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The impact of improving the safety management system on situational awareness in the context of safety: a case of a selected high-reliability organization

Abstract

In the aviation sector, maintaining a high level of safety is one of its main objectives. That is why these types of organizations are recognized as High Reliability Organizations (HROs). This paper aimed to identify and understand the relationship between the quality of the Safety Management System (SMS), and situational awareness (SA) allowing organizational members to perceive, comprehend, and respond to safety-related situations promptly and accurately. Based on a literature review, the authors present adopted concepts of the SMS and SA. The survey methodology involved document research, and a questionnaire on the SMS and SA, which consisted of 11 questions. The survey was conducted in the Approved Training Organization (ATO) in the Greater Poland voivodeship. The research considered two periods before and after the introduction of improvements in the SMS. The research indicated a relationship between improvements in the SMS and better SA of the HRO in the context of safety. The development of the SMS in the HRO was significant. The implementation of new SMS elements has undoubtedly contributed to an increase in safety levels and situational awareness within the HRO. A noticeable surge of incidents reported through the incident reporting system can be observed. This is confirmed by the opinions of the respondents. Additionally, students showed a more critical approach to safety than instructors, which may be due to insufficient safety culture education.

Keywords: safety management system; situational awareness; risk management; safety culture; HRO
JEL Classification: M210, M530, L930

Introduction

In the aviation industry, maintaining a high level of safety is one of its main objectives. That is why these types of organizations are recognized as High Reliability Organizations (HROs). The HRO is a management term that refers to organizations characterized by exceptionally high levels of reliability, safety, and the ability to operate in situations that could pose a threat to other organizations [Le Coze, 2019]. This concept primarily originates from areas where safety and accident prevention are of paramount importance. The aviation is one of these areas. In civil aviation, until 2019, there was an annual increase in the number of passengers served and flight operations conducted. The COVID-19 pandemic significantly slowed down these statistics, but ensuring the safety of passengers, crew, and ground staff became even more important. According to data provided on the Civil Aviation Authority's website, commercial air traffic decreased by 61.1% in 2020 compared to 2019 [ULC, 2021]. Therefore, the aviation industry has been significantly affected by the COVID-19 pandemic.

Due to the development of the aviation industry and the continuous need to improve safety standards, it is necessary to concurrently develop a Safety Management System (SMS). In civil aviation, all service organizations, flight training centers which are called Approved Training Organizations (ATO), and those managing the continuous airworthiness of aircraft are currently required to implement and maintain a Safety Management System (SMS) [ICAO, 2016; Regulation – 1178/2011EC, 2011]. An ATO is an organization that provides approved flying training for specific flight training programs (airplane or helicopter). The increasing number of flight operations increases the likelihood of hazardous situations occurring. The primary goal of safety management in aviation is to proactively mitigate safety risks before they lead to accidents and serious incidents (events with high severity). The Safety Management System evolves through knowledge about incidents and hazardous situations. However, to have such knowledge, individuals involved in or witnessing the incident must report such cases to the appropriate authorities.

Airlines are prepared and committed to ensuring a high level of safety. They have departments within their structures dedicated to analyzing flight parameters, investigating reported incidents, and providing training for pilots and crews. Such departments consist of many employees, each responsible for certain tasks, and have teams that work on and handle each branch of the Safety Management System. However, the resources of ATOs are not as extensive. Regulations require each ATO to appoint a safety manager [Batuwangala, Silva, Wild, 2018]. In most organizations, the safety manager is the only professional person responsible for safety in the unit due to the small number of students and instructors, as well as the operations performed,. Of course, just as every person is different, every safety manager is differently engaged and dedicated to their work. However, safety should be a priority for every ATO to ensure the safety of their instructors and students. Unfortunately, the belief of many that "nothing bad will happen to us" is very common and results in a minimalist safety management system.

Unfortunately, instructors who have been flying their whole lives at a flying club without a fixed schedule, sometimes do not understand the need for developing a safety management system because their flights are usually "almost perfect". Running out of fuel or losing air in a tire is not a big problem for them, and they see no need to stand out by reporting the situation. However, due to the pandemic and the decrease in the number of operations performed by operators, many pilots with instructor ratings have taken advantage of their free time and have been employed at ATOs as instructors. Knowing how the safety management system operates in large organizations, adapting to the HRO's requirements is not a major problem for them, as long as the HRO has a properly functioning SMS.

The results of the analysis of the Scopus scientific database as of February 14, 2024, obtained after searching for the term safety management system show 116,239 results, of which 15,565 are in management and social sciences. There are 14,914/2,388 works related to situational awareness in the database, respectively. Searching for both terms at the same time yielded 465/76 results, respectively. These facts demonstrate a cognitive gap. The originality and innovative approach of the proposed research are based on filling the presented cognitive gap in the field of safety management systems and situational awareness in high-reliability organizations.

The research problem is to investigate the impact of enhancing the safety management system (SMS) on safety situational awareness within a chosen high-reliability organization (HRO). Specifically, the study aims to explore how improvements in the SMS influence the level of safety situational awareness of employees in the selected HRO. By addressing this research problem, the study seeks to contribute to the existing literature on safety management systems and safety situational awareness in high-reliability organizations, thereby providing insights for enhancing safety practices and mitigating risks within such organizations.

Therefore, the purpose of this paper was to identify and understand the relationship between the quality of the SMS and the ability of organizational members to perceive, comprehend, and respond to safety-related situations promptly and accurately. Resolving the research problem involved specific research objectives:

- identifying concepts of the SMS and SA through a literature review;
- analysis of reported adverse events in the organization through document research;
- developing survey questionnaire for the SMS and SA research;
- evaluating the SMS and SA levels based on the research methods used;
- analyzing the relationship between the SMS and SA in the context of safety.

Achieving all the specific objectives aimed to provide a comprehensive framework for assessing the quality of the SMS and SA, and analyzing the aspects and factors that influence the relationship.

Literature review

Multiple definitions of the SMS can be found in the literature. Here is one specific definition: A safety management system is a method that aims to synchronize, streamline, and incorporate management procedures, safety values, and operational risk evaluation [Waddington, Lafortune, Duffey, 2009]. It guarantees adherence to legal obligations, detects potential dangers, evaluates risks, and oversees working conditions. Companies should adopt the SMS in order to mitigate the occurrence of catastrophic accidents and thereby enhance aviation safety. The International Civil Aviation Organization (ICAO) establishes a framework that outlines the essential criteria for developing and sustaining a Safety Management System within an organization. This framework comprises four key features and twelve components, as depicted in Table 1 [ICAO, 2018]. The four essential components that must be incorporated into proactive safety are: Safety Policy, Safety Risk Management, Safety Assurance, and Safety Promotion [Goglia, 2023].

Table 1. Aspects and factors of the SMS

Number of aspects	SMS framework aspects	SMS framework factors
1	Safety policy and objectives (SP&O)	1.1 Management commitment and responsibility 1.2 Safety accountabilities 1.3 Appointment of key safety personnel 1.4 Coordination of emergency response planning 1.5 SMS documentation
2	Safety risk management (SRM)	2.1 Hazard identification 2.2 Risk assessment and mitigation
3	Safety assurance (SA)	3.1 Safety performance monitoring and measurement 3.2 The management of change 3.3 Continuous improvement of the SMS
4	Safety promotion (SP)	4.1 Training and education 4.2 Safety communication

Source: based on CAO, 2018.

The safety policy and objectives should accurately convey the organization's dedication to safety and include a concise statement of the human and financial resources required for its implementation. The organization should effectively convey this commitment, ensuring that it is visible and supported by all members [Łuczak, 2016].

The aviation entity must establish and implement a systematic procedure to identify potential hazards associated with the products or services it provides in order to effectively manage safety risks. Threat identification involves the use of both reactive and proactive strategies to support decision-making in the face of uncertainty. It provides information on specific hazards in the risk management process [Ewertowski, Butlewski, 2022].

The organization's safety assurance process entails establishing and maintaining methods to assess its safety performance and verify the efficacy of its safety risk management. The organization's safety performance is assessed by evaluating safety indicators and comparing them

to safety performance targets within the Safety Management System (SMS) [Yeun, Bates and Murray, 2014]. Organizational safety promotion entails the creation and implementation of a safety training program to guarantee that employees are adequately prepared and competent to perform their SMS duties. The extent of safety training should be suitable for individuals' engagement in the SMS [Kešeľová et al., 2021].

It is worth emphasizing the importance of safety culture in safety management systems. Safety culture consists of:

- information culture – organizations continuously collect and analyze data and share it with others in order to maintain up-to-date knowledge about factors affecting safety, which they communicate to their employees;
- reporting culture – employees report events and situations without fear of being accused or blamed;
- just culture – employees know the boundary between acceptable and unacceptable behavior. They know that they can make mistakes, but that knowingly breaking the rules may be punished;
- culture of flexibility – in the face of dynamic and diverse events, the organization is able to reconfigure itself to adopt an appropriate approach to solving the problem of ensuring safety;
- learning culture – the organization draws conclusions from events that have occurred and introduces changes to avoid their repetition, and provides training to its employees to raise their awareness [Reason, 2016].

The concepts of just culture and reporting culture play a crucial role in the context of this paper. Based on the events reported, an investigation can be carried out to determine their circumstances and causes and to make recommendations to prevent similar accidents and incidents in the future [Ewertowski, 2015].

The concept of situational awareness (SA) was first formulated during World War I by Oswald Boelke, who recognized the importance of gaining awareness of the enemy before the enemy gained similar awareness and developed methods to achieve this [Woods, 2015]. The concept of situational awareness, initially used in reference to military pilots – pilots must understand, remember, and work with a large amount of data – is attributed to Endsley, who described the situational awareness of an individual in a system [Endsley, 1995]. Over the years, situational awareness has become a research topic in various areas of practice, where people perform tasks in complex and dynamic systems, such as military operations, aviation, air traffic control, driving, or C4i environments [Salmon et al., 2006].

Situational awareness is an essential type of information in talks about human action and explanations of incidents [van Winsen et al., 2015]. This consciousness occupies a unique position in the study of human behavior within intricate and ever-changing systems. It plays a pivotal role in decision-making processes i.e. in safety management systems by perceiving external and internal environmental elements, understanding their significance, and predicting their future states [Sadłowska-Wrzesińska, Gabryelewicz, Krupa, 2017].

The first mentions related to the topic of a High Reliability Organization (HRO) are associated with a research program on "almost error-free operations" [La Porte, 2016]. Over the next 10–15 years, in the 1980s and 1990s, a series of publications related to the HRO emerged [Rochlin, 1989; La Porte, 1996; Grabowski, Roberts 1997, Weick and Sutcliffe, 2011]. These works outlined the research tradition in the subject area.

Weick and Sutcliffe characterized the HRO by five distinctive features that facilitate problem detection and organizational management. It was stated that, although to varying degrees and without a specific hierarchy, these features should be present in such organizations.

The characteristic features include:

- Preoccupation with failure – every mistake should be treated as a symptom of a system problem that could have serious consequences.
- Reluctance to simplify interpretations – deliberate actions should be taken during failure analysis to create a more complete picture of the situation.
- Sensitivity to operations – a well-developed situational awareness should lead to continuous adjustments to prevent the accumulation and escalation of errors.
- Commitment to resilience – the ability to detect, eliminate, and learn from inevitable errors that are part of the uncertainty of the environment. HROs are not error-free, but errors are used to achieve goals more safely.
- Deference to expertise – decisions are made at the frontline of management, or authority migrates to those with the greatest expertise.

Hopkins [2009] put forth the theory that not necessarily all five of the mentioned characteristics must be fulfilled by an organization to meet HRO criteria.

Aviation is a classic example of the HRO. Airlines, air traffic control, and other aviation-related organizations are highly focused on ensuring the highest level of safety and reliability. HRO practices in this sector include rigorous procedures, continuous safety assessment, and open communication. The role of safety management systems in enhancing safety situational awareness is based on a proactive strategy of hazard identification primarily based on safety reporting and ultimately appropriate risk management.

Materials and methods

The research employs a methodological approach consisting of four stages: (I) Description of the existing concepts of the SMS and SA through a literature review; (II) Analysis of reported adverse events in the organization through document research in the two periods considered before and after the introduction of improvements in the SMS; (III) Preparation of an assessment tool for the SMS and SA (survey questionnaire); (IV) Conduction of the survey of the SMS and SA.

The first stage (I), involving the selection of existing concepts of the SMS and SA, entailed choosing the most suitable concepts for the study. It was decided that adopting ICAO's SMS

framework, consisting of 4 aspects and 12 factors, would provide a solid foundation. This decision was based on the widespread adoption of ICAO's SMS concept within organizations, with member states authorities considering it a best practice. As for SA, the concept outlined by Sadłowska-Wrzesińska was chosen. This approach describes situational awareness as perceiving external and internal environmental elements, understanding their significance, and predicting their future states. The decision to select this concept was influenced by the fact that it best fits the research problem of the study.

The second stage (II) "Analysis of reported adverse events in the organization in the two periods considered before and after the introduction of improvements in the SMS" was based on the analysis of documents and reporting system of adverse events derived from the surveyed HRO. This data collection method involves the examination of written or virtual documents to draw conclusions in accordance with the study's parameters. Primarily employed in qualitative research, it serves as a means of qualitative analysis.

The gathered materials and information have been divided into two time periods:

1) 01.10.2016–31.01.2020 – Partial period – The basic safety management system was implemented with minimal legal requirements and was created solely for the approval of the HRO by the State Civil Aviation Authority;
2) 01.02.2020–01.02.2022 – Post-improvement implementation period – The current system has been fully operational.

During the first period the HRO utilized:

- Safety Management System management instruction – available in the office in paper format;
- Voluntary safety reporting form (SMS) – available on the website in pdf format;
- Annual aviation safety conferences;
- General flight safety classes, conducted in the first period of studies prior to the start of practical training.

During the second period the HRO utilized:

- Safety Management System (SMS) management instruction – available in the office in paper format and in the cloud in electronic format;
- 6 reporting forms: 3 safety reports (SMS, URF, and ASR), and 3 personal reports (FTG, UTF, and UVLB) available on the website for completion and submission, or in pdf format for download and submission after completion;
- Directive on the introduction of safety forms;
- Posters illustrating the types of reports and showing the differences between them;
- Posters showing the reason, time, and method for reporting each type of report;
- Providing students and instructors with information about incidents in the HRO;
- Providing students and instructors with materials on flight safety and selected incidents reports in the general aviation sector;
- Popularization of the just culture principle;
- Annual aviation safety conferences;

- General flight safety classes, conducted in the first year of studies prior to the start of practical training;
- Additional meetings with flying personnel, organized as needed, regarding the functioning of the safety management system;
- Informational meeting before the start of practical training, presenting newly admitted student pilots with the functions, and capabilities of the safety management system.

The voluntary SMS form is used for open reporting of general issues associated with safety. The voluntary URF form is used for anonymous reporting of general issues associated with safety, while the ASR form is used to report on the circumstances of events that impact safety. The ASR form is used to report events that are subject to mandatory reporting, such as collisions, animal strikes, near misses, and other events affecting safety [Regulation 376/2014EU]. Additional documentation, such as photographs, can be attached to the ASR form. The FTG form is used to report fatigue both before and after performing aviation tasks. Completing the FTG form results in exclusion from flights on the day of submission and the following day, regardless of the time the form is completed. The UTF form is used to report unfitness due to health problems, including psycho-physical unfitness, illnesses, etc. The UVLB form is used to report unfitness due to any random circumstances, such as personal problems, transportation issues, etc.

The risk classification of all reported adverse events is assigned on the basis of the risk matrix developed in the SMS Safety Management Manual in force in the HRO, prepared on the basis of the Safety Management Manual. The matrix is illustrated in Table 2.

Table 2. The risk matrix of adverse events

Safety risk		Severity				
Probability		Catastrophic	Hazardous	Major	Minor	Negligible
		A	B	C	D	E
Frequent	5	5A	5B	5C	5D	5E
Occasional	4	4A	4B	4C	4D	4E
Remote	3	3A	3B	3C	3D	3E
Improbable	2	2A	2B	2C	2D	2E
Extremely improbable	1	1A	1B	1C	1D	1E

Source: based on CAO, 2018.

The safety level of risk acceptation with recommended action is illustrated in Table 3.

Table 3. The safety level of risk acceptation with recommended action

Safety Risk Index Range	Safety Risk Description	Recommended Action
5A, 5B, 5C, 4A, 4B, 3A	Intolerable	Take immediate action to mitigate the risk or stop the activity
5D, 5E, 4C, 4D, 3B, 3C, 2A, 2B	Tolerable	Can be tolerated on the safety risk mitigation
4E, 3D, 3E, 2C, 2D, 2E, 1A, 1B, 1C, 1D, 1E	Acceptable	Acceptable as is. No further risk mitigation required

Source: based on CAO, 2018.

During this stage the authors also got information about the number of flight operations performed, and the total time of flight operations performed. Therefore, it was possible to calculate the relative event rate per 1000 operations and per 1000 hours of operation according to the following formulas:
Relative event rate per 1000 operations:

$$\mathrm{Reo} = \frac{\mathrm{Ne}}{\mathrm{No}} * 1000 \tag{1}$$

Where:
Ne – number of events
No – number of operations
Relative event rate per 1000 hours of operation:

$$\mathrm{Reh} = \frac{\mathrm{Ne}}{\mathrm{To}} * 1000\mathrm{h} \tag{2}$$

Where:
Ne – number of events
To – total time of flight operations
The third stage (III), preparation of the assessment tool for SMS and SA, consisted of a survey questionnaire.

The questionnaire is an author's synthesis of the most important information regarding the SMS implementation status before and after improvements emphasizing the role of SA, just culture and reporting systems [EASA, 2023]. In total there were 11 questions in the questionnaire. A five-point Likert scale was used for the proposed scoring for individual response outcomes in the questionnaire utilized, outlined as follows:
Strongly Disagree – 1 point,
Disagree – 2 points,
Neither Agree nor Disagree – 3 points,
Agree – 4 points,
Strongly Agree – 5 points,

The surveys were prepared in Google Forms and divided into three sections:

3) Questions regarding respondent characteristics (start date of employment in the HRO, position – instructor or student);
4) Questions regarding safety situational awareness before the implementation of changes in the safety management system (1.1–1.5);
5) Questions regarding safety situational awareness after the implementation of changes in the safety management system (2.1–2.5).

Furthermore, two questions were added to identify the key elements of the safety management system that contributed to the safety situational awareness before (1.6) and after (2.6) SMS improvements.

Possible answers for 1.6.:

a) Voluntary Incident Reporting Form – SMS;
b) Aviation Safety Conferences;
c) Contact with the Safety Manager;
d) Discussions with instructors;
e) Civil Aviation Safety Bulletin issued by the Civil Aviation Authority.

Possible answers for 2.6.:

a) Safety Reports – SMS, ASR, URF;
b) Personal Reports – FTG, UTF, UVLB;
c) Aviation Safety Conferences;
d) Contact with the Safety Manager;
e) Directive regarding the implementation of safety reports and personal reports;
f) Handouts;
g) Discussions with instructors;
h) Notes informing about incidents occurring in the HRO;
i) Civil Aviation Safety Bulletin issued by the Civil Aviation Authority.

Respondents answered questions from all three sections or from two sections, skipping the second section regarding questions about safety situational awareness before the improvement of the safety management system. The qualification for the appropriate group of respondents related to the year of starting cooperation with the HRO. Individuals who began cooperation with the HRO between 2016 and 2019 answered questions from all three sections. The remaining group of respondents, who started working with the HRO between 2020 and 2022, answered questions from the first and third sections.

The fourth stage (IV), Conduction of the survey, took place between March 1, 2022, and April 20, 2022. The research sample consisted of one HRO in the Greater Poland voivodeship. The HRO is small (10–49 employees) based on [OJ L 124, 20.5.2003]. The authors considered the results to be of sufficient quality for the case study. However, the survey has limitations which are described in the discussion section. The sample type used in the survey was a non-probability convenience sampling due to time and cost limitations. The characteristics of the research respondents are depicted in Table 4.

Table 4. Features of the research subjects

Features	01.10.2016 31.01.2020	01.02.2020 01.02.2022	TOTAL
Number of instructor respondents	5	5	10
Response rate	62.5%	62.5%	62.5%
Number of student respondents	27	15	42
Response rate	79%	70%	74%

Source: own elaboration.

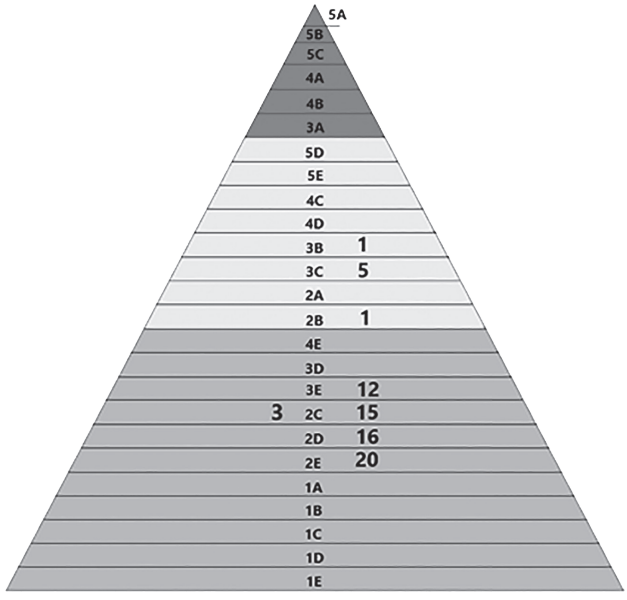
The survey included an accompanying cover letter explaining the survey's purpose. Participation was voluntary and anonymous, and respondents were instructed not to comment on the survey methodology and tools. The OR questionnaire consisted of 11 questions, and was subject to content validity [Czakon, 2019]. The questionnaire with all questions is presented in Tables 6 and 7. While the Likert scale can be considered an ordinal variable, it is possible to treat it as an interval variable under the assumption that there are equal distances between the answers [Joshi et al., 2015]. Variables on an interval scale with at least five degrees can be regarded as continuous variables [Więziak-Białkowska, 2011]. This assumption was applied in the subsequent analyses, where quantitative methods were employed.

Results

The analysis of the number of reported adverse events in the organization in the two periods before and after the introduction of improvements in the SMS is presented in Figure 1. The left side of the triangle represents the period before, and the right side the period after SMS improvements. The codes of the triangle are related to the risk matrix and the safety level of risk acceptance presented in Tables 2 and 3.

The calculation of the relative event rate per 1000 operations and per 1000 hours of operation according to formulas (1) and (2) respectively, are presented in Table 5. The statements describing companies' SMS and SA questionnaire results are presented in Table 6. The key elements of the safety management system that contributed to the safety situational awareness before (1.6) and after (2.6) SMS improvements are presented in Table 7.

Figure 1. The reported adverse events triangle before and after improvements in the SMS



Source: own elaboration.

Table 5. Relative reported event rates

Period of time	Number of operations	Total time of flight operations (h)	Number of events	Relative event rate per 1000 operations	Relative event rate per 1000 hours of operations
Before SMS improvements	9817	3399	3	0.31	0.88
After SMS improvements	8609	3953	74	8.60	18.72

Source: own elaboration.

Table 6. Results of the SMS and SA questionnaire

No.	Rated Item	Average of instructors	SD	Average of students	SD
1.1	Average level of safety situational awareness was significant in the period before SMS improvements	4.0	0.5	3.1	0.8
1.2	I witnessed situations that could negatively impact the level of safety before SMS improvements	1.8	0.4	2.9	1.0
1.3	If the situation that could negatively impact the level of safety occurred before SMS improvements, it was ultimately reported	2.8	1.6	1.9	1.1
1.4	The "Just culture" principle was promoted before SMS improvements	4.0	0.3	2.9	1.1
1.5	I witnessed cases of violation of the "Just culture" principle before SMS improvements	2.6	1.1	3.7	0.9
2.1	Average level of safety situational awareness was significant in the period after SMS improvements	4.3	0.6	3.8	0.5
2.2	I witnessed situations that could negatively impact the level of safety after SMS improvements	2.2	0,5	3.4	0.8
2.3	If the situation that could negatively impact the level of safety occurred after SMS improvements, it was ultimately reported.	4.3	0.7	3.9	0.9
2.4	The "Just culture" principle was promoted after SMS improvements	4.3	0.6	3.9	0.7
2.5	I witnessed cases of violation of the "Just culture" principle after SMS improvements	2.4	1.1	2.7	0.9

Source: own elaboration.

Table 7. The key elements of the safety management system that contributed to the safety situational awareness

No.	The key elements of the safety management system that contributed to the safety situational awareness before SMS improvements (1.6)	% of instructors	% of students
1	Voluntary Incident Reporting Form – SMS	80	52
2	Aviation Safety Conferences	80	44
3	Contact with the Safety Manager	40	15
4	Discussions with instructors	80	63
5	Civil Aviation Safety Bulletin issued by the Civil Aviation Authority	0	4
No.	The key elements of the safety management system that contributed to the safety situational awareness after SMS improvements (2.6)	% of instructors	% of students
1	Safety Reports – SMS, ASR, URF	100	76
2	Personal Reports – FTG, UTF, UVLB	20	83
3	Aviation Safety Conferences	60	24
4	Contact with the Safety Manager	20	7

No.	The key elements of the safety management system that contributed to the safety situational awareness after SMS improvements (2.6)	% of instructors	% of students
5	Discussions with instructors	60	50
6	Notes informing about incidents occurring in the HRO	40	26
7	Civil Aviation Safety Bulletin issued by the Civil Aviation Authority	20	0

Source: own elaboration.

Discussion

The survey successfully met its objective. The literature review delineated prevailing concepts of Safety Management Systems and Situational Awareness, highlighting key characteristics. These insights were instrumental in developing the survey questionnaire. Subsequently, surveys were administered to assess the SMS and SA within a selected high-reliability organization. Overall, the research indicated a relationship between improvements in the SMS and better SA of HROs in the context of safety.

The development of the Safety Management System in the HRO appears to be significant. The implementation of new SMS elements has undoubtedly contributed to an increase in safety levels and situational awareness within the HRO. A noticeable surge in reported incidents through the incident reporting system can be observed. In the two periods compared, the difference in reports stands at 3 to 74, respectively. A more objective comparison can be made by analyzing relative indicators. The relative event rate per 1000 operations ranges from 0.31 to 8.60, while the relative event rate per 1000 hours of operations ranges from 0.88 to 18.72. These findings are corroborated by survey results, indicating a significant improvement in safety perception and increased situational awareness, despite varying results between the instructor and student groups. The assessment of Situational Awareness (SA) before and after the implementation of SMS improvements is as follows: in the instructor group, it changed from 4.0 to 4.3, and in the student group, from 3.1 to 3.8. Despite the improved results, students show a significantly more critical attitude, indicating the need for instructor training in safety culture and the SMS itself. This is confirmed by the negative attitude of some instructors towards the incident reporting system and the entire SMS. The analysis of the incidents reported reveals that nearly 91% of all reports were submitted by students, while instructors submitted only 7% of the reports. The results demonstrate an improvement in the assessment of compliance with the principles of just culture in the HRO. The assessment among instructors changed from 4.0 to 4.3, and among students, from 2.9 to 3.9. The difference in students' assessment before the implementation of SMS improvements regarding the observation of incidents and their reporting (2.9 to 1.9 respectively) indicates that not all observed incidents were reported during this period. It also turns out that student pilots were not always aware of the existing threat and the need to report it. This led them to ignore dangerous situations, also due to the inappropriate behavior of instructors who did not pay proper attention to them. After

the implementation of SMS improvements, this difference decreased in favor of reporting (3.4 to 3.9 respectively).

Regarding the key elements of the safety management system that contributed to safety situational awareness before SMS improvements, both surveyed groups valued the Voluntary Incident Reporting Form – SMS (instructors – 80%, students 52%), discussions with instructors (80% to 63% respectively), and aviation safety conferences (80% to 44% respectively). They consider annual AS conferences as one of the most important elements influencing the improvement of safety levels in the HRO. The information presented was also essential for participants due to the use of the airport.

Regarding the key elements of the safety management system that contributed to the safety situational awareness after SMS improvements, both surveyed groups valued safety reports – SMS, ASR, URF (100% to 76% respectively) and discussions with instructors (60% to 50% respectively). There is a significant discrepancy in the perception of personal reports – FTG, UTF, UVLB – (20% to 83% respectively). The introduction of the UTF report led to an increase in bold resignations from flights for health reasons by students. However, students often decide to carry out planned aviation activities due to their fear of being misunderstood by instructors. Disregarding symptoms of fatigue or other health problems, as well as not paying attention to potential threats, can ultimately lead to an incident.

This study is constrained by inherent limitations related to the sample size and the use of a non-probability convenience sampling approach. Sample selection was based on subjective judgment rather than random selection. In addition, the survey was based on self-reported data, which may lead to distorted results. While the study provides insights into workers' perceptions of SMS and SA aspects within the HRO, its findings are limited to this specific industry. Additionally, the aspects examined are primarily relevant to aviation, limiting the study's generalizability. Nonetheless, the authors believe that the results presented could serve as a basis for preliminary conclusions and further research efforts aimed at mitigating these limitations. As such, the research outcomes are particularly relevant to managers and specialists involved in addressing safety concerns within HROs.

Summary

The topic of Safety Management System (SMS) is broad and highly important. To establish a properly functioning SMS that significantly enhances SA, and safety levels, action must be taken on multiple fronts. The survey results indicate that the creation of an SMS and its components does not end with their implementation in the High Reliability Organization. For the system to function and yield tangible results, individuals who understand and, above all, utilize the system are essential. Young individuals learning the art of piloting, absorbing knowledge, are easily taught appropriate behaviors when provided with opportunities and explanations of their purpose. However, providing modern systems to experienced instructors who lack

the habit of incident reporting is a challenge. Bad habits cannot be eliminated and replaced with new ones in just a few days. Therefore, implementing even the best safety management system will be insignificant if the individuals expected to utilize it are immediately skeptical. This can lead to a rift and a disruption in the student's sense of safety right at the beginning of the training, which is undoubtedly a dangerous situation. The HRO staff is aware of this situation and is constantly monitoring it and engaging in discussions with students to make them aware of safety issues in the HRO. Despite these challenges, the HRO has witnessed a significant increase in reported incidents.

The use of observation methods, document analysis, and surveys enabled the collection of information and the achievement of all the study's objectives. The main aim of the study was a comparative analysis of safety before and after the implementation of changes in the safety management system. It revealed an improvement in the quality of the safety management system and, above all, a positive impact on SA in the HRO, as acknowledged by the respondents. After the implementation of changes and the expansion of the incident reporting system, the HRO finally has a database of incidents from which it can draw knowledge about threats occurring in the organization, and most importantly, share this knowledge with individuals working in it. Despite the problems identified, the surveyed HRO has achieved significant success in implementing changes in the safety management system. These changes have realistically contributed to improving safety SA. Students who were previously afraid to call the instructor to cancel flights due to illness now submit appropriate reports that exclude them from these flights, and the instructor has no influence on the students' decision change. Meetings with students to raise safety awareness and the increasing number of UTF and others reports indicate that HRO's actions are yielding the intended results. Finally, the absence of reports in the organization does not mean that the organization is ideal and does not experience situations; on the contrary, it indicates the concealment of information about incidents and situations because only an aviation entity that does not perform any aviation operations can boast a lack of hazardous situations and incidents. Everyone must realize that it will never be possible to eliminate risks in 100%, but the main goal is to avoid events of higher severity and learn from those of lower severity. Technology, human error, the environment – any of these elements can fail at any time, and despite all preventive actions, it will not be possible to prevent their failure or temporary incapacity. This work can provide a basis for further research and practical actions to improve safety in aviation.

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