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SAFETY IN TRANSPORTATION: A REVIEW OF THE CONCEPT, ITS CONTEXT, SAFETY PRESERVATION AND IMPROVEMENT EFFECTIVENESS

Summary. The article presents definitions of and approaches to the concept of safety in order to confirm the subjective character of its determination, description, and interpretation. By presenting examples of security statistics and safety-related behaviours, its ambiguity and complexity are revealed. The author draws attention to the media's attitude towards safety-related incidents. With reference to contemporary scientific knowledge about the methods of improving safety in transportation organizations, the author also suggests that safety improvement initiatives should focus more strongly on facilitating closer cooperation between leaders, superiors and subordinates with different levels of experience.

Keywords: safety; security; transport; aviation; psychology; media

1. INTRODUCTION

Every contemporary discipline in life is associated with the concept of safety (or security)[2]. It has become a natural and integral part of any discussion, analysis and criticism of projects

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[2] As safety and security are, in the literature, often used as synonyms, the author uses both notions interchangeably (see Chapter 3, Paragraph 1).

and development initiatives. A Google search under "level+of+safety" returns almost 24 million responses. When determining the level of safety or its change, we claim that our understanding of the essence of the concept is universal. As a result, we are minded to view its adjectival, qualitative or even quantitative interpretations in a common way. However, the analysis of scientific and professional literature, along with media reports and public opinion, reveals that safety perception and awareness are affected by a significant amount of seemingly unrelated factors.

The following article aims to show safety from different perspectives, through the prism of the conditions and methods of its establishment, regulation and assessment. The intent here is to indicate how subjectivity, within the interpretation of the term, may become an inhibiting factor in its preservation and development. It also explains how people who are believed to be directly responsible for the level of safety, due to a distorted and unclear information flow, can be forced into taking defensive positions and, in turn, obliged to present excessive, and sometimes useless, albeit socially expected, caution.

2. DEFINING SAFETY AND SECURITY

According to the Polish definition, from the *Glossary of National Security Terms*, security is "a condition which gives a sense of certainty and guarantees its preservation as well as the chance to improve" and "the situation distinguished by a lack of risk of losing something that one particularly appreciates" [2]. Authors of this particular definition divide the concept into subunits focusing on the following components of life: economic, social, psychological, military etc.

Analysing the definitions of security in English and German reveals an interesting fact. The *Cambridge Dictionary* defines security thus: "protection of a person, building, organization or country against threats such as crime or attacks by foreign countries" [12]. At the same time, the *Merriam-Webster Dictionary* explains security as: "the quality or state of being secure; [...] freedom from fear or anxiety" [42]. The definition in German, based on the works of Kuhlmann and Jungemann, presented in *Dorsch Lexikon der Psychologie*, states that security is a "condition without damage or perception of a state without damage or potential damage" ("*Zustand ohne Schädigung oder Wahrnehmung eines Zustands ohne Schädigung oder potenzieller Schädigung*") [17, 28, 34]. A disparity between all three definitions is clearly visible. The Polish interpretation of the concept concentrates on sense and a guarantee, but is also open to improvement. The English explanation focuses on a lack of fear and anxiety (psychological states) and refers to the threat of foreign state attack. Finally, the German interpretation relates the theory to a state or sense of damage. Thus, all definitions try to establish the essence, the source and the direction of possible threats. They also suggest that achieving complete and absolute security is impossible because the notion itself is relative, which means that it is always the result of a subjective evaluation. Maurice et al., in their definition, describe safety as control over the occurrence of risks, hazards or conditions, which are conducive to human health and the loss of well-being [41]. They add that, to achieve a high level of security, it is necessary to recognize the actual existence of adequate protection against danger ("sheltered from danger"). In order to achieve this, among the four basic, necessary preconditions, the authors refer to respect for the individual, along with her or his psychological integrity.

All of the definitions presented above prove the internal, psychological source of safety or security perception. The German description especially links the notion with the most

unpleasant perspective of damage, thus placing itself closest to the most-known concept with Maslow's hierarchical order of needs. At the same time, definitions of security, through a process of clarification about their essence, indicate the dependence on external factors. For example, a condition of economic security is an "opposition to external pressures" [2]. However, according to Stankiewicz, such a goal constitutes only a limited range of impact, whereas global security, as its name suggests, concerns "all mankind" [59]. This points to the fact that creating a definition of security is a burdensome task involving a significant degree of discretion and subjectivity. For example, the definition of energy security recognizes the need for the "economic justification" of the demand for energy, which is required by virtually every sector in the economy [63]. Bojarski, meanwhile, reminds us that the statement of economic rationale may indicate protection of the interests of suppliers, not society, by ensuring adequate financial rates and eliminating the risks associated with competitiveness [9]. This, however, creates room for the formation of pressure from companies and, in turn, affects local politics and subsequent media coverage, which reaches society.

3. TRANSPORT SAFETY DATA PRESENTATION

To conduct an analysis of the concept of safety in transportation, one should first consider the meaning of the two, usually exchangeable, notions: "safety" and "security". According to *The New Penguin English Dictionary*, safety is defined as "the condition of being safe from causing or suffering harm or loss" [61]. Security, however, is described as "freedom from danger, fear, anxiety, destitution, etc." [61]. Fellner, by pointing to the need for the highest standards of safety in the operation of unmanned aerial vehicles (UAVs), quotes Sładkowski, who defines security in relation to aviation security (in terms of preventing of acts of unlawful interference) [19, 54]. The other idea (safety) is set on the basis of work by Sładkowski, who describes it with regard to "environmental and technical parameters, regulations [...], causing the level of risk of injury, of a fault or an error occurrence to be lower than the maximum level approved by the competent authority" [55].

The above-listed definitions indicate how imprecise or unrealistic the concept of safety or security is, both from the point of view of psychology and of society as a whole, given its specific expectations. First, the definitions allow for the existence of a risk of error or detriment. Second, they recognize the right to determine the level of acceptance of risk or detriment. In addition, they determine the perception of safety/security as subjective, by the existence of "feeling" and, in parallel, by striving to reach an unreal state of the disappearance of any anxiety (although a substantial or complete deficit of fear, at least at a moral level, may be considered one of the psychopathic personality traits). At the same time, they claim protection against a loss, although failure or defeat remains in line with the natural structure of life, or even particular preferences among human beings (e.g., in business, sports or gambling), which in turn results in conflict with our own choices.

The subject of security, as mentioned in Chapter 2, clearly exposes itself here. According to the definition by Sładkowski, aviation security refers to measures, which have an impact on the whole (state) or on a limited, specific social group (e.g., in the case of terrorist attacks, by a specific range; or, in the case of a tragic outcome, by the number of victims). The definition by Sładkowski also concerns organizations or social groups (airline, airline pilots, air navigation service provider, air traffic controllers, passengers etc.). On a smaller scale, it relates to individuals (a general aviation pilot, a car driver etc.). These definitions do not recognize the temporal variation in the level of security threats, but rather depend on local or

global events. As Stach and Maliszewski mentioned, among the security threats to the state at the main airport in Warsaw are "low-lying fogs (visibility of less than 600 m)" and the possibility of changes in the role of border guards, who are engaged in protecting the state border, given the commercialization of the Polish Airports State Enterprise [56]. Six years after the publication of these authors' work, the former threat has been reduced by investment in airport infrastructure (low-visibility procedures), whereas the latter has become out-of-date in light of certain business and political decisions, as well as the influence of current European law. This proves a continuous variation in the meaning and importance of the factors that determine the subjectivity behind establishing the level of security.

Chronology and a reference to the past or previous forecasts represent a strong argument in the discussion about the level of safety, especially when such information is set together with locations, courses of events, backgrounds and effects of specific incidents. For example, the information that the number of road accidents in 2015 was 5.7% lower than in 2014 is objectively optimistic [32]. However, further analysis of the statistics reveals that, in the Lubusz Voivodeship (Western Poland), the number of fatal accidents increased by more than 13%. It was also determined that one of the months with the greatest number of accidents was December. While it may be considered that this is due to a particular aura in the winter months, the authors draw attention to two different factors: the early time of dusk and the worsened visibility of pedestrians on the roads. The same analysis also shows that the incomparably greater number of accidents took place under good weather conditions, even when compared to conditions of strong wind or fog. Meanwhile, another analysis indicated that a straight section of the road is the most common site of accidents; this factor accounted for almost 87% of events in 2012 [20]. Although general statistics and research studies claim that the level of safety on the roads is subject to continuous improvement, a deeper analysis and comparison of data, which are typically not compared or even ignored, diminish the positivity of the picture on initial viewing. One example of such a misleading image, although the overall coefficients are positive, is that the average number of accidents per 10,000 people, in the period from January 2010 to October 2013, in the Kuyavian-Pomeranian Voivodeship (north-western part of Central Poland) was 0.52, whereas, in the city of Lodz (also Central Poland) alone, it was 1.32 (or 254% more) [66].

Referring to the field of aviation and its development by forecasts, STATFOR (Eurocontrol's Statistics and Forecast Service) predicts that air traffic will grow by 2.2% (on average) in the period between 2015 and 2022 [48]. It is worth remembering that, despite the economic crisis in 2009, the cost-efficiency of air traffic management/communications, navigation and surveillance services within the European region showed a decrease in costs by almost 10%. From the point of view of estimated indexes and social expectations, such information is objectively positive. The authors suggest, however, that, to date, acceptable levels of safety performance were neither defined nor established. According to the ICAO definition, acceptable levels of safety performed are defined according to "the minimum level of safety performance of civil aviation in a State, as described in its State safety programme, or of a service provider, as defined in its safety management system, expressed in terms of safety performance targets and safety performance indicators" [27]. This minimum, and therefore acceptable, level of safety is calculated as the probability of an aircraft accident, separately for each company providing the services within the field. Moreover, the definition of security, in the context of aviation, states that the possibility of harm "is reduced to, and maintained at or below, an acceptable level". It should be achieved by "a continuing process of hazard identification and safety risk management" [27]. In comparison to the definitions presented in Chapter 2, such wording recognizes the perseverance of the safety protection

process. Interestingly, the ICAO acknowledges here the significance of internal (domestic) and external (international) normative influences, as well as the importance of accepting various cultural factors [27].

The fundamental analysis of the data, as well as the assumptions presented above, shows how complicated the concept of safety is. While the simple message, in the form of usually favourable statistics, provides the feeling of an adequate level of protection, the realistic approach to achieving the expected outcomes must be the result of systemic, objective and even interdisciplinary attitudes towards the challenge. Otherwise, success in such missions, as presented by a particular group, can in fact, and within a different framework, localization or time span, remain a state of unacceptable risk for another party.

4. SAFETY AS A DERIVATIVE

It is still often recognized that security is the result of activities by a human being or group of people, or end users (drivers, pilots, whole crews, air traffic controller, a team of controllers, etc.). Such an approach, however, results in the conscious rejection of other components of a complex chain of dependencies. Moreover, it diminishes the importance of factors, which are beyond the control of human will, opinion or decision. Bak and Bak-Gajda highlighted such a limitation, stating that, "in the system of road safety, the human being is the decisive element. He or she is, on one hand, the co-creator of the road traffic, and, on the other, a user of the road" [8]. Sadłowska-Wrzesińska pointed out, by using any workplace as an example, that, apart from the lack of proper knowledge or a wrong approach to the execution of one's work, the driving force behind work-related errors are inadequate working conditions [53]. The author did not necessarily refer to technical or social conditions, but indicated the importance of the social component and the need to "promote good practices in a broad sense of safety culture".

The sense of security, and therefore the perception of the level of threat possibility, results not only from objective reality, but also from individual personality traits [50]. The level of anxiety or even fear is the result of the structure of personality, current psychological conditions, and one's experiences (subjectively perceived risk, frequency of hazardous events, quality of rewards and severity of punishments, legal systems and level of criminalization etc.). In effect, one's behaviour does not result only from a simple choice between known options, but from the context in which one has to make this choice. At the same time, and according to behaviouristic psychology, only observed behaviours constitute reliable data. Thus, in principle, during an analysis of incidents or accidents, it is not possible to consider previous alternative intentions as arguments. Hence, a rich source of knowledge about the overall decision-making process is rejected, while analysts lose the ability to identify and study many elements of the "puzzle". Beyond psychology, a similar distortion occurs with incidents' media coverage, which strongly affects the public perception of the level of security (by usually presenting only the most negative components of the occurrence) and decreases the level of trust towards the entities that, as a result of media coverage, are being assessed.

Almost 20 years ago, Mackay stated, in an article, that contemporary air traffic control could be perceived as "extremely safe and efficient" [39]. This article covered the issue of flight strips, which are tools that have bene used by most controllers for decades and throughout the world. The author noticed that altering the amount of computer support in a flight strip computing process will most likely not account for the numerous safety elements

involved, which may result in fatal accidents. On the other hand, strip augmentation, as suggested in the same work, has been a factor for many years. Experiences from the past have confirmed that such negative safety expectations were no more wrong than any other major revision of standard operating procedures in air traffic control. Over time, a new and previously unknown human factor entered into the equation, resulting from the challenges posed by human-machine interaction. Thus, the definition of flight strip use safety had to be changed and a different perspective needed to be taken to convince the public that safety levels were still being kept at an adequate level.

In the aviation field, where air traffic flow is largely a result of the continuous exchange of data, communication is the critical element in safety. One of the most tragic aviation disasters in history (at Los Rodeos Airport, Tenerife, in March 1977) is an example of an event in which the quality of communication has been recognized as a causal factor. A more thorough analysis of this particular event, through the prism of knowledge about cooperation styles in cockpits and general relationships between crew members almost four decades ago, indicates that the mental state of the captain, not the communication content, was the main factor that led to the lack of unequivocal opposition among the rest of the crew and, in turn, the tragedy [13]. Fischer and Orasanu stated that up to eight different methods of communicating a need can be distinguished. Among them, only one bears the hallmark of an instruction (e.g., "Stop now!"). The rest represent suggestions or hints to varying degrees of severity and possible or expected responses (e.g., "Shouldn't we stop now?") [21]. This interesting discovery points to the fact that not every communication carries a message, which, despite the sender's best intentions, will be adequately understood by the recipient. In the event of a significant difference in the status of individual team members, the message may be further distorted up to a state in which it becomes completely useless, even though the original content remains critical to the safety state. Alongside well-studied effects of cognitive or expectation bias, other scientific findings have shown that pilots tend to seek continuous reassurance about their original judgements, such that, due to such high demands resulting in a "think fast" attitude, communication gradually loses its absolute value [4]. In communication between pilots and air traffic controllers, this problem can even lead to the unintentional rejection of critical information, arising from ambiguity or limited suggestibility (as well as due to the physical distance between sender and receiver). Phrases such as "We have a limited amount of fuel", "We're running out of fuel" and "We have fuel for 10 minutes of flight time" are examples of such a communication trap (cf. the Avianca plane crash in 1990). The problem concerning the lucidity of relationships between pilots was discussed during the Go-Around Safety Forum conference, which took place in Brussels in 2013, where it was entirely justified that there exists a need to establish a clear and categorical method to inform other members of the cockpit crew about one's decision to interrupt an approach to landing (in the case of an unstabilized approach). It was further recognized that one of the challenges is to secure the right of less experienced pilots to communicate their opinions and decisions, even considering the possible objection to an experienced commander of the aircraft. In the domain of air traffic control, a similar situation concerns a potential conflict between employees of different seniorities, experiences or even obtained ratings.

Apart from episodic issues, Nevile and Walker highlighted the problem of a possible gradual build-up of interaction problems [45]. According to Dekker, and based on research among pilots, both the environment around them and their location within the environment continuously recreate communication standards [16]. To identify adverse changes, recordings of communication, which are typically carried out using the aircraft's on-board equipment (or recording equipment in air traffic control centres), should be analysed, not only in respect of

their verbal content. When trying to understand reasons for a possible human decision or error, in cases of accident analysis, experts should make an attempt to determine participants' moods and emotions, both before and during an act of decision development or execution, as well as throughout the duration of the flight or duty. Well established qualitative methods, for example, discourse analysis [31, 64] or thematic analysis [11], grant access to detailed data, but also allow for actors' perceptions and perspectives to be considered, including on a purely emotional level. On the other hand, it should be noted that, despite the tempting idea that emotions may condition decision-making, the results of scientific research are inconclusive. In chronological order, Green has found a relationship between accidents and pilots' personalities [24], while Lester and Bombaci, Lester and Connolly, and Platenius and Wilde, when studying impulsiveness, have been unable to confirm any significant correlations [36, 37, 49]. According to Hunter, an effect size of only 4% of variance was calculated between dangerous or fatal occurrences and risk tolerance [26]. Further, Fischoff et al. stated that overconfident people evaluate the level of risk wrongly for up to 30% of the time [22]. In the case of an incident or accident, such overconfidence can be directly attributed as a personality-related causation. Meanwhile, research by Copper shows that risk-taking does not necessarily have to be a personality component, as it can also be a derivative of the need for achievement [14], which is so rarely taken into account during incident or accident analysis.

For over two decades, there has been a change in perspective, shifting from individual responsibility to an organizational safety climate. The original responsibility of the individual has been divided into values and elements on which a person may have only a limited influence: namely, management values and concern, quality of equipment and training, and conditions for employees' involvement in safety culture [44]. It has been found that environmental influence exceeds individual traits. Therefore, a responsible approach to safety analysis requires additional efforts in order to match personal choices with organizational, legal and psychological needs.

5. SAFETY AND THE MEDIA

Apart from the fact that any individual, when making a decision, must take into account a particular context, safety-related domains are carefully observed by contemporary media and the wider public. For them, context mainly concerns the social effect of the decision (in the case of any tragic event, this usually means the number of victims or the range of losses). The media, however, are aware that the present approach to information requires the provision of short, compressed and expressive content, which, in general, consciously resists alternative interpretations or additional opinions.

No single decision carries a fixed effect. Although many everyday decisions are based on experience, and thus reinforced by expected outcomes, the variable context (environment, standards, culture, penalization, experiences of others, expectations etc.) can actively determine the interpretation and evaluation of the decision. Examples of two different police officers' decisions reveal the weight of appraisal, despite the obvious complexity of the context. In June 2016, a police officer from Czestochowa helped the parents of a suffocating toddler by instructing them on the telephone about how to conduct resuscitation [47]. Social reactions (Internet comments) were mostly positive, praising the abilities and attitude of the officer. However, one could also find critical, negative opinions about inaccuracy of the police officer's instructions, while pointing out that the positive outcome was only a coincidence. To compare, another article described police officers' intervention against an

aggressive 32-year-old man with diagnosed paranoid schizophrenia. After being subdued, the man began to suffocate, with bystanders asking the police officers to provide help. In the end, the suspect died as a result of not having been rescued by the police officers or anyone else [67]. The Internet comments were all negative, including invectives and threats directed at the police officers. Here, one should note that the latter article was much longer than the former one and included the victim's life story, as well as comparison with four other cases. All of these cases, however, happened in the US and concerned two events where police officers had shot drivers who had failed to stop for a roadside check, as well as the infamous case when a police officer killed the black teenager Michael Brown in Ferguson in 2014.

In general, it is now widely believed that one of the functions of contemporary media is to tell people how to make choices and what to think [33]. In the pursuit of better audience ratings, the media use numerous techniques, which originate from psychology, sociology or marketing. Provocation is one of their techniques. Driessens defines this as "a mediated act that questions norms, values, rules, laws and symbolic power in such a way that it intentionally runs counter to the 'normal' horizon of expectations in a given situation or context" [18]. According to Kowalik, and based on the political type of provocation, the aim is to create an alternative reality in which to attack an opponent and ridicule her or him. A common reaction to the first reports (and hence a reality created by the media) about the Germanwings 9525 crash, containing information content that the second pilot, Andreas Lubitz, committed suicide deliberately by using the airplane as a tool, led to the immediate and constant monitoring of Lubitz's neighbourhood and numerous interviews with Lubitz's neighbours. Knowing that "social acts lose their meanings if considered outside their social settings", the media had a rather easy task in combining neighbours' statements in a provocative manner [5]. Thus, without any formal accident analysis (which, in the final reports, revealed a different reality to the one presented by media), the suspect was almost immediately ridiculed and lynched. The effects, however, concerned the whole aviation world, forcing airlines and aviation organizations to constitute rules and offer mitigation in order to satisfy the expectations of society, whose knowledge was formed by media provocations, not the facts (see also Chapter 6, Paragraph 2).

After more than a year, airline representatives began to notice that expectation-induced mitigations failed to solve the dilemma concerning psychological problems among airline crew members. Nowadays, the question remains as to what can be done to prevent adverse occurrences as that involving Germanwings 9525. According to the article by Adamaszek, the bystanders, who observed the schizophrenic man suffocating without any help provided by the police officers, were informed by the officers that their lack of actions was conditioned by the law [67]. It seems simply unnatural to accept such a statement as the reasoning behind their professional choice. However, one should consider what could be the overall context of the situation. Were the officers ever involved in high risk-related training or interventions? Were such training courses useful or interventions successful? What were the organizational contexts and standards regarding police officers' superiors in terms of policies and methods of interventions and risk-taking? What were officers' experiences concerning unsuccessful attempts to provide premedical help to suspects, etc? Furthermore, the question remains as to police officers' experiences concerning the media's approach to high-risk interventions, knowing that biased media content may significantly alter risk perception and, in effect, distort actual legal responsibilities [65].

In the aviation domain, the parallel between risk perception and risk evaluation is clearly visible in case of emergency medical kits, which are placed on board aircraft. Apart from first aid items, they constitute part of the aircraft's medical equipment. However, no member of

the crew is allowed to use its contents (drugs, medical instruments etc.); only a medically qualified person can handle the kit. According to the Australian Transport Safety Bureau, between 1975 and 2006, over 15% of all medical events on board aircraft were heart attacks, which were also the most common reason for aircraft diversions [46]. According to DeHart, statistically, in 85% of cases, there is at least one medical practitioner on board an aircraft in flight [15]. What is the overall context regarding this particular problem? While the risk of there being no licensed doctor or nurse on board is only 15%, at least one in every six cases of medical emergencies is severe enough to require medical assistance and diversion. Therefore, in up to five out of six cases, airlines are willing to place a higher risk on passengers' safety, while, at the same time, protecting themselves against the possible risk of an unsuccessful medical intervention by the respective airline's employees. In the author's opinion, there exists a correlation between such calculations and the "post-Germanwings" mitigations. Although several experts have already noticed the need for additional medical training for cabin crew (at least covering cardiopulmonary incidents, involving the use of modern, light and external defibrillators), the discussion (most probably media-induced) will only be considered justifiable after the first tragic event on board an aircraft is considered "attractive" to the "viewer".

Probably, any safety-related domain nowadays faces the problem of decision-making, risk and responsibility. The idea of efficiency, in particular, against expectations, experiences or even anxieties, requires people to make decisions in no time at all, even when their risk perception is limited or biased. Thus, it seems that the tendency is to focus on critical opinions and assessments of the past, as well as protect oneself, rather than act in the name of general "utilitarian" safety. The position and abilities of the present-day media strengthen the belief that expected, rather than objectively correct, actions should be taken, again to protect oneself. As modern technology allows for easier information gathering, editing (including manipulation) and publishing (also by amateurs), the challenge, in the field of safety, is to be able to oppose the expected "exciting" method of "digestible" and attractive content presentation, while ensuring the right for thoughtful discussion about capabilities vs. expectations or underlying assumptions. Even in the case of tragic events.

6. SAFETY AS A DEVELOPMENT TOOL IN AN ORGANIZATION

It is understandable that the degree of confidence about safety will always be kept at the highest-possible level. This results from the expectations and needs of society, but also allows for its protection by monitoring and reacting. Any negative or neutral forecasts announce phases that should involve the analysis of past occurrences, whereas positive predictions anticipate times in which such analysis and its resulting reactions are verified. Such a scheme corresponds to the definition of safety promotion by Zohar and Luria [69]. According to these authors, this involves a process of environmental modifications (including political, economic and organizational layers) and safety-related behaviours. In addition, safety promotion cannot exist by simply pursuing these goals to a partial extent, as there are constant interactions between them. In parallel, Neal and Griffin noted a correlation between safety participation and motivation, with more intense participation in safety initiatives incrementing the latter [43]. However, they also stated that such a relationship results from positive feedback, presented as a reward for active participation. The conclusion of their findings is that conformity for a given safety state only, as it is rarely rewarded, does not build a culture of safety motivation.

Aviation market analysis shows that air traffic doubles every 15 years. Indeed, by 2035, over 33,000 more aircraft will be demanded by the market [35]. Moreover, it is known that the economy is a key factor in aviation market development. Therefore, the expenditure on safety development will be correlated with the development and growth of technical or human resources in the aviation field. Such growth must, without a doubt, correspond to innovations and modifications of technology and regulations. A delayed reaction, as in the case of UAVs, can serious affect the level of safety. Reports about airspace infringements, near-misses and uncoordinated operations of UAVs, especially in busy controlled airspace, have drastically lowered the perception of the safety level. Meanwhile, the process of learning about threats and risks regarding live traffic has generated much opposition, as well as expectations about fast, universal and optimal protection of safety. In a similar way, after the Germanwings accident, the aviation world had to confront the value and importance of the psychological well-being of airline employees. However, this particular case has clearly demonstrated the effects of impulsive decisions. The original requirement for the continuous presence of two persons in the cockpit, presented less than a week after the accident, was adopted by many operators in and outside Europe almost immediately, with no specific comments on the quality of the resolution. Interestingly, Carsten Spohr, the CEO of Lufthansa, stated that a single accident, however terrible, should not affect the entire aviation system [1], despite the fact that all of the Lufthansa Group decided to endorse the cockpit occupancy requirement, for precaution. The Syndicat National des Pilots de Ligne, the union of Air France pilots, criticized such a hasty and media-driven resolution, indicating that no definite actions should be taken without the evaluation of risks, especially in an operational environment. The discussion and resistance among pilots with regard to risk-increasing were not presented by media, preferring instead to protect the social judgement of air travel. In the air traffic control domain, there was also no discussion was the idea of remote control towers [60]. Although their economic benefits have confirmed their attractiveness, apart from assumptions and confident predictions, there is no clear and widely available record of real-life environment safety analyses. Yet, remote towers have been added to the SESAR project even though the presentations from 2014 juxtapose lower costs with "increased threats to society," "contingency solutions" and a question of availability of airports in case of emergencies [58].

According to Reason, supported by Sträter, systems can function in a continuous state involving safety defects, based on the assumption that, as long as there has been no incident, the system is perceived as safe [3]. In 1977, Borgida and Nisbett defined such a state as risk homeostasis [10]. The authors also suggested that such an equilibrium is a derivative of the balance between safety measures and unsafe occurrences. Therefore, and in respect of what has been presented above, the initiatives, which are perceived as insecure (not properly assessed, showing unknown risks etc.) and driven by expectations about better results, would likely lead to low safety priority perceptions [69]. In effect, the homeostasis becomes violated, while new initiatives must be undertaken to retrieve it.

If unsafe acts are preconditioned, they can also be predicted and thus prevented. Rash listed numerous preconditioning influences, among them organizational impacts [51]. He also divided them into categories: resource management (including inadequate funding, poor equipment design), regulatory climate (policies, values and culture-related beliefs) and processes (quality, pressures and objectives of safety programmes). Such classifications reveal the critical role of supervisors and superiors at any level (a politician may also be considered a superior). Hofmann et al., meanwhile, found that the quality of the relationship with a supervisor predicts the safety behaviours of subordinates [25]. Such a finding, when juxtaposed with the reversed ICAO definition of safety culture, shows that the attitudes of

superiors and employees are equally important to the overall level of safety. Moreover, as accidents are rare events, most likely caused by unintentionally wrong decisions, their "opportunity" to arise must, at least partially, be an effect of pre-existing conducive conditions [52]. Therefore, one may suspect that certain actions in the past could have made the system, in which the accident has happened, vulnerable to the occurrence. If such vulnerability has not been identified before, this means that the system has not or could not be adequately evaluated. If, however, this susceptibility has been previously diagnosed, but has not been or could not have been reported (hence, it has been overcome by supervisors or superiors), the safety culture may not be considered as working, thereby allowing problems and obstacles to accrue over time [43].

Eurocontrol's performance review report for 2015 revealed an interesting fact about occurrence reporting (including aircraft separation infringement, unauthorized penetrations of airspace or runway incursions). Between 2006 and 2015, for all these types of incidents, their frequencies were presented by a sinusoidal-like line. The authors claimed that conclusions should not be drawn from the data provided because it is not clear whether the fluctuations are an effect of actual safety performance or whether they resulted from variable reporting levels. They also added that the results could have been an effect of the "inadequate prevention of similar incidents or inadequate sharing and dissemination of lessons learned" [48]. A question immediately arises as to whether such an approach is authorized to reassure society about a continuous process of safety improvement or whether the characteristic of "seasonal" variations in safety levels is an inherent part of it and so should be presented. There also remains an issue about the effectiveness of information sharing and how active and efficacious this is within local safety initiatives, shared between subordinated and superiors.

The aviation domain, and probably the entire field of transportation, continuously conduct discussions into safety improvements. The effects, which, according to general statistics, exhibit improvements to some degree, expose limitations that express themselves in negative terms. In the author's opinion, this calls for the partial redefinition and re-evaluation of safety standards (risks, threats, priorities, methods, mechanisms). The active and responsible role of supervisors and superiors discloses itself as critical, with less burden on operational personnel (drivers, pilots, air traffic controllers etc.). Leaders (regardless of the level of authority) must be able to create a vision and "create conditions for the team to work in, build and maintain the team, coach and support the team to achieve success" [23]. To achieve this, it is necessary to go beyond the immediate licensing requirements, basic safety standards and exclusively positive public relations. This may only be possible by building strong partnerships and adapting promptly, yet early enough, as well as considering future expectations and advances in the overall field of transportation. According to Martinussen and Hunter, the development of a leadership-induced safety culture shapes positive safety-oriented behaviours among employees [40], whereas the lack of such a culture leads to counterproductive attitudes [62]. According to Zhang, Wand, Liu and Song, this can be achieved within the air traffic control domain by promoting safety culture activities, protecting air traffic controllers' psychological health and investing in new technologies, with a view to creating new safety nets [68]. Stadnicka and Antosz found that, in most companies with a greater part of Polish capital (42% of aviation and 34% of automotive businesses in the research), safety problem-reporting was based on oral or email reports, which suggests that there exists a certain resistance to formal problem analysis and archiving (in order to "learn from mistakes") [57]. The interesting fact is that many improvements, beyond a safety management system's (SMS') formal requirements and expectations, depend on a number of employee reports, preceded by an optimal motivation system, which is not necessarily based on financial rewards. Concerning

financial costs, a significant correlation was also found between the cost of employment (along with workload) and the rate of accidents, which are recognized as related to human error [30].

7. CONCLUSIONS

The sense of safety is an integral part of human life and a strong determinant behind concepts and projects in various fields. It accompanies humankind and, according to Maslow (in 1943), is the most critical need of a human being. Although not all scientists agree with Maslow nowadays, which indicates that the contemporary world (technology, culture, shape of society) have changed the structure of needs, it remains one of the most-known theories.

Human nature and performance are highly variable and depend on an extreme number of variables. Therefore, it has been acknowledged that it is not possible to fully eliminate aviation incidents and that aviation will always be subject to threats and risk [27]. Given that any transportation system is a dynamic structure, the process of safety assessment must be continuous. It must always reach the most primary source of information and opinion, namely, the employee, who should continually be kept in a state of optimal motivation towards sharing any thoughts on the actual state of safety and security. In this process, the crucial cooperation between subordinates and superiors is supported even by works of David Hume, 18th century Scottish philosopher and economist, known for his perspective of combining the concepts of empiricism, naturalism and scepticism. He stated that, in the domain of the economy, there exist limited resources. To create the best rules for governing these resources, cooperation is required. To obtain cooperation, trust is necessary; and, although this effect is hard to achieve in a contemporary, heterogeneous society, as well as in complex organizations, a safety-driven climate is necessary, not only to fulfil the legal requirements, but also because it relates strongly to safety performance, and in turn to the overall organizational climate. Only then will safety or security stop being an instrument against employees' interests, but a source of innovation for all concerned.

References

1. Adams R. 2016. "In lieu of a 2nd pilot: the two-person cockpit debate." *The Journal for Civil Aviation Training*, 27(3): 18-20.
2. Akademia Obrony Narodowej. 2008. *Słownik Terminów z Zakresu Bezpieczeństwa Narodowego*. [In Polish: *Glossary of National Security Terms*]. Warsaw: Akademia Obrony Narodowej.
3. Andrzejczak C., W. Karwowski, W. Thompson. 2014. "The identification of factors contributing to self-reported anomalies in civil aviation". *International Journal of Occupational Safety and Ergonomics* 20(1): 3-18. DOI: 10.1080/10803548.2014.11077029
4. Anonymous. 2016. "Your pilot's decisions are probably as irrational as yours and mine". *The Psychologist* 29: 511.
5. Asch S.E. 1952. *Social Psychology*. Upper Saddle River, NJ: Prentice Hall.
6. Awan Faisal Mushtaq, Malik Muneeb Abid, Anwar Khatib, Junaid Tariq. 2017. "Impacts of dilemma zone situations and red light running on the safety at signalised junctions". *European Transport/Transporti Europei* 63(8). ISSN: 1825-3997.

7. Barić Danijela, Hrvoje Pilko, Josip Strujić. 2016. "An analytic hierarchy process model to evaluate road section design". *Transport* 31(3): 44-54. DOI: http://dx.doi.org/10.3846/16484142.2016.1157830.
8. Bąk, J., D. Bąk-Gajda. 2008. "Psychologiczne czynniki bezpieczeństwa ruchu drogowego". [In Polish: "Psychological factors of road safety"]. *Eksploatacja i Niezawodność* 3: 22-29.
9. Bojarski, W. 2004. "Bezpieczeństwo energetyczne". *Wokół Energetyki* 3. [In Polish: "Energetic safety". *Around Energy* 3].
10. Borgida E., R.E. Nisbett. 1977. "The differential impact of abstract vs. concrete information on decisions". *Journal of Applied Social Psychology* 7: 258-271.
11. Braun V., V. Clarke. 2006. "Using thematic analysis in psychology". *Qualitative Research in Psychology* 3: 77-101.
12. *Cambridge Dictionary*. Available at: http://dictionary.cambridge.org/dictionary/english/security.
13. Ministerio de Transportes y Comunicaciones. 1978. *Colision Aeronaves Boeing 747 PH-BUF DE K.L.M. Y Boeing 747 N737PA de PANAM en los Rodeos (Tenerife) el 27 de Marzo de 1977.* [In English: *Collision of Boeing 747 PH-BUF of K.L.M. and Boeing 747 N737PA of PANAM Aircraft in Los Rodeos (Tenerife) on 27 March 1977*]. Available at: http://www.project-tenerife.com/engels/PDF/Tenerife.pdf.
14. Cooper, D. 2003. "Psychology, risk and safety". *Professional Safety* 48: 39-46.
15. DeHart, R. L. 2003. "Health issues of air travel". *Annual Review of Public Health* 24: 133-151.
16. Dekker, S.W.A. 2001. "The disembodiment of data in the analysis of human factors accidents". *Human Factors and Aerospace Safety* 1(1): 39-57.
17. *Dorsch Lexikon der Psychologie*. Available at: https://portal.hogrefe.com/dorsch/sicherheit/.
18. Driessens, O. 2013. " 'Do (not) go to vote!' Media provocation explained". *European Journal of Communication* 28: 556-569.
19. Fellner, R. "Bezpieczeństwo i bezzałogowe statki powietrzne w dyskursie naukowym oraz prawniczym". [In Polish: "Safety and unmanned aerial vehicles in scientific and legal discourse"]. Available at: http://www.psz.pl/127-unia-europejska/radoslaw-fellner-koniec-wolnoamerykanki-na-europejskim-niebie-ue-bierze-sie-za-drony.
20. Figlus T., A. Wilk, A. Gawron. 2014. "Analiza stanu bezpieczeństwa ruchu drogowego dla obszaru miasta". [In Polish: "Analysis of road safety for the city area"]. *Logistyka* 3. Available at: http://www.czasopismologistyka.pl/artykuly-naukowe/send/-/3972.
21. Fischer U., J. Orasanu. 1999. "Cultural diversity and crew communication." In *50th Astronautical Congress in Amsterdam*. Available at: http://homes.lmc.gatech.edu/~fischer/AIAA99.pdf.
22. Fischhoff B., P. Slovic, S. Lichtenstein, S. Read, B. Combs. 1978. "How safe is safe enough? A psychometric study of attitudes towards technological risks and benefits". *Policy Sciences* 9: 127-152.
23. Flin R., P. O'Connor, M. Crichton. 2008. *Safety at the Sharp End*. Boca Raton, FL: CRC Press. ISBN 978-0754646006.
24. Green R.G. 1977. "Joint Committee on Aviation Pathology: V. The psychologist and flying accidents". *Aviation, Space, and Environmental Medicine* 48: 922-923.
25. Hofmann D.A., F.P. Morgeson, S.J. Gerras. 2003. "Climate as a moderator of the relationship between leader-member exchange and content specific citizenship: safety climate as an exemplar". *Journal of Applied Psychology* 88: 170-178.

26. Hunter D.R. 2002. *Risk Perception and Risk Tolerance in Aircraft Pilots*. Washington, DC: U.S. Department of Transportation, Federal Aviation Administration. Available at: http://www.dtic.mil/dtic/tr/fulltext/u2/a407997.pdf.
27. International Civil Aviation Organization. 2013. *Doc 9859 - Podręcznik Zarządzania Bezpieczeństwem (SMM).* [In Polish: *Safety Management Manual (SMM)*]. Available at: http://www.icao.int/safety/SafetyManagement/Documents/Doc.9859.3rd%20Edition.alltext.en.pdf.
28. Jungermann H. 1982. "Zur wahrnehmung und akzeptierung des risikos von großtechnologien". [In German: "To perceive and accept the risk of large-scale technologies"]. *Psychologische Rundschau* 33*:* 217-238.
29. Jurecki Rafał Stanisław, Tomasz Lech Stańczyk, Marek Jacek Jaśkiewicz 2017. "Driver's reaction time in a simulated, complex road incident". *Transport* 32(1): 44-54. DOI: http://dx.doi.org/10.3846/16484142.2014.913535.
30. Karanikas N. 2015. "Correlation of changes in the employment costs and average task load with rates of accidents attributed to human error". *Aviation Psychology and Applied Human Factors* 5(2).
31. Kim H. 2013. "Exploring the construct of radiotelephony communication: a critique of the ICAO English testing policy from the perspective of Korean aviation experts". *Papers in Language Testing and Assessment* 2: 103-110.
32. Komenda Główna Policji, 2015. *Wypadki Drogowe w Polsce w 2015 Roku.* [In Polish: Police Headquarters. 2015. *Road Accidents in Poland in 2015*]. Available at: http://statystyka.policja.pl/download/20/192140/stanBRD2015.pdf.
33. Kowalik K. (ed.). 2013. *Wybory w Sieci Mediów* [In Polish: *Elections in Network Media*]. Kielce: Wydawnictwo Wyższej Szkoły Ekonomii, Prawa i Nauk Medycznych im. prof. Edwarda Lipińskiego w Kielcach. Available at: https://wseip.edu.pl/dniw/images/pliki/pelne_teksty_ksiazek/ks107_Kowalik_Wybory.pdf.
34. Kuhlmann A. 1979. *Zur Risiko-Akzeptanz in der Technik*. [In German: *For Risk Acceptance in Technology*]. Cologne: Verlag TÜV Rheinland.
35. Leahy J. 2016. *Airbus Global Market Forecast 2016-2035*. Available at: http://www.airbus.com/company/market/global-market-forecast-2016-2035/.
36. Lester L.F., D.H. Bombaci. 1984. "The relationship between personality and irrational judgment in civil pilots". *Human Factors* 26: 565-572.
37. Lester L.F., Connolly T.J. 1987. "The measurement of hazardous thought patterns and their relationship to pilot personality". In: *Fourth International Symposium on Aviation Psychology, Columbus, Ohio*: 286-292.
38. Liu Yang, Jianzhu Zhao, FachaoJiang. 2016 "Study on the influence of the arrangement of battery pack on the steering characteristics of electric vehicle". *Mechanika* 22(6). DOI: http://dx.doi.org/10.5755/j01.mech.22.6.13608
39. Mackay W.E. 1999. "Is paper safer? The role of paper flight strips in air traffic control". *ACM Transactions on Computer-Human Interaction* 6: 311-340.
40. Martinussen M., D.R. Hunter. 2010. *Aviation Psychology and Human Factors*. Boca Raton, FL: CRC Press.
41. Maurice P., M. Lavoie, L. Laflamme, L. Svanstrom, C. Romer, R. Anderson. 2001. "Safety and safety promotion: definitions for operational developments". *Injury Control and Safety Promotion* 8: 237-240.
42. *Merriam-Webster Dictionary*. Available at: http://www.merriam-webster.com/dictionary/security.

43. Neal A., M.A. Griffin. 2006. "A study of the lagged relationships among safety climate, safety motivation, safety behavior, and accidents at the individual and group levels". *Journal of Applied Psychology* 91: 946-953.
44. Neal A., M.A. Griffin, P.M. Hart. 2000. "The impact of organizational climate on safety climate and individual behaviour". *Safety Science* 34: 99-109.
45. Nevile M., M.B. Walker. 2005. "Analysis of crew conversations provides insights for accident investigation". *Flight Safety Digest* 24.
46. Newman D.G. 2006. *An Analysis of In-flight Passenger Injuries and Medical Conditions: 1 January 1975 to 31 March 2006*. *ATSB Transport Safety Report*. Canberra: Australian Transport Safety Bureau.
47. Pawlik P. 2016. "Częstochowa: policjant przez telefon uratował dziecko". [In Polish: "Częstochowa: a police officer saved a child by the phone"]. Available at: http://wiadomosci.onet.pl/slask/czestochowa-policjant-przez-telefon-uratowal-dziecko/q9e9y5.
48. Performance Review Commission. 2016. *PRR 2015 - Performance Review Report: An Assessment of Air Traffic Management in Europe During the Calendar Year 2015*. Available at: http://www.eurocontrol.int/sites/default/files/content/documents/single-sky/pru/publications/other/PRR-2015.pdf.
49. Platenius P.H., G.J.S Wilde. 1989. "Personal characteristics related to accident histories of Canadian pilots". *Aviation, Space, and Environmental Medicine* 60: 42-45.
50. Pokruszyński, W. 2011. *Filozoficzne Aspekty Bezpieczeństwa*. [In Polish: *Philosophical Aspects of Security*]. Józefowie: Wydawnictwo Wyższej Szkoły Gospodarki Euroregionalnej im. Alcide De Gasperi w Józefowie.
51. Rash C.E. 2012. "Persistent problem". *AeroSafety World* 7: 35-39.
52. Reason J.T. 1990. *Human Error*. Cambridge: Cambridge University Press.
53. Sadłowska-Wrzesińska J. 2014. "Bezpieczeństwo behawioralne (BBS), społeczna odpowiedzialność biznesu (CSR) i dialog społeczny-współczesne wyzwania bezpieczeństwa pracy". [In Polish: "Behavioural safety (BBS), corporate social responsibility (CSR) and social dialogue: contemporary challenges in work safety"]. In: Knosala R. *Innowacje w zarządzaniu i inżynierii produkcji*. T. 2. Opole: Oficyna Wydawnicza Polskiego Towarzystwa Zarządzania Produkcją. P. 606-615. [In Polish: *Innovation in management and production engineering*]. Available at: http://ptzp.org.pl/files/konferencje/kzz/artyk_pdf_2014/T2/t2_606.pdf.
54. Siadkowski A.K. 2015. *Prawodawstwo w Ochronie Lotnictwa Cywilnego.* [In Polish: *Legislation in the Protection of Civil Aviation*]. Dąbrowa Górnicza: WSB.
55. Sładkowski A. (ed.). 2013. *Some Actual Issues of Traffic and Vehicle Safety.* Gliwice: Silesian University of Technology Gliwice.
56. Stach W., P. Maliszewski. 2010. "Ochrona portu lotniczego im. Fryderyka Chopina w Warszawie. Służby ochrony i sposób ich działania". [In Polish: "Security at Fryderyk Chopin Airport in Warsaw. Security services and their modus operandi"]. In: Tyburska A. (ed.). 2010. *Ochrona Infrastruktury Krytycznej*. [In Polish: *Critical Infrastructure Protection*]. Szczytno: Wydawnictwo Wyższej Szkoły Policji w Szczytnie.
57. Stadnicka D., K. Antosz. 2015. "Continuous improvement practice in large enterprises: study results". *International Journal for Quality Research*, 9: 9-26.
58. Standar M. 2014. *SESAR Remote Tower Services*. Available at: http://www.sesarju.eu/sites/default/files/documents/events/atcglobal2014/ATC-2014-RTS.pdf.

59. Stankiewicz W. 1992. *Ekonomika Obrony.* [In Polish: *Economics of Defence*.] Warsaw: AON.
60. Szczukowski M. 2015. "SAAB, mamy problem!" [In English: "SAAB, we have a problem!"]. Available at: http://dlapilota.pl/wiadomosci/kontrola-ruchu-lotniczegocom/saab-mamy-problem-maciej-szczukowski.
61. *The New Penguin English Dictionary*. 2001. London: Penguin Group.
62. Uchenna C.O. 2013. "Counterproductive work behavior among employees in emotionally demanding jobs: the roles of perceived organizational support, job burnout, and age". *Nigerian Journal of Applied Behavioural Sciences* 1: 105-114.
63. Ustawa z Dnia 10 Kwietnia 1997 r. Prawo Energetyczne. [In Polish: The Act of 10 April 1997. Energy Law]. (Dz. U. z 1997 r. nr 54 poz. 348). Available at: http://isap.sejm.gov.pl/DetailsServlet?id=WDU19970540348.
64. Von Thaden T.L. 2003. "Information behavior among commercial aviation CFIT accident flight crews: transcript analyses". In: *Proceedings of the 12th International Symposium on Aviation Psychology.* Columbus, OH: The Ohio State University (CD-ROM).
65. Wahlberg A.A., L. Sjoberg. 2000. "Risk perception and the media". *Journal of Risk Research* 3: 31-50.
66. Wójcik A. 2015. *Statystyczna Analiza Bezpieczeństwa w Ruchu Drogowym w Układzie Województw*. [In Polish: *Statistical Analysis of Road Traffic Safety in the Structure of Provinces*]. Katowice: Zeszyty Naukowe Uniwersytetu Ekonomicznego w Katowicach.
67. Wyborcza.pl. "Człowiek się dusi. Policjanci nie reanimują. Prokurator umarza śledztwo [video]". [In Polish: "A man is suffocating. Police officers do not resuscitate. The prosecutor discontinues the investigation"]. Available at: http://wyborcza.pl/1,87648,17900926,Czlowiek_sie_dusi__Policjanci_nie_reanimuja__Prokurator.html.
68. Zhang J., W.L. Wang, Y.X. Liu, X.B. Song. 2012. "Establishment of the safety culture in civil aviation air traffic control." In: *CICTP 2012: Multimodal Transportation Systems - Convenient, Safe, Cost-effective, Efficient*: 1886-1890. ASCE.
69. Zohar D., G. Luria. 2005. "A multilevel model of safety climate: cross-level relationship between organization and group-level climates". *Journal of Applied Psychology* 90: 616-628.

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