

БИБЛИОГРАФИЧЕСКИЙ СПИСОК

1. *Ивашук И.Ю.* Система уровней доверия к беспроводной сети на основе реализованных в ней механизмов защиты // Теория и технология программирования и защиты информации: Сб. трудов XIV Междунар. научно-практ. конф. (Санкт-Петербург, 20 мая 2009 г.). – СПб., 2009. – С. 31-33.
2. IEEE Standard for information technology – Telecommunications and information exchange between systems – Local and metropolitan area networks – Specific requirements. Part11: Wireless LAN Medium Access Control (MAC) and Physical Layer (PHY) Specifications. – IEEE Std. 802.11. – 2007 Edition.
3. *Ивашук И.Ю.* Критерии оценки безопасности беспроводных сетей // Теория и технология программирования и защиты информации: Сб. трудов XI Междунар. научно-практ. конф. (Санкт-Петербург, 18 мая 2007 г.). – СПб., 2007. – С. 76-80.
4. *Гордейчик С.В., Дубровин В.В.* Безопасность беспроводных сетей. – М.: Горячая линия – Телеком, 2008. – 288 с.

**Ивашук Ирина Юрьевна**

Санкт-Петербургский Государственный университет информационных технологий, механики и оптики (СПбГУ ИТМО).

E-mail: irina.ivashchuk@gmail.com.

197101, г. Санкт-Петербург, ул. Саблинская, 14.

Тел.: 88122338651.

**Ivashchuk Irina Yurievna**

Saint-Petersburg State University of Information Technologies, Mechanics and Optics (SPbSU ITMO).

E-mail: irina.ivashchuk@gmail.com.

14, Sablinskaya, Saint-Petersburg, 197101, Russia.

Phone: 88122338651.

УДК 656.7.08

**Ján Piľa, František Adamčík**

**SAFETY RISK AND SAFETY HAZARD IN AVIATION AND SLOVAK  
WORKPLACE HEALTH AND SAFETY LEGISLATION**

*The topic of the article is to explain some peculiarities in definitions according to ICAO Safety Management System, USA FAA and Slovak legislation. Misunderstandings with terms “risk” and “hazard” following International Civil Aviation Organization (ICAO), USA Federal Aviation Authority (FAA) definitions and Slovak Workplace health and safety legislation it could make a problem in aviation risk management and hazard identification according to ICAO Safety Management System (SMS). In Slovak administrative law the term a hazard is missing. Instead of term hazard terms danger, threat or dangerousness are used.*

*Aviation safety; hazard; risk; danger; threat; aviation legislation; administrative law*

**Ján Piľa, František Adamčík**

**РИСК И ОПАСНОСТЬ В АВИАЦИИ И ИХ ПОНИМАНИЕ В СЛОВАЦКОМ  
ЗАКОНОДАТЕЛЬСТВЕ ОБ ОХРАНА ТРУДА**

*Объясняются понятия риск и азарт по ICAO, FAR и в словацком законодательстве. Неправильное толкование понятий «риск» (англ. risk) и «азарт» (англ. hazard), которые применяются в терминологии ICAO, FAR и законодательства Словацкой республики в связи с безопасностью и охраной здоровья во время труда, могут стать причиной проблем в системе управления безопасностью воздушного движения. В словацком административ-*

ном праве термин «азарт» не существует. Вместо него применяется термин «опасность» или «угроза».

*Авиационная безопасность; азарт; опасность; угроза; авиационное законодательство; административное право*

**INTRODUCTION.** Aviation is remarkable for the giant technological leaps it has made over the last century. This progress would not have been possible without parallel achievements in the control and reduction of aviation's safety hazards and strict aviation legislation. Given the many ways that aviation can result in injury or harm, those involved with aviation have been pre-occupied with preventing accidents since the earliest days of flying. Through the discipline of "*flight safety*," the frequency and severity of aviation occurrences have declined significantly.

Since Slovak republic is a member of the European Union bond by European legislation is obliged to execute liabilities according to it membership in other aviation organization (ICAO, EASA, EUROCONTROL a.i.). This reality is crucial brake-point in Slovak aviation legislation. Each organization engaged in aircraft operating and engineering has to adopt safety programs for a number of reasons. Some form of accident-prevention program is usually a regulatory requirement. These requirements may take the form of laws, regulations, and directives that govern the design, construction, maintenance, and operation of aircraft. Analogous to Quality Management System (QMS), the Safety Management System (SMS) play important role in aviation operation.

**1. ISK AND HAZARD CONFUSION.** Generally term **safety** according to ICAO is defined as "the state in which the risk of harm to persons or property damage is reduced to, and maintained at or below, an acceptable level through a continuing process of hazard identification and risk management".

Risk is an assessment, expressed in terms of predicted probability and severity, of the consequence(s) of a hazard taking as reference the worst foreseeable situation [1]. The differentiation between hazards and safety risks is oftentimes a source of difficulty and confusion. In order to develop safety management practices that are relevant and effective, a clear understanding of what is a hazard and what is a safety risk is essential.

The concise Oxford Dictionary defines **risk (noun)** in terms of a hazard, chance, bad consequences, loss, etc., exposure to mischance. It defines **risk (verb)** in terms of: to expose to chance of injury or loss, venture on, accept the chance of. The dictionary definitions do not correspond entirely with what epidemiologists or professionals in the field of aviation would understand these terms to mean.

The meaning of the word **hazard** can be confusing. Often dictionaries do not give specific definitions or combine it with the term "risk". For example, one dictionary defines hazard as "a danger or risk" which helps explain why many people use the terms interchangeably.

**Hazard** is not deemed to be synonymous with risk although it can be an important determinant of risk. Although risk may be related to a chance event and expressed as a probability, there is much more to it than that. Probability is not an entirely haphazard one of course but relates to a number of factors which will be discussed further. A hazard is any source of potential damage, harm or adverse health effects on something or someone under certain conditions at work. Basically, a hazard can cause harm or adverse effects (to individuals as health effects or to organizations as property or equipment losses). Sometimes a hazard is referred to as being the actual harm or the health effect it caused rather than the hazard.

The characterization of **risk** has both quantitative and qualitative components to it. These can be described separately (Fig.4). One must not forget that often statements about causation are made which depend on certain assumptions. Therefore statements about risk must also be guided by indication of the uncertainty that may be associated

with them. You may wish to find out more about critical appraisal of published literature, for example.

If **risk** is defined as the probability of death, past risk in traveling can be empirically determined from fatality rates. Commercial aviation accidents involving large jets can result in the deaths of hundreds of people; thus, a single accident can significantly influence fatality rates. Consequently, trend analyses of fatality rates require data from time periods of roughly five years or more. These rates give poor indication of short-term changes in risk [2].

The relationship between hazard and risk must be treated very cautiously. If all other factors are equal - especially the exposures and the people subject to them, then the risk is proportional to the hazard. However all other factors are very rarely equal.

**2. AO AND FAA RISK AND HAZARD DEFINITIONS.** International air commerce is almost completely controlled by various multilateral and bilateral treaties. One of the more famous treaties, the Chicago Convention, spawned the International Civil Aviation Organization (ICAO). The ICAO is an international organization which is dedicated to aviation safety and uniformity in international aviation. International aviation safety and uniformity are self-regulating in the sense that member states agree to abide by international principles. To the extent that the member states of the ICAO have agreed upon uniform standards for navigation, engineer, design, communication and safety, etc., the rules and standards promulgated by the ICAO are binding on the member states and the aviation industry within those member states.

The Federal Aviation Administration (FAA) is tasked by the Federal Aviation Act to maintain aviation safety and to promote air commerce. Thus, the FAA wears two hats. Under one hat, the FAA promotes business growth in the aviation industry. Additionally, the FAA regulates and enforces as necessary to maintain aviation safety.

Both organizations have their own definitions regarding aviation safety.

**Hazard** is defined as "*condition or object with the potential of causing injuries to personnel, damage to equipment or structures, loss of material, or reduction of ability to perform a prescribed function*" [3].

Consequence is potential outcome(s) of the hazard. A wind of  $8\text{m}\cdot\text{s}^{-1}$  blowing directly across the runway is a hazard. A pilot may not be able to control the aircraft during takeoff or landing is one of the consequences of the hazard.

There are three types of hazards:

- ◆ natural (hurricanes, major winter storms, drought, tornadoes, thunderstorms lightning,, wind shear) - Fig. 1,
- ◆ technical (aircraft and aircraft components, systems, subsystems, related equipment)
- ◆ economic (growth, recession, cost of material or equipment) - Fig. 2.

**Hazard FAA definition.** A hazard is defined as a "*Condition, event, or circumstance that could lead to or contribute to an unplanned or undesirable event*". Seldom does a single hazard cause an accident. More often, an accident occurs as the result of a sequence of causes. A hazard analysis will consider system state, for example operating environment, as well as failures or malfunctions.

Hazard and its equivalent in the Slovak workplace health and safety legislation

The term of hazard in Slovak Workplace health and safety legislation doesn't exist. Instead of hazard the term of "*bezpečnosť*" in Slovak language (i.e. danger, dangerousness, and threat) is used (Fig. 2). Hazard in Slovak meaning is joined with gambling activities that could have different meaning to danger or threat.

**Danger** is the state or property of working process and work environment factor that can make harm of man health. **Threat** is situation in which is not possible to elimi-

nate harm of the man health. **Harm** – physical or mental damage. **Loss** - the damage, trouble, disadvantage, deprivation, etc. caused by losing something.



Fig. 1. Natural hazard - helicopter bird strike

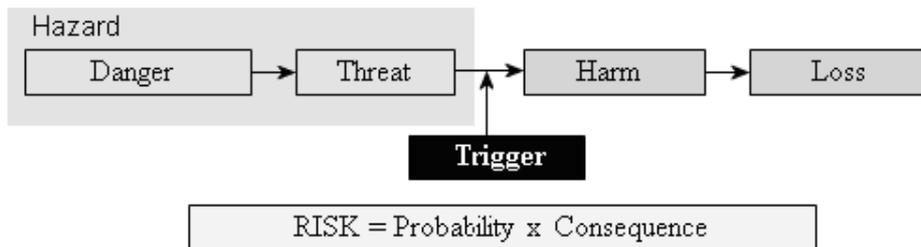


Fig. 2: Causal relation of accident generation

Since the Slovak republic is a member of JAA (Joint Aviation Authorities) and EASA (European Aviation Safety Agency) we retire all documents and are required to keep common European regulations and rules in aviation legislation. Different languages may sometimes cause different terms meaning. Danger and threat in Slovak language is known as something that cause harm or adverse effects to individuals as health effects or to organizations as property or equipment losses.

**Danger:** if any single object or single operation, e.g. machinery, engineering systems, materials, technology and other operating activities are characterized by sudden negative occurrence, e.g. harm to persons or property damage – is concerned to dander or dangerous activities. Danger can be seen as the hidden property of the object, potential to make harm [4].

**Threat:** when engineering object starts its operation and there is not accepted its dangerous property, when activities start with emerging danger, when materials with potential danger are actively used, than the danger is generated in space and time dimension. Threat is manifestation of danger and a way to injury or harm making [4].

**Threat as a potential of risk.** Mathematically risk can be expressed as:

$$R = P \times S$$

where: R – risk, P – probability (likelihood that an unsafe event or condition might occur), S – severity (the possible effects of an unsafe event or condition, taking as reference the worst foreseeable situation)

$$R = f(P, S)$$

$$R = \sum_i^n P_i \times \sum_j^m S_j$$

$$R = P \times S^C$$

where i, j – indexes relating to potential i – threat and j – consequence, C – express different types of consequences (based on the scale,  $C \geq 1$ )

Term “threat” is not used in ICAO SMS. In aviation the **threats** are defined as “**events or errors** that occur beyond the influence of the air traffic controller, increase operational complexity, and which must be managed to maintain the margins of safety” [5]. During typical ATC operations, air traffic controllers have to take into account various contextual complexities in order to manage traffic. Such complexities would include, for example, dealing with adverse meteorological conditions, airports surrounded by high mountains, congested airspace, aircraft malfunctions, and/or errors committed by other people outside of the air traffic control room (i.e. flight crews, ground staff or maintenance workers). In Slovak common use of the term danger and threat are expressed by one word only, usually as a danger that in English language is meaning a hazard.

**ICAO risk definition.** Safety risk is defined as “the assessment, expressed in terms of predicted probability and severity, of the consequence(s) of a hazard taking as reference the worst foreseeable situation”(Fig. 3).

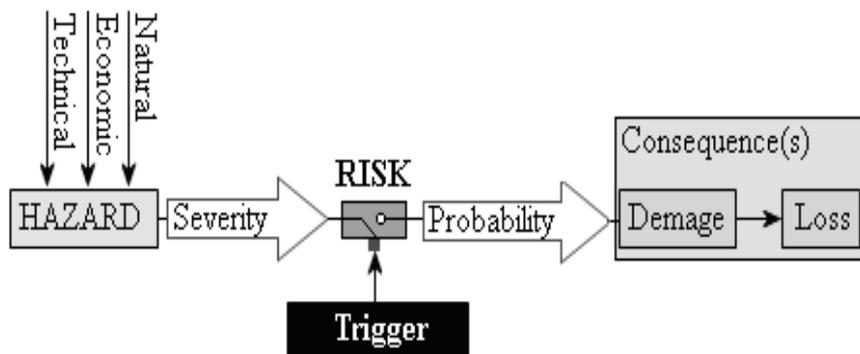


Fig. 3. ICAO SMS risk definition

**Risk probability** is defined as the likelihood that an unsafe event or condition might occur. **Risk severity** is the possible effects of an unsafe event or condition, taking as reference the worst foreseeable situation. **Risk management** is the identification, analysis and elimination, and/or mitigation to an acceptable level of risks that threaten the capabilities of an organization.

**FAA Safety risk severity:**

**A – Catastrophic**

- ◆ Equipment destroyed;

- ◆ Multiple deaths.
- B – Hazardous**
- ◆ A large reduction in safety margins, physical distress or a workload such that the operators cannot be relied upon to perform their tasks accurately or completely;
- ◆ Serious injury.
- C – Major**
- ◆ A significant reduction in safety margins, a reduction in the the operators to cope with adverse operating conditions as a result of increase in workload, or as a result of conditions impairing their efficiency;
- ◆ Serious incident.
- D – Minor**
- ◆ Nuisance;
- ◆ Operating limitations;
- ◆ Use of emergency procedures;
- ◆ Minor incident.
- E – Negligible**
- ◆ Little consequences.

		QUALITATIVE COMPONENTS					
		Severity	No safety effect	Minor	Major	Hazardous	Catastrophic
QUANTITATIVE COMPONENTS	Likelihood		5	4	3	2	1
	Probable A						
	Remote B						
	Extremely Remote C						
	Extremely Improbable D						

High Risk   
  Medium Risk   
  Low Risk

Fig. 4. FAA AMS Matrix of risk severity

**FAA risk definition.** Risk is the future impact of a hazard that is not controlled or eliminated. It can be viewed as future uncertainty created by the hazard. If it involves skill sets, the same situation may yield different risk [2]. Assessment of risk is made by combining the severity of consequence with the likelihood of occurrence in a matrix.

**CONCLUSION.** The differing use of the terms “risk” and “hazard” could be one explanation for the misunderstandings that arise in risk communication between public authorities, industry, non-governmental organizations and the general public. The results of the studies show that the terms “risk” and “hazard” are used differently by the various

scientific disciplines like the natural sciences, social sciences and humanities and each has its own clear definition.

Risk and hazard are two words that you may hear used interchangeably, but there is a very important difference in the meaning of these two little words. Hazard is the harm that something can cause. The harm may be physical injury, damage to health, property and/or the environment. Risk is the likelihood that a hazardous material will cause harm to people, property or the environment. In Slovak language instead of hazard we say danger or threat which has the same meaning as a hazard.

#### REFERENCES

1. ICAO Doc 9859, Safety Management Manual, ICAO, 2009. – 264 p.
2. *Alexander T. Wells*. Commercial Aviation Safety, The McGraw-Hill Companies, 2003. – 475 p.
3. FAA-8083, Risk management handbook, Flight Standards Service, 2009. – 112 p.
4. *Hana Pačaiová, Juraj Šinay, Juraj Glatz*. Bezpečnosť a riziká technických systémov, Viena s.r.o., 2009. – 246 p.
5. ICAO Cir 314, Threat and Error Management in Air Traffic Control, ICAO, 2008. – 34 p.

#### **Ján Pila**

Faculty of Aeronautics, Technical University of Košice.  
E-mail: Jan.Pila@tuke.sk.  
Rampova 7, 04121 Košice, Slovak Republic.

#### **František Adamčík**

Faculty of Aeronautics, Technical University of Košice.  
E-mail: Frantisek.Adamcik@tuke.sk.  
Rampova 7, 04121 Košice, Slovak Republic.