RISK ELIMINATION IN AIR TRANSPORT

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Summary. Risk analysis and risk management are the main disciplines of science of risk used in crisis management in aviation. The article stated in brief form, their categorization and methods used in the analysis, as well as basic aspects of risk management towards its domination, required the elimination of the negative consequences of crisis situations and opportunities creating positions to prevent their occurrence.

Keywords: safety system in aviation, dangerous situation, crisis management, risk analysis, risk management

1. INTRODUCTION

Solution to the crisis generally requires a maximum deployment of human capacity, material and financial resources and is subject to the ability of getting a crisis situation under control and minimizes losses. The best solution to the crisis situation is to create a state of impossibility of their origin, i.e., knowledge of the risks and opportunities of their occurrence (risk analysis) with such management of units that it is impossible for potential risks to occur (risk management). These are the two main disciplines of risk theory - the science of risk, knowledge of which may substantially affect the effectiveness of crisis management.

2. THEORY OF RISK

Risk (from Italian risico) can be translated as obstacle. The word risk originated in the 17th century in the Navy and designated the reef that need to be avoided so that ships would not wreck. In various encyclopedias, the word risk is linked with synonym danger or probability of loss, or threats; if this danger is realized, there is damage and losses (physical, psychological, economic, financial, etc.).

Risk is thus the possibility of a specific decision situation involving uncertainty, which generates a solution different from the approach of decision-making situations without uncertainty.

Risks are subdivided into different categories and groups. The breakdown is mainly associated with the area to which they relate (manufacturing, commercial, financial, political, technical, business .... risks) and with a characteristic feature of the risks (static, dynamic, systematic, operational, speculative risk ...). Example of a possible risk categorization is shown in figure 1.

Figure 1 Risk categorization

The study or science of risk is an organized and systematic thinking necessary to the management of units that are forming the human society in the broadest sense.

There consists of two disciplines:

1. **Risk engineering (Re),**
2. **Risk management (Rm)**

3. RISK ENGINEERING AND RISK ANALYSIS

Risk Engineering is primarily concerned with the technical aspect of risk and its evaluation. The main part of the risk engineering is risk analysis (AR). Risk analysis is an essential element of risk engineering and is a necessary condition in decisions about risk and therefore an essential process in risk management. Therefore, it is increasingly applied to non-technical areas of our lives such as natural disasters, imbalances in the various subsystems and the like.

Quality and qualified solutions to any problem in any area is always based on quality risk analysis, which is an essential input for risk management. The role of risk engineering is to provide data for decision-making about risk.

Risk analysis is generally in the sequence:

1. the intended purpose of RA,
2. own risk analysis (identification and quantification of risks, assessment of risks and probability of occurrence)
3. the risk assessment,
4. preparation of the measures.

Risk analysis is therefore the identification and assessment of hazard + risk quantification with identifying of unfavorable events, causes and consequences of these events. Risk analysis is currently using large number of various methods which arose mainly as an order for risk analysis of a particular enterprise or institution.

Risk analysis method is divided into:

1. Inductive methods of RA - to foresee the malfunction of equipment in a complete operational formation, the risk analysis points to factors that could cause failure. Inductive methods are helping to evaluate the number and consequences of failures and take appropriate precautions.

2. Deduction methods of RA - are analyzing accidents which have arisen in practice and are looking for events and the context that have caused them.

Risks are random (stochastic) variables, which intersect, connect and intensify (chain) each other. Their analysis is a complex process, which uses methods of statistics, probability theory, queuing, operational analysis, modeling and process simulation using computer technology.

The risk is understood as a potential to compromise system security, object or process. It is the probability of a crisis phenomenon formation and its consequences. Risk analysis is a process of detailed identification of risks, determination of their resources and size, reviewing of their relations and predicting the range of negative impacts on the system in a crisis situation (CS).

Methods (approaches) of the risk analysis are divided into traditional and specific.

Traditional methods of RA:

a) Analysis by control list / CLA /,
b) Routine tests / RT /,
c) **S**ecurity/safety audit / SA /,
d) What happens when... / WFA /.

Specific methods of RA:

a) Preliminary Hazard Analysis / PHA /,
b) Relative regard / ReR /,
c) Rapid regard / RaR /,
d) Hazard study and operational capability / HAZOP /,
e) Failure impact effect analysis / FMEA /,
f) Hazard analysis / HAZAN /,
g) Failure three analysis / FTA /,
h) Hazard three analysis / HTA /,
i) Cause and consequence analysis / CCA /,
j) Human reliability analysis / HRA /,
k) Chemical processes Quantitative risk analysis / CPQ RA /.

Mentioned risk analysis methods are mostly used in various modifications and adjustments to the specific conditions of the specific investigation, and each is demanding (procedures, algorithms and restrictions).

4. RISK MANAGEMENT

Risk management is the second discipline science of risk and is focused on management and economy of company. Risk management (RM) is part of the strategic thinking and it is the ability to recognize and effectively manage risks in order to:

- reducing the negative consequences of decisions in uncertain conditions (risk management)
- is a complex process of detection, control, elimination and minimization of uncertain events, respectively. impact on the losses.

  Risk management is used for the development of strategies that eliminate or remove the loss and therefore is a general indication of spontaneous and systematic actions that seek to control risk. Without perfect risk analysis / which is an essential input for qualified risk management / risk management can not be successful. This can be expressed by sequence shown in the following figure. 2.

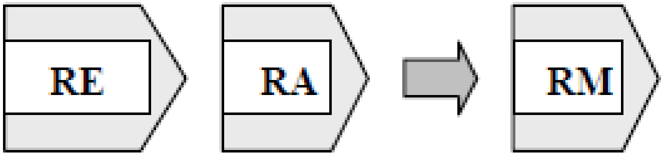

Figure 2 from risk engineering, analysis to risk management

Risk analysis is an essential element of risk engineering and a necessary condition for making decisions on risk and, therefore, an essential process in risk management. Risk management of the effort to conquer it - is the essence of risk management. The two components risk interacts be the content of risk theory.

We can rate the occurrence of risk phenomenon by the probability of its occurrence. Risks generally overlap, combine and intensify each other. Chaining of multiple risks, causes and consequences is therefore difficult to calculate and express mathematically. The synergy of several phenomena is sometimes unpredictable. If we denote $\mathbf{1- R_1}$ as the probability of non- occurrence of risk phenomenon and $(1- R_1)^n$ as the probability of occurrence of n risk factors, then the relationship.

$$\mathbf{R_n = 1 - (1- R_1)^n} \tag{1}$$

it expresses the probability of occurrence of n risk events, what we also call "a cluster of coincidences“,
where:

- $\mathbf{R_n}$ **-** i**s** the probability of a dangerous (risk) situation / under the action of **n -** factors /, and the probability
- $\mathbf{R_1}$ **- is** the officials of many variables /as a rule, the conditional probability of risk phenomenon /.

To formularize the size of the damages, or damage to the system we can use **Mn** which is the mathematical expectation, i.e., formularization of consequence of risk phenomenon occurrence in the system.

5. CRISIS MANAGEMENT

The scope and complexity of ensuring the safety and protection of the population and passengers while solving risk (emergency) situations is determined by the complexity of control systems (safety, manufacturing, financial, supply, health, energy,...).

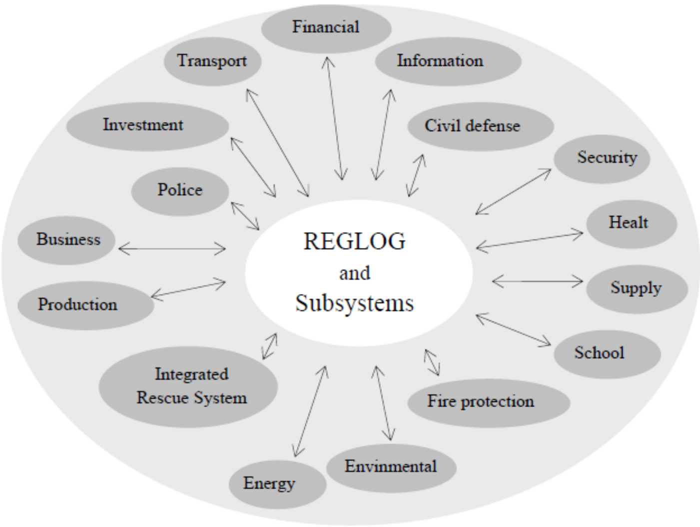

Figure 3 Subsystems of crisis management

Due to occurrence of risk events, there are risk (crisis) situations, which are solved by risk management. In a comprehensive understanding of the crisis situations in society, it is called crisis management. In addressing the crisis situations in the aviation, important role is played by preparation for imbalances and providing of proactive safety and public protection. The problem of solving a crisis situation is a multispectral information base, extreme amounts of data and search for best solutions in a hurry. Search for neuralgic places in difficult and dangerous situations, prevention of serious accidents and incidents in aviation, but also prediction and solutions to the impacts of natural disasters, acts of terrorism and unlawful conduct, as well as ensuring continuous logistic readiness for rapid assistance, efficient operation and coordination of rescue is very complex problem. Crisis situations and emergencies are only occasional phenomenon and therefore safety (emergency) logistics gets only insufficient attention.

To cope with these situations is a need for thorough structural analysis of the solvable subsystems, thorough analyses of the potential risks and prepare effective measures to prevent escalation to repeat the experience (prevention), respectively, the choice of such a risk management in order to maximum elimination of their consequences.

6 CONCLUSION

To handle emergency situations in aviation, detailed knowledge of the subsystems, assessing their behavior under normal and non-equilibrium situations, modeling of subsystems activities with different variations and optimization of possible procedures, dynamic adaptation of system operation at rapid changes or creative synergy of subsystems during emergency situations is required. In air transport, it is even more important because to build a proactive safety system requires close collaboration and cooperation of subsystems at the national and especially international level.

BIBLIOGRAPHY

[1] TICHÝ, M.: *Ovládání rizika.* Praha: C.H.Beck, 2006. ISBN 80-7179-415-5.
[2] PETRUF, M.: *Logistika krízových situácií. e-learningová učebnica – Digital support*, FBERG TU Košice -2005 , 250s. ISBN 80-8073-378-3.

[3] TEPLICKÁ, K., SZABO, S., CEHLÁR, M.: *HACCP - new trend of risk management in air force*, 2011. In: AFASES 2011 : Scientific research and education in the air force, Brasov. Air Force Academy, P. 1199-1203. - ISSN 2247-3173
[4] PETRUF, M.: *Hospodárska mobilizácia a občianská bezpečnosť*. SPU-Nitra 2008 (e-learningová učebnica pre FEŠRR).
[5] TŮMA, L., ENDRIZALOVÁ, E.: *Online Marketing Campaign Proposal for the SmartWings Company.* In: eXclusive e-JOURNAL. 2015. Vo, 3. No.1. ISSN 1339-4509