checks of FS status and monitoring of results in order to analyze FS indicators and reduce or eliminate emerging problem areas.

None of these elements alone are capable of meeting today's expectations for improving Flight safety. It seems that only the complex application of most of these elements can increase the ATS resistance to unsafe actions and conditions, and increase the Flight safety level.

In civil aviation (CA) of most countries, a system for ensuring FS has developed, in which four areas of activity of state bodies, enterprises of the aviation industry and CA can be distinguished (fig. 1):

a) Ensuring FS at the stage of aircraft creation provides:

- regulatory actions on airworthiness of aircraft, their engines and equipment;
- strict regulation of design, construction and testing of aircraft, engine and equipment;
- certification of aircraft types, engines and equipment.

b) Ensuring FS at the stage of creation of airports and their equipment includes:

- regularity actions on the suitability of aerodromes, airways and their equipment for operation;
- certification of relevant facilities.

c) At the stage of operation of aircraft and airports, the FS is provided by:

- strict regulation of the flight operation of the entire aircraft fleet and individual aircraft types in accordance with the manual for their flight operation (AFM);

• regulation of the process of technical operation (TO), maintenance and repair (using regulatory documentation for the aircraft fleet as a whole and for each type of aircraft (regulations, maintenance technologies, guidelines for TO of aircraft types);

• organization of meteorological support of flights according to the relevant flight rules;

• organization of transportation of passengers and goods in accordance with the relevant rules;

• providing protection against illegal interference in CA;

• search-and-rescue services;

• the system of aviation personnel training with the issuance of licenses and certificates;

• regulations of other flight support systems.

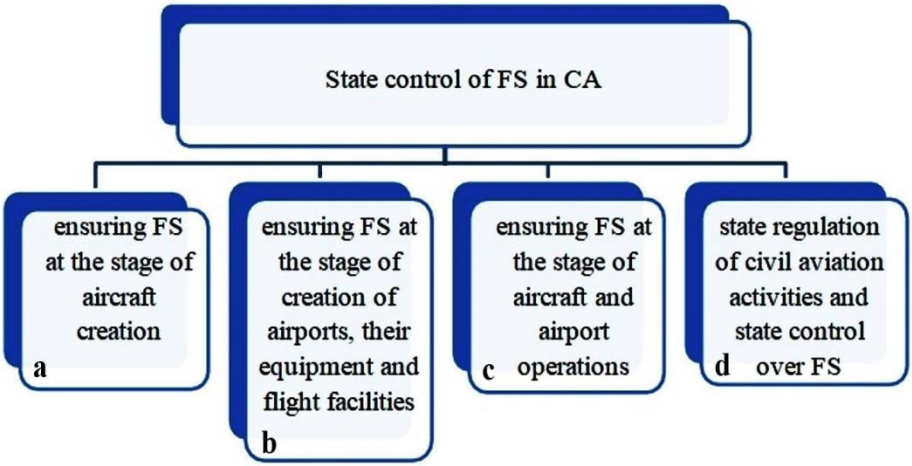

Fig. 1. Generalized structure of the Flight Safety Control System of most countries:
a – ensuring FS at the stage of aircraft creation;
b – ensuring FS at the stage of creation of airports, their equipment and flight facilities;
c – ensuring FS at the stage of aircraft and airport operations;
d – state regulation of civil aviation activities and state control over FS.

In accordance with the ICAO Safety Management Manual (SMM), this approach should be classified as "traditional", which was effective until 1970 [2].

Later, however, accidents continued to occur despite compliance with all rules and regulations. The traditional approach has been to respond retroactively to unwanted events by prescribing measures to prevent recurrence. Thus, it was possible to achieve FS indicators of approximately $N_{cat} = 1x10^6$ (i.e. 1 catastrophe per million).

Increasing FS levels further using this approach has become less effective.

The modern approach to the issue of flight safety provides for a transition from a pure response to aviation events to a more proactive method. The proactive method is based on the fact that, in addition to a solid base of legislative acts and regulatory requirements (if they are observed), the sphere of factors providing FS should be supplemented by the obligations of the state and other CA governing bodies, as well as a number of other factors affecting FS.

d) State regulation and control over civil aviation activities is carried out in order to

ensure FS, aviation safety in general, as well as to ensure the quality of work and services. State control is exercised over the following factors:

• compliance with the law, incl. air legislation of Ukraine and international agreements by civil aviation enterprises and the entire industry as a whole;

• the state of the FS by the inspectors of the civil aviation authorities and the Interstate Aviation Committee (IAC);

• certification of civil aviation enterprises and licensing of all types of activities that affect FS;

• solution of problems of continued airworthiness the aircraft fleet [3];

• conducting investigations of accidents and incidents with the development of preventive measures to ensure the Flight Safety and control over their implementation.

The investigation process of an accident or incident includes collecting and analyzing information, conducting the necessary research, establishing their causes, preparing a report and conclusions, developing recommendations, analyzing the results of the investigation.

Investigation of an accident or incident is carried out according to the multifactor principle, which provides for the identification of deviations from the normal functioning of the aviation transport system and the assessment of the impact of these deviations on the outcome of the aircraft flight. The investigation process does not involve advocating or defending the interests of the parties involved.

The Authority for Accident Investigation, in accordance with Annex 19 to the ICAO Convention, is granted independence in the conduct of an investigation and unlimited powers to conduct it [4].

In order to comply with the provisions of the aforementioned Annexes (SARPs), ICAO has developed and continues to develop specific guidance material, including 2018 Safety Management Document 9859 (4th Edition, 2018) [2]. The methods and procedures described in this Manual are drawn from experience gained in the successful development and implementation of safety measures by aircraft operators, ATS providers, aerodromes and maintenance organizations. The manual reflects the best practice for ensuring operational safety of trustworthy aviation organizations. Consistent application of these safety management best practices has led to a significant decline in the frequency and severity of accidents worldwide.

References

1. S. Dmitriev, O. Tuharinov, Yu. Kazarinov, O. Rugain. Continuing Aircraft Airworthiness: Manual. – K.: NAU, 2014. – 106 p.
2. Doc 9859, Safety Management Manual. Order Number: 9859 ISBN 978-92-9258-552-5. – 2018.
3. Пучков Ю.П. Підтримання льотної придатності парку повітряних суден України / Ю.П. Пучков, М.Ф. Молодцов, О.В. Ругайн, Д.В. Попов // Вісник Національного авіаційного університету. Том 61, № 414. – К: НАУ, 2014. – 169 с. – С. 105-110. ISSN 1813-1166.
4. ICAO. Annex 19 — Safety Management. Order Number: AN19 ISBN 978-92-9249-232-8. – 2013.
5. Repository of National Aviation University, Ukraine: https://er.nau.edu.ua/handle/NAU/35499.