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THE PRINCIPLES TO MAINTAIN AN ACCEPTABLE LEVEL OF AIR NAVIGATION SAFETY IN UKRAINE

Abstract. Due to the current situation in the Eastern part of Ukraine and Autonomous Republic of Crimea (ARC), there was an urgent need to introduce changes of the Ukrainian air traffic management (ATM) system and to the air navigation services (ANS). Those ATM/ANS changes concerned both the Ukrainian national airspace and the airspace over the High Seas, where the responsibility for ATS is delegated to Ukraine by international agreements (hereinafter - airspace under the responsibility of Ukraine).

Those changes were aimed at ensuring safe and continuous provision of air navigation services in the airspace under the responsibility of Ukraine.

The airspace under the responsibility of Ukraine is that within the boundaries of the Flight Information Regions (FIRs) in accordance with the basic principles of the Convention on International Civil Aviation. Ukraine provides air traffic management in the airspace over the High Seas on the basis of valid bilateral and multilateral agreements with the neighboring countries, including the Russian Federation, based on the ICAO Council Decision of February 17, 1997 (No. EUR/NAT96/38-ATS).

Keywords: flight safety, air traffic management, EUROCONTROL, UkSATSE.

Introduction

The airspace under the responsibility of Ukraine is that within the boundaries of the Flight Information Regions (FIRs) and Upper Flight Information Region (UIR) in accordance with the basic principles of the Convention on International Civil Aviation. Ukraine provides air traffic services in the airspace over the High Seas on the basis of valid bilateral and multilateral agreements with the neighbouring countries, including the Russian Federation, based on the ICAO Council Decision of February 17, 1997 (No. EUR/NAT96/38-ATS).

The provision of air navigation services is safe at all levels and is based on the implementation of the concept of constant and continuous service provision with the use of appropriate policies, UkSATSE also developed a modernization plan based on the European ATM Master Plan and the European Single Sky Implementation Plan (ESSIP) objectives. The planned modernization steps will be performed according to Ukrainian Strategy of the Air Navigation system development for the years 2015-2025 that was elaborated jointly by Ukraine and EUROCONTROL in framework of Project Management Plan (PMP) WP9 according to Agreement signed in 2009 between EUROCONTROL and SAA of Ukraine with the main goal of establishing a single ATM Centre. Prior to 2014, UkSATSE already had plans for the modernization of ATC Systems in all ATM Centers (ACCs) including reorganization of air navigation services within Simferopol' FIR. Those plans immediately were implemented during the Spring 2014 [1, 2].

Due to existence of the modernization plan, UkSATSE was in the position to transfer the area control service from Simferopol' ACC to Odessa and Dnipropetrovs'k ACCs and, thus, to continue without any interruption in the safe air navigation services provision. The efficiency level of procedures, personnel and technical equipment operation, necessary for the provision of air navigation services, remained unchanged.

In order to fulfil the safety and security-related requirements concerning the conflict zones, Ukraine implemented additional measures, particularly setting airspace restrictions and prohibitions within various portions of the Ukrainian airspace.

Ukraine confirms its firm support, commitment and adherence to the principles of the Convention on International Civil Aviation by ensuring the safe operations within the airspace under responsibility of Ukraine.

The primary objective of this document is to provide sufficient evidence to support the statements that the declared types of air navigation services within the airspace under the responsibility of Ukraine are and will be provided at a safety level that is not lower than it was before transition to the new configuration of services in March 2014. [5,6]

The evidence presented within the frame of this document is aimed at demonstrating the continuation of provision of safe air navigation services in the airspace under the responsibility of Ukraine.

Theoretical part

The Integrated Management System allows for the application of static and dynamic information management principles, which makes it possible to identify restrictions and limitations. This concept of the Integrated Management System operation is based upon the

separation of static and dynamic information as well as its graded use in the context of implementation of retro-active, proactive and predictive approaches to the man-agement during the services provision.

Retroactive approach is based on the application of corrective measures on the ground of static information received after the fact of a non-conformance or an oc-currence has already happened. Distinctive items of static component for this approach are the results of relevant audits (inspections) and investigations of occur-rences in the course of which the facts of incompliance with the established requirements are recorded. [3,4]

Proactive approach combines application of the static component's information particularly analytic efforts and project evaluation in order to manage or take appropriate corrective measures before the fact of non-conformance or an occurrence has already happened. Analytic efforts and project evaluation towards the changes enable the development of preventive measures concerned with the services rendered together with other items of static and dynamic components.

Predictive approach involves application of dy-namic information. Such an approach to management processes enables non-conformances identification under conditions of day-to-day operations of the ANS system and taking adequate measures for it correction, based on prompt response and predicting the actual state of services if relevant deviations, occurrences, etc. are present.

According to the information received from the re-sults of operation of static and dynamic

components of information collection process, rou-tine and periodic analysis, management review, risk assessment and other measures the appropriate correc-tive measures are being developed. The above measures address the following:

– development of non-conformances correction strategy;

– approval of non-conformances correction strat-egy;

– allocation of responsibilities on non-conformances correction;

– execution of non-conformances correction strat-egy;

– development of preventive measures which will disable recurrence of non-conformances in the field of services provision.

Corrective measures are planned in line with the procedure for planning of the Integrated Management System operation.

Turning now to a description of the major trends in the matter of rational choice of strategies aimed at en-suring and maintaining a guaranteed result, it is neces-sary first of all to emphasize that the activity is no un-ambiguous relationship between the prediction of the results (outcomes) and the problem of decision-making.

It has been said that the chaos of possible outcomes facing the decision maker; At the same time, decision should be made, and it should eventually be uniquely. It is important to draw attention to the fact that even the mathematically and the information problems of fore-casting and decision-making is usually not the same.

At present there are the following principles of ra-tional choice.

Isolationism – replacement of the i-th participant only its criteria so as to reduce the number of variables that affect the i-th criterion of efficiency, and ideally to reduce it to the criterion of the type that has to be opti-mized and no matter what the rest of the participants. This method of action is generally accepted in the pres-ence of random factors as efficiency criterion is re-placed by its expectation.

Collectivism, i. e. introduction of a single general criterion (general purpose) for the group participants. In this case we speak of coalition and compromise between the parties. The second principle is the formation of rational strategies in the pursuit of good mutual aware-ness, allows for constant performance criteria form a rational strategy.

The quest for knowledge as the basis of rational choice behavior, of course, is not contrary to the first principle, but rather complements it. For example, the coalition unthinkable substantially without a collective sharing of information, and the extracted individual information reduces the amount of required clotting individual member separate criterion.

The third and very important principle of develop-ing rational behavior consists in the pursuit of sustain-ability, understanding which vary widely. Here, above all it deserves special mention the principle of guaran-teed result calling side operates with the lack of infor-mation based on the consideration of the worst possible situations, taking into account available information. It is widely understood principle of guaranteed result can be applied in the selection of rational strategies and the results expected. This principle includes, of course, the usual maximum is used in an antagonistic activity and interaction with the environment, but is not limited to it.

It should be emphasized, however, that a reason-able reduction of the number taken into account the values of x1 is reasonable and even an inevitable step. Such a process usually referred to as the method of test, and the 'choice of variables accounted for xx, usually performed by expert procedures.

The most common form of representation of the relationships and interactions of disparate processes and events is a cause-and-effect relationship [7–9].

The causal relationship and interaction of proc-esses, events and phenomena in real systems are formed and implemented between objects of different nature. Related technological, informational, administrative, economic, social and other processes are combined in a

complex interaction, which is currently not sufficiently precise and easy to use mathematical models. Development of models and methods focused, usually for a specific kind of process and results in a formal apparatus, which is not always convenient to combine disparate processes, objects and phenomena. With the development of common models and methods for solving problems with the use of such models is needed to move from specific and specialized concepts to more general categories of causation. An important and crucial tool models are tangible, imaginable, math ...

Isolation in a variety of interactions between objects (processes, events, phenomena) causality is fundamentally difficult.

One option for harmonization of the complex set of developers and users is the availability of the agreement the developer and the user of the universe of objects, processes, events and phenomena used in the synthesis of the complex. Cybernetic sense of purpose related to the behavior of cybernetic systems, presented the process of changing states of the system and the achievement of the desired state of the system. This behavior can be represented by a phase trajectory in the space of states of the system and the set of all possible trajectories of the phase picture.

Model is not a second copy of the original. The model contains or may contain:

- properties that are available and the original,
- propertiesinherentonlymodel,
- properties for which is not yet known that they belong to the original.

The mathematical models of the iconic, not all designs have a direct interpretation in the model application. Broadly speaking, the development of the formalism of causal systems connected, first of all, with the desire for representation of determinism in the interaction of system components and system actions. "In order to use mathematical methods for the analysis of those or other processes necessary for a mathematical description of this process, ie, a description of the language of mathematics. It is what we call a mathematical model." The human mind from the experience tends to perceive reality through the causality. It comes down to a causal relationship.

In assessing the overall meaning of the exchange of information, it should be noted that it should help to reduce the uncertainty in the production process, leaving a narrow variation limits for the selection of operators - in a word, to make the situation more definite.

So, it is advisable to introduce the information sent by one operator to another.

Intuition and experience suggest the reasonableness of collective decisions. One can distinguish three levels of collective action operators $m (m \le n)$ (we assume that the coalition includes the first m operators):

The exchange of information on activities and process conditions;

The joint selection vector $x_c = \{x_x, . . x_м)$ on the basis of a joint information;

The pooling of resources and the subsequent selection of a joint course of action, based on the combined resources.

It is clear that each successive stage creates great opportunities coordination. The possibility of combining in the second or third stage is, in fact, collective rules of conduct, collective strategy. Unification, producing such a strategy, according to tradition will be called coalitions.

A very common type of collective aspirations should be considered joint mixed strategies - distribution laws $\omega_c = x_c$, ,depending, in general, on the elections $x_j$operators that are not included in the coalition, and natural uncertainty β . Thus, you can enter ω_e, the same as previously defined x_1

The use of mixed strategies associated with the introduction and averaged criteria coalition:

$$w_i = \int w_i d\omega_c (x_c), i = 1, ... m.$$

Regarding the criteria for operators outside the coalition, they are averaging can only be discussed as one of the possible options. Notice that pure strategies take the form coalition $x_c(x_т+1 , . . ., x_п, P) = x_c$. The set of admissible strategies of the coalition will be denoted by X_c; these designations may be accompanied by a number I coalitions, such as x_c1.

In discussing the possibilities of coalition cannot forget about the additional interactions between the members of the coalition, and between members of coalition and the rest of the operators, although they can be considered as already included x_c, in the future, given their importance, we usually write them separately. Therefore, together with $x_c$we consider the vector $z_c = \{z_{c1}, ..., z_{cm}\}$, representing the additional interaction of the coalition as a whole.

$$z_1 = \left\{ \sum_{j=1}^{m} \lambda_{ji} z_{ji} - \sum_{j=1}^{n} z_{if} , and, u_i = \sum_{j=m+1}^{n} \lambda_{ji} z_{ji} \right., \text{ but if}$$

$$t_i = \left\{ \sum_{j=m+1}^{n} \lambda_{ji} z_{ji} - \sum_{j=1}^{n} z_{if} , and, v_i = \sum_{j=1}^{m} \lambda_{ji} z_{ji} \right. t_i =$$

$$= \left\{ \sum_{j=m+1}^{n} \lambda_{ji} z_{ji} - \sum_{j=1}^{n} z_{if} , and, v_i = \sum_{j=1}^{m} \lambda_{ji} z_{ji} \right..$$

Then the performance criteria can be written as:

$$w_i = f_i(x, \beta) + t_i + v_I, i = m+1, ..., n, w_i =$$
$$= f_i(x, \beta) + t_i + v_I, i = m+1, ..., n,$$

where the coalition chooses $u_1 u_1$ and $v_1 and t_1 v_1 and t_1$ determined by the actions of other operators. If the coalition is exchanged only with additional interactions between its members, the

$$w_i = f_i(x, \beta) + t_i, i = m+1, ..., n, w_i =$$
$$= f_i(x, \beta) + t_i, i = m+1, ..., n,$$

where now

$$z_i = \left\{ \sum_{j=1}^{m} \lambda_{ji} z_{ji} - \sum_{j=1}^{m} z_{if} \right., \text{and}, t_i =$$
$$= \sum_{j=m+1}^{n} \lambda_{ji} z_{ji} - \sum_{j=m+1}^{n} z_{ij}.$$

As traditional research has not led to a manageable and unambiguous guidelines, we shall proceed from the inability to complete the formalization of the problem of rational choice, including the choice of coalitions is now necessary to study the process rather particular form, but the study of the processes of rational choice in which it should be possible exhaustive. In addition, analysis of the question of the benefit of joining the union of different species, taking into account possible changes in the mutual awareness of the players. This analysis may be, will reduce the amount considered coalitions and thus make the task of rational choice more transparent. For all these purposes, it is desirable to create a sufficiently flexible formalized description of the behavior of the coalition, similar to reality and yet is relatively simple.

It seems that one way of formalizing this is the introduction of the common goals of the coalition, reflecting a compromise between the respective characteristics of the operators. Thus, the coalition turns as if to a single operator [5–7].

Of course, the efficiency criterion of the coalition can be anything. However, judging from this, it will be difficult to introduce the study of collective action in any foreseeable limits. It is desirable to limit the kind of reasonable compromise criterion on the basis of common sense and the possibilities of mathematical research. Of course, there should be enough space for informal selection criterion performance compromise.

Conclusions

Total actual damage due to accidents and other adverse events is determined by the sum of these components as a consequence of the damage of each individual event, and taking into account the real damage for a certain period. To correctly predict the losses need to evaluate two factors determines their value: the average value of the expected losses in the event of an accident or an event and the probability of an accident or event.

In some cases, implemented in the area of guaranteed safety of air navigation services investment project is aimed at reducing the incidence of accidents and events. In this embodiment, a complex calculation that takes into account all types of losses should be performed. Building a risk management system in the area of guaranteed safety and reliability of air navigation services, it is necessary to provide:

- full and timely implementation of measures aimed at achieving the strategic security objectives;
- optimal use of resources allocated to the investment; obtaining additional effect due to optimal

matching of mutual investment projects implemented, including their location and the time of implementation;

- more efficient use of technical means used and the optimal use of the results of projects implemented in previous periods.

On the basis of the strategic objectives in the field of safety and reliability of air navigation services need to solve a number of the following tasks:

1. Objectives of the formation and perfection of normative-methodical security and reliability management database.

1.1. The revision and updating of the existing regulatory framework and its harmonization with international standards.

1.2. Development of normative-methodical documents aimed at improvement of safety management practices.

1.3. Development and implementation of risk management practices related to safety, and the development of a safety management system.

1.4. The development of guidelines and training material for the development and assessment of safety culture.

2. Challenges for the development of technical and technological base

2.1. Development and implementation of measures to upgrade the technical technological base associated with safety and reliability of air navigation services.

2.2. Conducting periodic analysis of efficiency of the use of technology and the results of the ongoing scientific and technical work.

3. Challenges for the development of human resource capacity in the management of safety and reliability of the transportation process.

3.1. Improving personnel management system relating to safety and reliability.

3.2. Adaptation of vocational training to the changing technological requirements.

3.3. Organization of training processes and risk management practices related to safety.

3.4. Organization of training personnel management practices, risk and reliability in the stages of the life cycle of aviation operations.

4. Challenges for the development of information technology to ensure the safety and reliability of the transportation process.

4.1. Creation of information decision support systems to ensure the safety and reliability.

4.2. Implementation of an automated knowledge testing system in terms of safety requirements.

4.3. Development and implementation of automated management systems, risk and reliability in the stages of the life cycle of the air navigation system.

4.4. Improving automated systems to ensure safety performance monitoring functions of technological safety processes.

4.5. Improvement and development of situational monitoring and control safety and reliability of air navigation services, taking into account the existing political situation.

4.6. Improve the recording and investigation of accidents and liability allocation rules.

4.7. Development of methods for identifying causal relationships safety violations.

References

1. Regulation about the flight safety management system of air transportation. – SAA Order #895, 25.11.2005. SAA, 2005.

2. Safety case. Regarding provision of air navigation services within Ukraine. – UkSATSE, 2015.

3. Regulation about supervision of flight safety in air traffic management system. – Min. of Trans. Order #320, 31.05.2010: MoT, 2010.

4. DOC 9859. Safety Mamagement Manual. – Montreal: ICAO, 2009.

5. DOC 9734. Safety Oversight Manual. – Montreal: ICAO, 2006.

6. ESARR 1. Safety oversight in ATM. – Brussels: Eurocontrol, 2009.

7. ESARR 4. Risk assessment and mitigation in ATM. – Brussels: Eurocontrol, 2001.

8. Tocenko V. Methods and system of decision making support / V. Tocenko, 2002.

9. Cir. 241. Human Factors in Air Traffic Control – Montreal: ICAO, 1993.

ПРИНЦИПЫ ПОДДЕРЖАНИЯ ПРИЕМЛЕМОГО УРОВНЯ ВОЗДУШНОЙ НАВИГАЦИОННОЙ БЕЗОПАСНОСТИ В УКРАИНЕ

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В связи с нынешней ситуацией в восточной части Украины и Автономной Республики Крым (АРК) возникла настоятельная необходимость внесения изменений в систему управления воздушным движением Украины (ATM) и аэронавигационных служб (АНС). Эти изменения ATM / ANS касались как национального воздушного пространства Украины, так и воздушного пространства в открытом море, где ответственность за ATM делегирована Украине по международным соглашениям (далее - воздушное пространство под ответственность Украины).

Эти изменения были направлены на обеспечение безопасного и непрерывного предоставления аэронавигационного обслуживания в воздушном пространстве под ответственностью Украины.

Воздушное пространство, находящееся под ответственностью Украины, заключается в том, что в пределах Районов полетной информации (РПИ) в соответствии с основными принципами Конвенции о международной гражданской авиации. Украина обеспечивает управление воздушным движением в воздушном пространстве в открытом море на основе действующих двусторонних и многосторонних соглашений с соседними странами, включая Российскую Федерацию, на основании решения Совета ИКАО от 17 февраля 1997 года (№ EUR / NAT96 / 38 -ATS).

Ключевые слова: безопасность полетов, управление воздушным движением, EUROCONTROL, UkSATSE.

ПРИНЦИПИ ПІДТРИМКИ ПРИЙНЯТНОГО РІВНЯ ПОВІТРЯНОЇ НАВІГАЦІЙНОЇ БЕЗПЕКИ В УКРАЇНІ

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У зв'язку з поточною ситуацією в східній частині України та Автономної Республіки Крим (АРК), існує нагальна необхідність внести зміни системи українського управління повітряного руху (ОрПР) і в аеронавігаційних служб (ANS). Ці зміни ATM / ANS стосувалися як національного повітряного простору і повітряного простору над відкритим морем, де відповідальність за ОВС делегованих України за міжнародними договорами (далі - повітряний простір під відповідальністю України).

Ці зміни були спрямовані на забезпечення безпечного і безупинного надання аеронавігаційного обслуговування в зоні відповідальності України.

Повітряний простір під відповідальністю України є те, що в межах районів польотної інформації (РПІ) у відповідності з основними принципами Конвенції про міжнародну цивільну авіацію. Україна забезпечує управління повітряним рухом в повітряному просторі над відкритим морем, на основі діючих двосторонніх і багатосторонніх угод з сусідніми країнами, в тому числі Російської Федерації, на підставі рішення Ради ІКАО від 17 лютого 1997 роки (№ EUR / NAT96 / 38 -ATS).

Ключові слова: безпека польотів, управління повітряним рухом, EUROCONTROL Украерорух.