Synergies and Tensions Between Safety and Security in Civil Aviation

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Abstract: Safety has been a major concern for the aviation industry. With the rise of security threats over the past two decades, safety and security have come together and now coexist as strategies and management practices. However, they often do so, without careful reflection on their interrelationships and the kind of implications this may have. Investigating this area from different perspectives and identifying the synergies and tensions between safety and security was the focus of this study. The development of this paper brought enlightening insights into the complex interrelationships between safety and security, but also into the challenges associated with research and management.

Keywords: Safety. Security. Risk management. Vulnerability. Threats.

Sinergias e Tensões entre Safety e Security na Aviação Civil

Resumo: O safety tem sido uma grande preocupação para a indústria da aviação. Com o aumento das ameaças ao security nas últimas duas décadas, safety e security se uniram e agora coexistem como estratégias e práticas de gerenciamento. No entanto, muitas vezes o fazem, sem uma reflexão cuidadosa sobre suas interrelações e o tipo de implicações que isso pode ter. Investigar esta área a partir de diversas perspectivas e identificar as sinergias e tensões entre safety e security foi o foco deste estudo. O desenvolvimento deste artigo trouxe percepções esclarecedoras sobre as complexas inter-relações entre safety e security, mas também para os desafios associados a pesquisa e gerenciamento.

Palavras-Chave: Safety. Security. Gerenciamento de riscos. Vulnerabilidade. Ameaças.

Introduction

In the field of civil aviation, it is difficult to find clear parameters for the terms safety, security and risk. There is no generally accepted and widely used semantic basis. Similarly, there is no standardization in defining the opposite, which would be a lack of safety or security.

Definitions of these terms are necessary for effective communication, an important element in the management of civil aviation. It is necessary to discuss the use of restrictive

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terms, which can limit the solution of problems, or the use of broader terms based on practical experience, where it is possible to achieve results with the use of different definitions.

Safety has been an official part of engineering for at least 100 years. It is common to limit safety to events involving loss of lives and injury. Historically, safety in civil aviation has been defined in terms of fuselage losses. After World War II, the U.S. defense industry began to promulgate a broader definition of safety, stating that safety means being free of accidents (losses).

In civil aviation, security is synonymous with vulnerability, i.e. a weakness in a product or system that makes it susceptible to loss. In a more general sense, security is often defined as a system that is free from threats or vulnerabilities, i.e. potential losses. Here, threat and vulnerability are treated as one and the same.

The areas of safety and security are traditionally kept separate, as the International Civil Aviation Organization (ICAO) has chosen to publish different definitions in its annexes to the Chicago Convention. In these documents, security is defined as "Safeguarding civil aviation against acts of unlawful interference", while safety is "The state in which risks associated with aviation activities related to or in direct support of the operation of aircraft are reduced and controlled to an acceptable level" (WIPF, 2020).

The aim of this paper is to discuss the differences between the concepts of safety and security in the context of civil aviation from an international perspective. In terms of the methodological aspect, the research is a literature review and document analysis. The sources used include published academic research and publicly available documents from governments and international organizations.

Conceptual Aspects

The Standards and Recommended Practices (SARP) developed by the International Civil Aviation Organization (ICAO), contained in the nineteen technical annexes to the Chicago Convention, are universally applied and provide a high degree of technical uniformity that has enabled the safe, orderly and efficient development of international civil aviation. The ICAO was founded in 1944 and is based in Montreal, Canada. Its purpose is to establish principles and agreements for the development of international civil aviation and to provide services related to international air transportation on the basis of equality of opportunity and in accordance with economic principles. It is a specialized agency of the United Nations (DECEA, 2023).

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The delegates at the Chicago Conference could hardly have foreseen that hijackers and terrorists would exploit the operational vulnerabilities of civil aviation in the following decades, making the rules established in 1944 anachronistic (PELSSER, 2022, p. 02). In a five-year period (between 1968 and 1972), 326 attempted hijackings were recorded, one every 5.6 days (HOLDEN, 1986).

As a result, the ICAO Council approved the new SARP on aviation security in March 1974 and included them in Annex 17 ("Security - Safeguarding International Civil Aviation against Acts of Unlawful Interference"). The objective of the ICAO contracting states is to protect passengers, ground personnel, crew and the public from acts of unlawful interference (PELSSER, 2022).

Safety and security are key factors for the success of aviation activities. The ICAO defines safety in Annex 19 ("Safety Management") as the condition in which the risks associated with aviation activities that are related to or directly support the operation of aircraft are reduced to an acceptable level and controlled. The term security (also known as AVSEC - Aviation Security - in the aviation sector) is explained in Annex 17 as the safeguarding of civil aviation against acts of unlawful interference (BRASIL, 2021).

Portuguese speakers face an additional challenge when it comes to defining the terms safety and security, as the word "segurança" encompasses both terms. The National Civil Aviation Agency - Agência Nacional de Aviação Civil (ANAC), which is responsible for the regulation and supervision of civil aviation in Brazil, has made available on its website a database with two bilingual glossaries (Portuguese-English/English-Portuguese) which summarize the terms and acronyms characteristic of text production in the field of aviation in Brazil and abroad. When accessing the ANAC website, it becomes clear that the Portuguese term "segurança" does not appear in isolation. The term "segurança operacional" is translated into English as "safety". At the same time, "segurança da aviação" is translated into English as "security" (COSTA, 2016).

As already mentioned, the areas of safety and security are traditionally kept separate in aviation. While the former deals with the general risks associated with aviation activities, the latter protects civil aviation from acts of unlawful interference. According to Ale (2009, p. 13), establishing clear definitions of these terms is a real challenge, as there are no specific words for safety and security in many languages (including Portuguese). The different academic definitions and the colloquial use of the terms in practice also cause confusion.

Safety is a major concern for aviation organizations, especially with the introduction of dangerous technologies and activities. Consequently, there are established policies and institutional practices related to the prevention of incidents and accidents. Maintaining the effectiveness of these approaches is considered important for the protection of hazardous technologies, as they are based on previous incidents and involve the dynamic but fragile organizational network of safety defenses (BIEDER; GOULD, 2020).

Until the end of the Cold War, security was strongly linked to state security and protection against threats from foreign states. In the case of the civilian sector, security became an issue when these actors began to play a more active role in the military capacity and defense of a state. After the Cold War, the threat of violent non-state actors, who can exploit the vulnerability of societies through malicious acts such as sabotage and terrorism, became increasingly evident.

Today, decades later, states and societies have become much more familiar with dealing with non-state illegal acts, especially after the attacks of September 11, 2001. The establishment of an agency in the United States (Transportation Security Administration - TSA) in the early 2000s, attached to the Department of Homeland Security and specialized in the security of transportation systems, is emblematic (UNITED STATES OF AMERICA, 2004).

The increasing importance of security and related security risk reduction measures leads to an obvious overlap between safety management and security management in industries exposed to risk and illegal activities, such as civil aviation. Managers and analysts have had to understand and incorporate a new category of threats. In the context of September 11, 2001, new forms of cooperation and new areas of operation have also developed.

It should be emphasized that the definitions provided by academia mainly refer to two types of distinctions between safety and security: safety is related to unintentional or accidental risks and hazards, while security focuses on malicious threats and intentional risks (SMITH; BROOKS, 2012).

A recurring question is whether the focus should be on the distinction between safety and security or on better management of hazards in general, regardless of the type of classification (YOUNG; LEVENSON, 2014). A central concept is the idea of risk management, but there is no consensus on how it should be implemented in these two areas (SHORT; CLARKE, 1992).

In the area of airport operations, the fact that the teams responsible for security and safety are usually trained differently, use different technologies and work in different ways is an additional complication. The different regulatory frameworks and the nature of some of the contracts in place at airports reinforce this separation (BONGIOVANNI, 2016).

In practice, measures to protect certain objects related to civil aviation from threats or hazards or to mitigate potential risks are implemented by organizations without it being clear whether it is a safety or a security issue. Many of these decisions involve ordinary workers, managers, safety management system specialists and security officers, leading to confusion and a juxtaposition of functions.

In contrast to safety, security is often compromised by external threats, which in most cases are beyond the ability of organizations to fully understand and manage. Since a hostage-taking or terrorist attack is an extremely low probability security event, it should be discussed whether the application of security culture concepts should be applied in the same way to safety and security situations.

It should be noted that the organizational security literature has long recognized that accidents are neither random nor accidental, but rather the result of inadequate resources, organization and planning (REASON, 1997). According to Bieder and Gould (2020), security management, whether related to safety or not, presents some organizational challenges in both research and practice. While safety has reached a stage where openness and information sharing are recognized as criteria for improvement, security is a world of secrecy, both for attackers and for potentially affected organizations which avoid increasing their vulnerability by disclosing their practices.

Pettersen and Bjornskau (2015, p. 170) use the example of the Germanwings disaster of 2015 to address this dichotomy between the two ideas. Germanwings, a low-cost subsidiary of Lufthansa, was traveling with an Airbus A320-211 on flight 9525 from Barcelona-El Prat Airport to Düsseldorf Airport. On 24 March 2015, the plane crashed a hundred kilometers northwest of Nice in the French Alps. All 144 passengers and six crew members were killed. According to the investigation, the crash was deliberately caused by co-pilot Andreas Lubitz. The possibility of having employees who should be treated as trustworthy because of their contribution to safety and at the same time treated with suspicion as a potential threat from a security perspective is a major challenge for organizations.

Dealing with the interrelationship between safety and security is not as simple as "blending" the two using a broad risk approach or expanding the scope of existing safety approaches to include security. Security involves vulnerabilities that lie outside the boundaries of organizations. This observation has several implications: practical and managerial within an organization, but also methodological when it comes to describing, analyzing and understanding the interrelationship between organizations and their increasingly global environment. Dealing with the interrelationship between safety and security thus requires a certain caution in order not to be blinded by the conceptual elegance or the methodological solutions already available (BIEDER; GOULD, 2020; GOULD, SCHULMAN, 2016).

According to Gould (2016), the apparent proximity between safety and security can tempt researchers to extend the scope of concepts and methods from one discipline to another. One reason for this may be the research environment that needs to be created to gain access to security-related aspects, or the contributions between security and safety research topics and communities. Other reasons may be related to the challenges of dealing with different scales, dimensions and aspects.

Risk in Safety and Security

According to Blokland and Reniers (2017), although there are no standard definitions for safety and security, this does not apply to the concept of risk. The International Organization for Standardization (ISO) defines risk as "the effect of uncertainty on objectives, whether positive or negative" (ISO; ABNT, 2018).

Blokland and Reniers (2020, p. 13) believe that the understanding of "objectives" is the starting point for understanding the concepts of risk, safety and security. For the authors, objectives are the tangible and intangible things that individuals, organizations or society as a whole (as a group of individuals) want, need, pursue, try to achieve or strive for. Objectives can also be conditions, situations or possessions that have already been established or acquired and that are or have been maintained as a purpose, desired state or necessary condition, regardless of whether they are consciously and intentionally expressed or unconsciously and unintentionally present.

Regardless of actual conditions and possible future outcomes, risk, safety and security will always vary from person to person due to different objectives and related values. Risk, safety and security are therefore constructs in people's minds. Each individual has different

objectives or values the same objectives differently, leading to different perceptions of the same reality. An important difference between safety and security becomes clear when considering the "effects" of uncertainty on objectives and introducing the idea that the effects can be seen as "intended" or "unintended" (accidental). If the negative effects on the objectives are "intended", it is appropriate and correct to use the term security instead of safety (BLOKLAND; RENIERS, 2017).

Consequently, it would also be inappropriate to use the term "security" when the effects of uncertainty involved are "unintended" acts. Terrorists, for example, intend to cause physical and psychological harm and damage to property. They intentionally increase the likelihood of negative effects on the society they wish to terrorize. Similarly, criminals intentionally act against laws designed to protect specific social, organizational or individual goals.

According to Jore (2019), the same perspectives and methods seem to apply to risk analysis in the areas of safety and security in risk management practice. For Smith and Brooks (2012), the approaches to risk management in security and safety differ. Safety looks at risk from the perspective of hazards which expose someone to injury or loss, while security looks at threat risk in the context of an adversary's intentional actions and capabilities. According to Brooks (2011), the goal of security is to minimize the risk of malicious acts. Furthermore, threat is central to the understanding and risk management in security.

As Gould (2016) notes, many of the major safety and security risks we face today, while they have different causes, are all products of human activities that are deemed necessary. In other words, the risks arise from activities that we need or want and that cannot be "managed" by science. Demands for safety and security can confuse politicians and regulators and create unrealistic and unjustified expectations for action. The margins of error may change, but the risk remains as long as the activities continue. This has influenced and broadened the approach to uncertainty in risk research.

According to Aven (2014), an important question for risk assessment and risk management is whether the uncertainty is positive or negative. For example, in relation to nuclear power plants or airlines, is it good or bad to have uncertainty? Does it depend on the threats and hazards? A growing body of work has recognized that uncertainty plays an important role in our understanding of safe and secure systems and societies.

Furthermore, Ale (2009) teaches that the value of an activity is closely linked to the assessment of whether the risk is worth taking. Consequently, both risk assessment and risk

management of threats and hazards are influenced by individual and social factors. As Short and Clarke (1992, p. 19) note, in situations where there is a heightened need for safety or security, such as after a major disaster or terrorist attack, one should expect risk perception to be heightened and standards to become more stringent. However, in situations where the need for safety and security are low, you can expect risks to be mitigated and standards to be more relaxed.

Finally, Blokland and Reniers (2017) theorize that each individual has their own unique perception of reality, as reality always requires interpretation and can only be perceived. Therefore, there will always be a residual level and lack of understanding in relation to risk, safety and security that varies from person to person. Security science must therefore strive for the highest possible quality of perception, in which the divergence between reality as it is and the perception of this reality is as small as possible.

Threats and Vulnerabilities

According to Martins (2008), security in acts of illicit interference must involve intentional threats that target the vulnerability of a system. The vulnerability factor can be understood as a "security gap or potentially insecure point in a system", the exploitation of which "can cause harm or damage" (PEREIRA et al, 2020, p. 200).

As Leveson (2011) notes, the equivalent term for danger is vulnerability, i.e. a weakness that makes you susceptible to loss. In the most general sense, security can be defined as the state of a system that is free from threats or vulnerabilities, i.e. potential losses. In this context, danger and vulnerability are basically synonymous. Vulnerability itself can take many forms and offers many opportunities to potential saboteurs. Vulnerability means being exposed to risk, but vulnerability also refers to an innate ability to be harmed.

Schulman (2020) points out that an obvious difference between safety and security management lies in the primacy of hostile intent. Identifying and managing the risks of operational failure is different when it comes to destructive intent. There are always more opportunities for a complex system to fail than for it to function as designed. But hostile strategies, both external and internal, can provide additional opportunities for disaster by exploiting vulnerabilities as strategic targets. If the attacks on these vulnerabilities are suicidal in nature, the possibilities are even greater. An example of a response to the risk of an attack is

the strategy after September 11, 2011, when airlines began reinforcing aircraft cabin doors to prevent actions by potential terrorists among the passengers.

When it comes to hostile intentions of an internal nature, the scenario is even more challenging. Organizations with high reliability (e.g. in the energy and aviation sectors) are prepared for an external attack or an unintentional internal error, but probably not for deliberate internal sabotage.

The incompatibility between internal and external systems for protection against intentional acts can lead to catastrophic situations. According to the final report of the Bureau d'Enquêtes et d'Analyses pour la sécurité de l'aviation civile - BEA (2015), the co-pilot of the Germanwings flight used the protection mechanisms against external actions to lock the captain out of the cockpit and isolate him from the controls, with the aim of being alone in the cockpit and crashing the plane into a mountainside in a suicidal act.

As Schulman (2020) notes, protecting the cockpit from outside intrusion has actually created vulnerability and an opportunity for another form of attack. It is difficult enough to achieve reliability and security against nature or inadvertent human action. It becomes an entirely different challenge when the failure itself is part of a learning system that is able to develop counter-strategies. The resilience and ability of organizations and their professionals to anticipate vulnerabilities play an important role in the integrated response to both safety incidents and security events (ROE; SCHULMAN, 2008, p. 95).

The more complex a society becomes, the more its members are prepared to take risks. Technological development also contributes to an increase in uncertainty and new vulnerabilities (PIDGEON; KASPERON; SLOVIC, 2003). As the level of safety and security has increased significantly over time, it is possible that the perception of risk and vulnerability has also changed to the extent that the general acceptance of risk has decreased (BROOKS; COLE, 2020).

Conclusion

In the wake of recent events and disasters, and with threats and hazards increasingly defined as systemic risks and products of modern society, safety and security are being conflated in both regulation and management strategies. Despite their obvious or intuitive proximity when viewed conceptually, safety and security reveal some nuances and differences

when analyzed in detail, as we have seen. Technologies and activities also differ in terms of the frequency and form of the threats they face.

By looking at the synergies and tensions between the two concepts, it is possible to rethink some perceptions and discuss the challenges of such a multi-faceted topic from both an academic and a management perspective. The definition of safety and security seems to be a natural starting point for discussing their interrelation, as it allows the different actors in the field of civil aviation to understand each other and improve their actions. However, it is possible to identify clear differences in the underlying body of knowledge between the safety and security professions, even if there are overlaps in risk management. The endless search for a single common definition is not the best goal to pursue, as safety and security knowledge varies widely depending on the hazards and threats, regulatory context, disciplinary approach and practice, and other factors (BROOKS; COLE, 2020).

Safety and security are closely integrated into a common research agenda, as professionals tend to use concepts, theories and methods from both fields. This leads not only to a transfer of research approaches, but also of fundamental premises. It should be noted that safety aims for everyone within the organization to share information. Furthermore, safety research is based on many well-developed collaborations between researchers and practitioners. From a security perspective, the same premises do not seem to be considered fundamental (BIEDER; GOULD, 2020), as this is a domain of secrecy. While it may be tempting to transfer and adapt safety approaches to security, understanding the differences between the various perspectives can be crucial to the success of work on security / safety issues.

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