Assessment of the risk of adverse events in aviation accidents

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Abstract: *The probability of flying safely in an adverse event situation is related to the probability of being hit and surviving it. Assessing the hazard of adverse events is an important task in aviation accident prevention. The correct quantitative determination of the potential danger of an event allows timely and targeted development of preventive measures: the introduction of new or improvement of old technology, training in actions under certain conditions, etc.*

KEYWORDS: *AIRCRAFT ACCIDENT, HAZARD ASSESSMENT, ADVERSE EVENTS, EMERGENCY SITUATION, ADVERSE EVENT RANKINGS, RANKING METHODS.*

1. Introduction

When investigating flight safety, relevant accident statistics include information on the number of fatalities in aircraft accidents, the especially in the passenger cabin. The probability of a passenger flying safely in an adverse flight event situation is related to the probability of the aircraft getting into an adverse situation and of the passenger surviving in this the incident Assessment of adverse event hazards is an important task in aviation accident prevention. Correct quantification of the potential danger of the event enables timely and targeted preventive measures to be developed: introduction of new or improvement of old technology and vehicle, aerodrome equipment and rescue equipment, training in certain accident conditions, assessment of passenger insurance premiums for different types of aircraft and destination aerodromes, etc. [1.2]

A hazard assessment indicates safety weaknesses in the aviation transport system. When reviewing statistical data, information for a given period is often compared with averaged data for a baseline period to determine trends in the level of safety. This method of analysis can also serve as a useful tool to investigate accident factors, especially in the case of fire incidents on a board of vehicle/

2. Tasks for ranking adverse events

The assessment of adverse events risk consists in ranking them according to the criteria adopted. This gives rise to the following ranking tasks:

1. selection of the hazard criteria on for adverse events;.
2. prioritizes the severity of any possible events that could lead to an aircraft accident (A.A.).

In practice, tasks 1 and 2 are often combined.

The main criterion to determinate the degree of hazard in practice is an indicator that shows the probability of an adverse event then turning into a mortal catastrophe case. This can be either the probability itself, derived statistically, or its derived value, usually obtained by methods of expert analysis.

The hazard is quantified according to the criterion adopted. In the case, if statistically reliable estimate cannot be obtained, the ranking task is to classified and prioritizing events according to their hazard.

3. Methods to rank adverse events

The selection of ranking methods is based on to state an adverse event hazard criterion as the probability then an event turning into an aircraft crash with mortal cases. [1]

There are two main ways of determining the probability of aircrash occurring:

- statistical methods;
- expert judgement methods;

The first method allows us to obtain a reliable estimate especially if a sufficiently large amount of statistical material is available.

The expert method does not have this disadvantage, but in turn carries an element of subjectivity and depends on the examination procedure**.**

4. Methods of Expert Estimation

The methods of expert evaluation allow us to use the experience of flight experienced specialists, when ranking adverse situations. In contrast to the statistical one, it also reflects the expert's attitude to a given type of event, which, based on extensive experience, can provide additional information about the degree of danger of the event. However, in this case there appears subjectivism in evaluation. To reduce it different methods are used. [3] In particular the rank of hazards can be determined in two stages.

At the first stage, the ranks of hazards for categories of events are determined according to statistics.

At the second stage, the ranks of the events themselves (their affects) are determined on the basis of expert evaluation.

The most widespread are methods of expertise based on the assessment of their degree of reliability. The ranking of hazards is performed with an assessment of the competence of experts and with an indication of the degree of consistency (concordance) of the results.

Let us dwell on them in more detail and consider a step-by-step ranking method .

5. Assessment of adverse Events

For each category of adverse events according to the Pi probability of their change to a catastrophe. At the second stage, each category of events from the selected list is assigned its own weight Gj according to the assessed severity, based on the expert survey. [2] The rank of hazards is determined by the value Pi Gj , and the final assessment of the hazard level of events is made for each type of aircraft by the formula

$$P_k = \sum_{i=1}^{m} \sum_{j=1}^{l} P_i^k G_j^k n_{ij}^k,$$

1 Stage

P_i- a probability of adverse events that can to change into a catastrophe,

assigned its own weight Gj according to the assessed severity, based on the expert survey [/ The total rank of hazards is determined by the value Pi Gj , and the final assessment of the hazard level of events is made for each type of aircraft by the formula

2 Stage

1. Each category of adverse events is evaluated by the degree of severity, by introducing a relative weighting coefficient Yi

2. Then the rank of danger is Pi Yi

3. Adverse event hazard level (for each type of aircraft, part, aerodrome, technical service, resque operators etc.)

$$P_k = \sum_{i=1}^{m} \sum_{j=1}^{l} P_i^k y_j^k n_{ij}^k,$$

where Pi is the probability of change of the i-th group of events into a catastrophe for the k-th type of aircraft;
mk - number of groups of events (here m=4);
Ykj - weight (rank) of the j-th event type for the c-th aircraft type;
n_{ij}^k - number of event types.

The distribution of adverse events is presented in the form of a matrix

Tab.1.

	1	…	j	...	l	Total
1	n_{11}	...	n_{1j}	...	n_1l	n_1
…						...
i						n_i
...						
m	n_{m1}		n_{mj}		n_{ml}	n_m
Total	n^1	...	n^j	...	n^l	n

Each column indicates the number of adverse events belonging to the appropriate group and type of event [2]. The matrix is compiled with respect to each type of aircraft

Summary

The total score for all types of aircraft is given by the expression

$$R = \sum_{k=1}^{s} R_k ,$$

where S- the number of aircraft kinds.

To account for the productivity of activities of airlines, it is possible to use a relative indicator of their activity ,

$$K = R/L$$

where L – the parameter of activity (flight hours, endurance time, number of flights etc.

The probabilities Pi are defined as the ratio of the number of catastrophes to the number of adverse events for the i-th group.

$$P_i = N_k/N_i ,$$

where $N_к$ –the number of catastrophe;
N_i-the number of adverse events

Summary

The statistics for Nik is chosen for the period of time immediately preceding the analyzed one, taking into account the obtaining of statistically reliable estimates. When calculating R, the values Pi are taken constant. Determination of Gj weights is performed by the expert survey method. For this purpose, a questionnaire containing a list of the main types of adverse events encountered in practice is prepared and distributed to experts from among the flight instructors. The scores are given on a point scale. The averaged data for each type of aircraft and represent the required weights...

Literature

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