SAFETY ANALYSIS OF RISKS AND RUNWAY STATUS EVALUATION

Ján Kolesár – Petra Lengyelová – Jana Ferencová

The article is a treatment on methodology of identification and recording safety risks in airport movement areas status evaluation.

Keywords: listing faults, safety risk, RWY status identification, level of RWY damage, safety risk matrix

INTRODUCTION

When assessing safety risk at civil airports, it is necessary to identify the „danger – threat – strike – damage chain. The category of airport safety risks also involves safety of aircraft moving along aiport areas. Appropriate attention is to be paid to airport transportation system to eliminate all risks that might threaten ground operation of aircraft.

1 SAFETY RISK FOR AIRCRAFT MOVING ALONG AIRPORT AREAS

Safety risk for aircraft moving along paved airport areas, mostly on the runway, (further only RWY) can be defined as the function of three risk parameters-nature of threats to safety depending on the changes of RWY operational characteristics (evenness, bearing power, breaking actions), level of damage on the airport shelter and the consequences of safety threats to aircraft manoeuvring on the RWY.

Risk= f(threat, level of damage, consequene) *(1)*

The level and nature of threat to ground operation of aircraft on the RWY is the measure of numerousness and character of threats (existing but also probable ones) and consequences of potential threats. The risk involved in the identification process of RWY status safety analysis risk evaluation is understood as the presence of damage or other type of threat to the RWY (e.g. crack, sunken cement-concrete panel, snow and ice on the RWY and other) and negative changes in the RWY operational characteristics (changes in breaking actions, slippery surface of the RWY, insufficient bearing power and the like). The result of the identification process, when assessing the risk, is in making up the variables with the help of which we are in position to define, in via the safety analysis, the severity and consequences of risks. At thorough listing the fault, depending on the RWY damage, its extent and numerousnes, we can determine the technological and economical austerity of repairs to RWY.

When developing the safety analysis and risk listing, it is possible to employ some of the accepted methods and approaches to processes.Applying the proper method and the mathematical algoritm, we can also determine the rate of acceptable risk we are able and willing to accept to ensure safe operation of aircraft on paved airport areas, particularly at takoffs and landings.

2 ASSESSMENT OF RWY STATUS AND OPERATIONAL WORTHINESS

The principal problem in RWY safety risk analysis consists in determining the rate of the acceptable risk defind by the coefficient of airport area operational worthiness. The coefficient is the basi parameter for RWY status eassessment. A reliable value of the rate of acceptable risk can be determined only in real time, under concrete condtions and precise location of the RWY. To this end, it is inevitable to ensure through listing of faults and objective assessment of the RWY status. In the light of the recommended practices and classification markings, one can develop a catalogue of RWY damages.

Using simulation models one can perform a safety risk analysis in the area of threats to airport movement area operations even for

a virtual airport. Data for the modeling and simulation process will be based on statistics and validated analyses of causes of damages, their further development, severity and consequences in terms of potential threats to operational safety of aircraft moving on the RWY.

Methodology-based approach to listing and identification of risks, their assessment and determination of vulnerable areas with empasis on the consequences is illustrated in the dalgorithm of safety and risk assessment, see Fig.1.

The result of the analytical process of can also involve the process of optimization. Selecting an optimal solution will serve both planning and organization of repairs of RWY damages to ensure the required operational worthiness of the RWY.

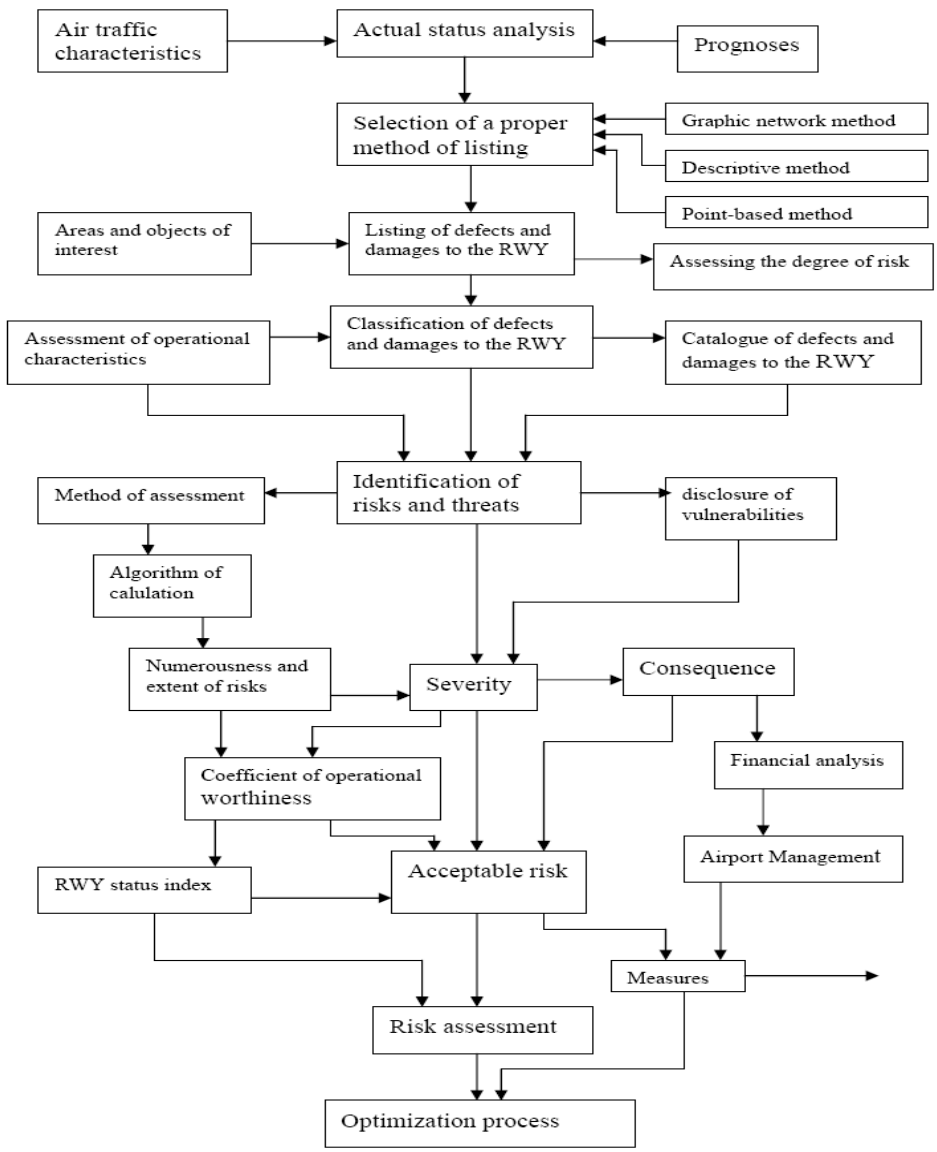

Fig. 1 Algoritm of risk identificationa and the process of RWY status safety risk assessment

In the process of risk analysis for safety management, practice makes use of a large number of methods of risk identification and risk rate assessment posed to the safety system in order to reveal points that are vulnerable. We know methods of both mathematical and aslo graphical risk modeling. The basic criterion when selecting for the method, the ractor of reliable assessment and determination of the most probable causes to risks in the system analysed. When it comes to assessing the presence of risks and threats to aircraft moving along the RWY, analysis is concerned with assessing primarily the functioning and endurance ibn terms of required operational characteristics of the RWY (evenness, bearing power, coefficient of braking effects, slping of the RWY, damages etc.)

Of high importance in safety analysis is the development of the socalled catalogue of potential causes of risks and their consequences. It can be written in the form of defining threats in the sphere of structural elements, e.g. when determining the location of the damages of the RWY (damages on the surfaces, joints, RWY substructure and grainout , snow and icing on the RWY and the like) or from the point of threats to the processes (takeoff, landing, winter operation, operation at low visibility etc.).

Defining the consequences, determining the nukmerousness of isk and estimationof their occurence is possible by way of identifying the threats, their causes and origins risks.

Based on the identification marks wee can determine the coeefficient of acceptable risk as a basic indentificator with the help of which we are able to assess, within the entire analytic process, the functionability and nature of the system aanalysed.

3 ASSESSMENT OF SAFETY RISKS

One of the ways which, within the framework of safety analyses, can be used when identifying and assessing risk is the point-based evaluation system applied to risk parameters. A suitable evaluation scale of parameter assessment can offer a simple and fairly reliable identification of the threat level, vulnerability and risk consequences. The individual elemnts of evaluation are ordered into a line scale forming an evaluation matrix with the individual categories arranged within the scope from minimum risk identification as high as to the level of inacceptable risk.

To this purpose, it is recommended to develop a what is called „card of threat assessment*"*. When evaluating RWY operational worthiness, it is a good practice to have the cards developed for the separate sections of the RWY established already in the phase of primary identification using a network graph thereby dividing the RWY into smaller parts for evaluation. However,, the RWY can be evaluated as a whole, too. Then the RWY status index under evaluation is affecteed with the relatively unreliable arithmetical mean calculated froum the numerousness and severity of of faults with the entire RWY.

Values obtained from risk assessment are then compared within the predefined scale using a constant- the coeefficient of the acceptable risk Such an approach to risk assessment of aircraft ground safety on the RWY can be extended into several dimensions, for example into civil engineering mechanics when assessment is concerned with the quality of materiel used (concrete, asphalt), their changes resulting from mechanical loading, climate factors and the like. The fundamental element of the risk assessment is that of the safety risk, the final value of which can be calculated by means of several variables. If we use a basic matrix with three factors, we are able to express it in a three-dimensional form, see Fig. 2.

The risk matrix comprises the individual categories of risk occurrence and the vulerability of the transportation system evaluated from known (or frequent) to potential thereats (hihgly improbable).

The interval of the risk matrix evaluation scale can be extended and described by means a suitable mathematical algoritm. System vulenrability is assessed along the scale of probable risk occurence in six categories from highly probable(frequent)as fara s to the highly improbable. The category will be comprised of assessment highly improbable (1), improbable (2), remote (3), occasional (4), probable (5) and frequent (6). The level of a six-level assessment in the process of risk indentification can be used

also for categorization of the perceived safety threat when assessing the probability of risk occurrence. Threat severity and the consequences will be evaluated by way of assigning it one of the four levels ranging from neglectable to catastrophic in the order of: neglectable (1), marginal (2), critical (3) and catastrophical (4).

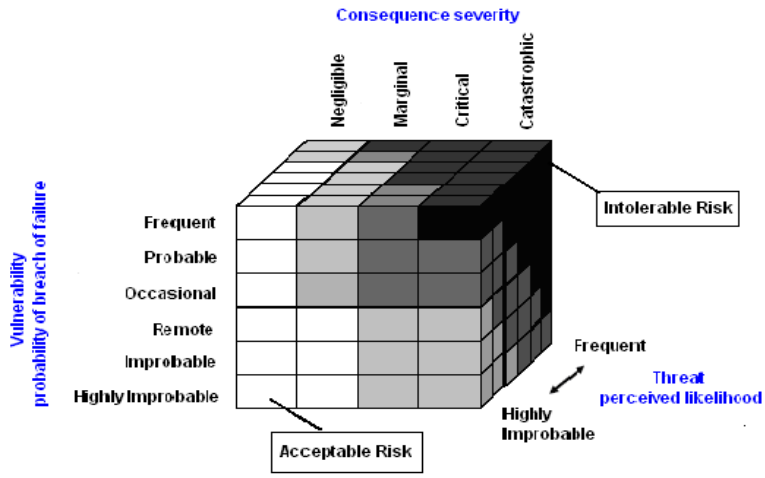

Fig. 2 Three-dimensional matrix of risks with assessment scales of threats, vulnerability and consequences

When applying the risk matrix, we can quantify the level of threat and vulnerability as parameters formulated from the point of probability of risk occurrence within the range of values from zero to one, or in the interval of 0 as much as 100 (resp. 0% - 100%), or otherevaluation interface if need be.

Scenarious of assessment to be based the occurrence of highly improbable threats, with minimum or no consequences will be considered as acceptable risks. On the other hand, cases with highly probable threats and the consequences of the most probable scenario is considered as the one of high riskor even catastrophical, will be taken for inacceptable risk.

Between the acceptable and inacceptable risks there is the so-called *„grey area"* (see risk matrix in Fig. 2). It is a category of risk when it can be reduced to an acceptable level through regular maintenance and adherence to the recommended practices applicable to Runway maintenance. Daily monitoring as part of the standard checks enable immediate identification of risks visually perceivable. Proper organization of the system of maintenance and common repairs makes it possible prompt and efficient reduction of the threat level thereby increasing the operational worthiness coefficient of the RWY.

The *„black area"* in the risk matrix involving catastrophic consequences and inaccceptable risk is about risk connected with huge and severe defects. When assessing RWY operational worthiness, we should, however, realize that a single fault, threat, probability of threat to tzhe RWY from the „black area" is the measure of inaccapteble risk. In such case, it is necessary to take measures to eliminate the risk as the overall RWY status will move into the critical or even catastrophical part of the scale.

Acceptable risks in the risk matrix are within the *„white places"* considering risks related to faults and RWY statuses, which by their nature, extent and numerousness pose no threat to air traffic. Risk might turn into threats only at a later time if insufficient measures are taken in terms of preventive actions that are inevitable to avoid further negative

development of faultsand potential degradation of operational worthiness of the RWY.

CONCLUSION

Analysis of safety risks aviation has climbed high on the agenda recently, substantially influencing the process of adopting safety measures and procedures in civil aviation. The results serve also as a basis for financial analyses of investment and operational costs, assessment of the level of airport safety.

It is the very category that the area of safety risk assesment and evaluation to RWY status and operational worthiness belong to by all means.

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AUTHORS´ ADDRESSES:

Ing. Ján KOLESÁR, PhD. – KLI, LF TU
v Košiciach, Rampová 7, 04121 Košice, SR,
jan.kolesar@tuke.sk
Ing. Petra LENGYELOVÁ - KLI, LF TU
v Košiciach, Rampová 7, 04121 Košice, SR,
petra.lengyelova@tuke.sk
Ing. Jana FERENCOVÁ - KLI, LF TU v Košiciach,
Rampová 7, 04121 Košice, SR,
jana.ferencova@tuke.sk