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A Conceptual Overlook at the Safety Management System

Halil ŞİMŞEK[1] **Sevil ÇULHA ÜNAL**[2]

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Abstract

The most important rule that does not change in the aviation industry, which naturally faces many dangers compared to other sectors, is safety. It is often not possible to compensate for the insecurity that causes devastating effects in terms of its consequences. This situation has made the concept of safety one of the most emphasized concepts throughout the history of aviation. The main purpose in aviation operations is to minimize the risks that cannot be eliminated but exist in every activity. Aviation enterprises, which continue their existence with this awareness, must integrate a common system developed to ensure safety. This system, which is called the "Safety Management System (SMS)", should be carried out with an understanding that should be adopted by all personnel, not by a single person and unit. The importance of a sound safety management system depends on the recognition and application of all aspects of this system. In this context, the concept of safety in the study, followed by the approach of the safety management system, is discussed together with its historical processes. As a result of the literature review on the subject, the safety management system was conceptually examined, and suggestions were made that would be beneficial to both sector employees and researchers.

Key Words: Safety, Safety Management System, Aviation Sector.

JEL Classification: M10, M12.

Emniyet Yönetim Sistemine Kavramsal Bir Bakış

Öz

Doğası gereği diğer sektörlere kıyasla pek çok tehlike ile karşı karşıya olan havacılık sektöründe değişmeyen en önemli kural emniyettir. Sonuçları bakımından yıkıcı etkilere neden olan emniyetsizliğin telafisi çoğu zaman mümkün olmaz. Bu durum ise emniyet kavramını havacılığın en kritik unsurlarından biri haline getirmiştir. Havacılık operasyonlarında temel amaç, ortadan kaldırılamayan ancak her faaliyette var olan risklerin en aza indirilmesidir. Bu bilinçle varlığını sürdüren havacılık işletmeleri emniyeti sağlamak üzere geliştirilen ortak bir sistemi bünyelerine entegre etmek zorundadırlar. "Emniyet Yönetim Sistemi" olarak adlandırılan bu sistem tek bir kişi ve birimin değil, tüm personelin benimsemesi gereken bir anlayışla yürütülmelidir. Sağlıklı bir emniyet yönetim sisteminin önemi, bu sistemin her yönüyle tanınması ve tatbik edilmesine bağlıdır. Bu kapsamda çalışmada emniyet kavramı, devamında ise emniyet yönetim sistemi yaklaşımı tarihsel süreçleriyle birlikte ele alınmıştır. Konuya ilişkin yapılan literatür taraması neticesinde emniyet yönetim sistemi kavramsal olarak incelenmiş, hem sektör çalışanları hem de araştırmacılara faydalı olacağı değerlendirilen önerilerde bulunulmuştur.

Anahtar Kelimeler: Emniyet, Emniyet Yönetim Sistemi, Havacılık Sektörü.

JEL Sınıflandırma: M10, M12.

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INTRODUCTION

In addition to basic activities such as flight and ground services, the aviation industry also includes interrelated operations such as maintenance, customer service, and security. The concept of safety in aviation, which is a constantly developing and renewing sector with high technology and risk, should be taken seriously. Because the aviation sector contains extremely great dangers and risks, the consequences of errors and accidents can cause great losses. All stakeholders in the sector should develop their safety-related precautions, struggles, and management capabilities. Considering that all stakeholders are responsible for safety, it is accepted that everyone is a link in the safety chain. For this reason, the culture of being meticulous, self-sacrificing, and careful becomes mandatory in all aviation operations. The biggest reasons for this situation are that the aviation industry has processes that require advanced technology and involve high costs, and that the last thing to be considered in aviation is risks and mistakes. For this reason, the importance of safety in the aviation industry is very high.

The main purpose in the aviation industry is to take precautions against situations arising from errors, faults, and negligence in all operations, to perform operations safely, and to minimize the possibility of accidents. For this purpose, a system has been developed by making use of the directives and instructions published by the International Civil Aviation Organization (ICAO) in 2005, which all aviation institutions and organizations, airports, airlines, and affiliated companies must comply with. The name of this system is Safety Management System (EYS). The International Civil Aviation Organization (ICAO) aims to implement a standard SMS process that will be understood and applied in the same way by every stakeholder around the world. With a correct IMS application, customer expectations in transportation activities, which are the most known operation of aviation enterprises, can be met in the safest way and made sustainable. Thus, the corporate image and income of the enterprise increase, and its performance indicators are positively affected.

In this context, the safety element required for the effective and efficient performance of all activities in the aviation sector, for the operation of a proactive process by preventing all kinds of insecurity by instant monitoring of the activities has been mentioned. Information on how safety, which is the starting point of all activities, was born and developed in the aviation industry, and the latest situation with the transformation experienced, is presented with a conceptual approach.

1. SAFETY IN AVIATION

1.1. Safety Concept

Looking at the dictionary, safety is defined as “the state of avoiding mistakes, being free from dangers and factors that may cause bad results, and risks” (Balderson, 2016). However, considering the hazards present in aviation, this definition is limiting and insufficient. We can say that all factors that may arise during the activities of the aircraft and that may reveal unexpected situations are hazards (the existence of which has not yet emerged). Although measures are tried to be taken to prevent these dangers, it is not always possible to keep

systems with human factors away from operational errors and risks (SHGM, 2012). However, this can be made possible by keeping risks at a reasonable level. Therefore, it is more accurate to define the concept of safety, which is critical in aviation, as reducing or keeping the probability of harm to persons or property to an acceptable level through hazard identification and safety risk management (ICAO, 2013).

Aviation safety has a dynamic system structure. For this reason, the constantly emerging and possible risks should be reduced as much as possible. If the dangers and risks that threaten safety are kept at a controllable level, aviation, which is an open and dynamic system, can be considered as structurally safe (SHGM, 2011). In addition, it is critical to note that the acceptability of safety performance is influenced by global norms and cultural structures (ICAO, 2013).

1.2. The Development Process of the Concept of Safety

In aviation history, there was a lack of technology, insufficient infrastructure, unpredictability, and an inability to understand the dangers of aviation operations. Due to all these reasons, the need for safety in aviation has arisen as a result of a large number of accidents. When it comes today, accidents in the field of technology have increased over time and the necessary infrastructure has been formed. In order to better understand the development process in aviation safety, it is examined under four factors according to activity periods (ICAO, 2018):

a) Technical factors: From the early 1900s to the late 1960s, aviation emerged as a mode of public transport where identified safety deficiencies were related to both technical and technological factors. Therefore, research and improvement of the technical elements for safety has been the main objective. By the 1950s, the frequency of accidents decreased over time with technological developments.

b) Human factors: Since the early 1970s, the frequency of aviation accidents has greatly decreased due to technological developments and improvements in safety regulations. Aviation has become a safer mode of transport and the focus on safety issues has been expanded to include human factors. Resources have been invested in order to reduce errors, and human factors have continued to appear as a recurring element in accidents. In the same years, human factors were individual-oriented without considering both operational and organizational aspects. Until the early 1990s, this was accepted that individuals act in complex fields that include various variables that can affect their behavior.

c) Organizational factors: In the mid-1990s safety was considered on a systematic approach and started to include organizational factors as well as other factors such as human and technical and then “organizational accident” has been introduced. In addition, normal safety statistics and analysis using not only reactive but also proactive methodologies enabled companies to monitor known risks related to safety and identify emerging trends of safety.

d) Total system factors: Since the early 21st century, governments and aviation organizations have adopted the safety subjects and have reached a higher level of safety maturity. The SMS procedures have become widespread, and many companies have

benefited from safety advantages. However, safety issues have mostly focused on personel safety performance and limited control. Therefore, it has led to the increasing awareness of various organizations playing a role in aviation safety.

1.3. Importance of Safety

Although the most important priority of aviation systems seems to be to ensure safety in air transport activities, the main factor is profitability. However, ensuring safety should always be kept in mind and should be worked on accordingly. The important point here should be how to operate and how to reach profit targets safely, rather than how to ensure safety. Therefore, it can be said that there is a direct relationship between safety and profit (Cusick, Cortés, & Rodrigues, 2017).

In aviation, accidents often have identifiable antecedents, rather than happening out of the blue. As a result of delaying such antecedents, the ground is prepared for the incubation period, which is the beginning of the disaster. There is no absolute safety in aviation. However, certain risks can be managed as long as they are not a major concern. Emphasizing the measures that can reduce these risks is of great importance to ensure a safe working environment. The person who plays the biggest role in aviation safety. Studies show that most accidents are caused by human error (Wood, 2003). Since human error is involved in most, if not all, of the accidents that occur, human factors such as ergonomics and human performance, and cognitive psychology is examined. Thus, the interaction between humans and machines can be further improved and flight safety can be increased significantly (Cusick et al., 2017).

Routine maintenance of aircraft for aviation safety is another important factor affecting safety. Maintenance of aircraft according to the World Airlines Technical Operations Glossary; is the activity of determining the condition of a tool by making regular revisions and repairing and modifications if necessary, in order to keep it working (Bayır, 1996). These activities can cause huge costs for airlines. Despite this, the possibility of preventing a possible accident is worth bearing these costs. Any airline can prevent major financial losses or negative perceptions in case of an accident by performing maintenance that will provide the necessary safety instead of avoiding maintenance costs. It should be noted that 12% of major aviation accidents are caused by inadequate inspection and maintenance (Gill & Shergill, 2004). In addition, if the training period of the maintenance personnel is shortened, flight safety is endangered (Soeter and Boer, 2000). As a result, it is possible to say that safety is of vital importance in order to avoid events that may result in tragedy and to break the chain of negative events.

1.4. Safety Models

In this section, some safety models that are widely used in aviation literature will be presented.

1.4.1. 5-Factor Model

Known as the 5-M model in the literature and created with the initials of "Man/Machine/Medium/Mission/Management", the model examines the nature of accidents. This model aims to eliminate the problems that may arise in aviation security and

to perform risk management in the most appropriate way (Ballesteros, 2016). In the 5-M model, the word “man” has evolved into the word “human” over time and is called the 5-factor model. The 5-factor model “man, machine, environment, task, and management” has become popular in teaching the theory of accident and is useful when examining the elements that cause an accident. The five factors given in Figure 1 are closely correlated and interact in various ways, but management generally plays a dominant role and is therefore shown to encompass other factors. On the other hand, the mission is in the middle as a central target or purpose to indicate its importance in effective mission success in aviation safety studies (Cusick et al., 2017).

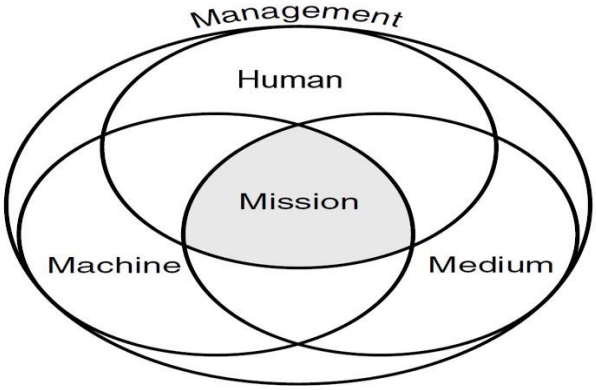

Figure 1. 5-Factor Model Diagram

Source: Wells, A.T. *Commercial Aviation Safety*. McGraw-Hill Companies, 2001.

1.4.2. SHELL Model

The SHELL model is a widely used model in aviation accident theory. This model was begun by Edwards in 1972 and later diagrammed by Hawkins in 1975. This diagram is given in Figure 2 and the components of the SHELL model are as follows (Cusick et al., 2017).

Software (S): Procedures, checklists, training

Hardware (H): Machines and equipment

Environment (E): Working conditions

Liveware (L) “Working”: human interface for S, H, and E

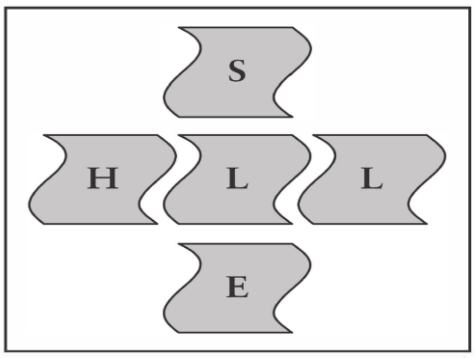

Figure 2. SHELL Model

Source: Cusick, S.K, Cortés, I.A., & Rodrigues, C.C. *Commercial Aviation Safety*. McGraw-Hill Education, 2017.

1.4.3. Reason's Swiss Cheese Model

Reason's model was introduced in 1990 as a way of showing how different levels of human factors in an organization such as an airline can cause accidents. This model explains that accidents are often caused by faulty actions or lack of action at an organization's management levels. Reason's model is widely used in the aviation industry (Reason, 1990), which aims to show that accidents and the factors that cause accidents are since the measures taken against accidents are not faultless (Cusick et al., 2017).

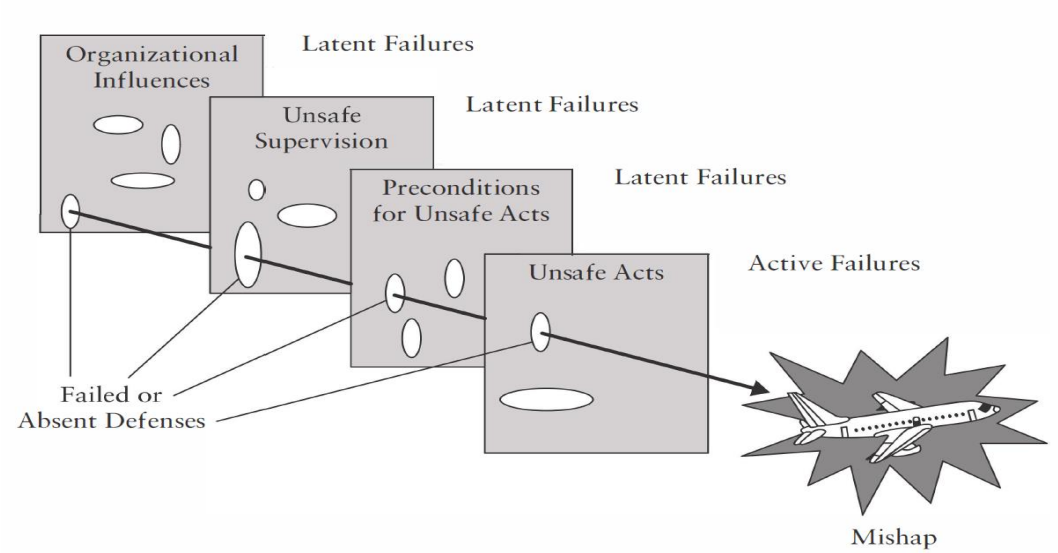

Figure 3. Reason's Swiss Cheese Model

Source: Cusick, S.K, Cortés, I.A., & Rodrigues, C.C. *Commercial Aviation Safety*. McGraw-Hill Education, 2017.

2. SAFETY MANAGEMENT SYSTEM IN AVIATION

2.1. Safety Management System Concept and Purposes

The SMS is a system that ensures the safe operation of aircraft by effectively managing the safety risk. This system, which is of great importance in aviation activities, has three basic features: systematicity, proactivity, and openness. The SMS also plays an important role for current aviation in eliminating or minimizing threats and risks that may be seen in ongoing aviation activities in a short time (ICAO, 2018). Safety management activities within the scope of the SMS are systematic as they are carried out consistently according to the pre-prepared plan. It is proactive in reducing and controlling safety risks before incidents affecting aviation safety occur. In addition, the documentation of all safety management activities organized in aviation organizations and the creation of a safety library point to the openness of the SMS (SHGM, 2012).

The main purpose of the SMS system is to identify hazards, collect and analyze safety data, continuously evaluate safety risks, and strive to improve safety (CAA, 2019). For safety improvement to occur, it is necessary to maximize opportunities (SM ICG, 2019). Another aim is to ensure that the passenger and cargo transportation services offered are carried out

at the highest operational safety level (Öztürk & Afacan, 2011). It also aims to proactively control and reduce risks as much as possible before accidents occur (ICAO, 2013). In other words, the basic logic of the system prevents the occurrence of incidents by focusing on potential safety problems with a perspective that is constantly active and controlling risks, not intervention after the event (Stolzer, Halford, & Goglia, 2008). Therefore, the SMS has a great responsibility to ensure safety in the aviation system. Because the occurrence of an accident in aviation shows that there is a failure, and the biggest factor underlying this failure is the SMS (SHGM, 2012).

2.2. Safety Management System Components

The SMS components consist of 4 main topics: safety policy and objectives, safety risk management, assuring the safety, and promoting safety. In addition, these components are divided into elements that include sub-processes and tools in terms of the safety management system they represent.

2.2.1. Safety Policy and Objectives

The best performance of safety management depends on the determination of the safety policy. The safety policy sets out the methods, processes and principles of the organization's safety management to meet its safety objectives. This policy guarantees the top management's safety and continuous improvement in their fields of activity (Cusick et al., 2017). At the core of the safety policies and objectives in the aviation system, there are 5 elements: the commitment and responsibility of the management, accountability for safety, the appointment of personnel who have a critical role in ensuring safety, the coordination of emergency response planning and SMS documentation (SHGM, 2012).

2.2.2. Safety Risk Management

Safety risk management determines the need and adequacy of new risk controls based on an acceptable level of risk assessment (Cusick et al., 2017). It consists of elements such as hazard identification, risk assessment and risk reduction (SHGM, 2011). Safety risk management identifies existing or potential hazards during the delivery of products or services. The danger can be the result of deficiencies in technical functions, designs, and the relations of the human element with other systems (ICAO, 2018).

Safety risk management is a clear, systematic, and comprehensive essential component for managing safety risk in all areas of the aviation industry. An SMS using the safety risk method develops safety steps through the measures to be taken to reduce the risk to occur. It is usual for an unsafe event to occur as a result of gaps in these protective stages (FAA, 2007). Therefore, it is necessary to carefully perform the steps in the safety risk management process in order to prevent any accident that may arise from gaps.

2.2.3. Ensuring Safety

The assurance of safety component consists of both monitoring and controlling safety performance, change of managing, and improvement of the SMS. This component ensures its safety in the enterprise through periodic monitoring, feedback, and continuous corrective actions in line with changing operational needs (SHGM, 2012).

The "Quality and Assurance" departments in airline companies mostly check the compliance of in-house activities with the rules of the regulatory authority and aim to ensure this over time by making the necessary analyzes (Gerede, 2005). Because, with the right analysis, if the safety assurance process shows a positive performance, positive reinforcement is provided that the risks are managed appropriately (Cusick et al., 2017).

2.2.4. Promoting Safety

The last of the safety management system components is the promotion of safety. This component consists of two elements, education-training, and safety communication. Effective safety management is not just about strict adherence to policies and procedures or authorization. Interpersonal trust and sincerity should be ensured in the organization, the importance of safety should be understood, and employees should be encouraged to report safety-related incidents by rewards when necessary (Perneger, 2005). Incentive affects corporate behavior as well as individual behavior. In addition, the organization's procedures, policies, and processes should be supported by providing a value system that supports safety initiatives (ICAO, 2018).

In aviation operations, a safety training program should be established and maintained to ensure that personnel are competent and trained to perform their SMS duties. The training content should be prepared in accordance with the position of everyone in the SMS. In addition, a form of safety communication should be established and maintained so that all personnel is informed about the SMS, which carries important safety information and explains why certain safety measures have been taken and why safety procedures must be followed (SHGM, 2011).

2.3. Establishment of Safety Management System

Today, SMS models and designs are established according to the standards presented in the ICAO Annexes. In this section, what need to be done during the establishment phase of an SMS is examined under the headings of planning the system, sharing the authority and responsibilities, and integrating the management systems.

2.3.1. Planning the System

As in many other sectors, planning should be done in line with the objectives and targets, with sufficient resources and appropriate timing for the establishment of the SMS in the aviation sector. Planning is the first management function in SMS (Gerede, 2005). In order to plan the SMS, first of all, a framework for mission and vision definitions should be established. Before implementing the SMS, whose framework has been created, management approval is required regarding the effective and efficient implementation of the SMS elements (SHGM, 2012).

During planning, it is of great importance to identify alternative ways that will enable the SMS to reach its goals. Because when faced with an extraordinary situation or a crisis, choosing one of these alternative ways ensures the continuation of the process.

The plan created does not have to be complicated. Instead, it should have details that can serve the purpose and objectives. This means that each element is present in terms of the

activities undertaken by any organization (CAA, 2019). In addition, procedures, policies, and SMS elements should be clearly stated in the prepared plan. The fact that the final plan has been put into writing is accepted by the civil aviation authorities who provide information about the SMS (Gerede, 2005).

2.3.2. Sharing the Authority and Responsibilities

In order to establish and activate the SMS in aviation, it is necessary to distribute the authorities and responsibilities. Successful handling of the SMS takes place not only with the accountable manager but with the active participation of all management and audit levels (CAA, 2002).

Appropriate allocation of technical, financial, human, and other resources should be provided by those responsible for the execution of the SMS. In addition, all employees in the sector should be given the safety-related authorities and responsibilities specified in their job descriptions. This is only possible if the safety-related powers and responsibilities of managers are explained in detail in the SMS document (SHGM, 2012).

The SMS employees are responsible to the SMS manager, and the SMS manager is responsible for the highest-level business manager. In order to further increase aviation safety, it is of great importance that SMS employees act independently from other functional subdivisions. For this reason, SMS managers should work under the responsible manager and should not take orders from anyone else (Gerede, 2005). Safety-related accountabilities and authorities are shown in Figure 4 as a functional chart (SHGM, 2011).

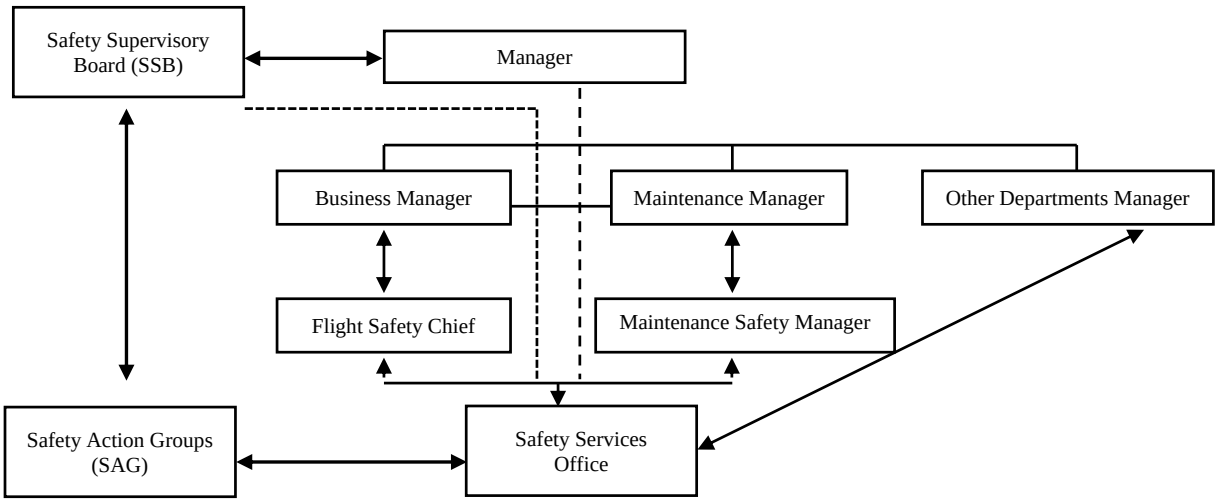

Figure 4. Safety Accountability Responsibilities

Source: Sivil Havacılık Genel Müdürlüğü-SHGM. *Emniyet Yönetimi El Kitabı*. HAD/T-16, Sivil Havacılık Genel Müdürlüğü Yayınları, Ankara, 2011.,

2.3.3. Integrating the Management Systems

In the aviation sector, businesses are integrated with various management systems in order to achieve their goals and objectives in the way of service provision. The integration creates a synergy that will enable the management of safety risk in different areas. An aviation

organization works in integration with some management systems such as safety, quality, occupational health, environmental, documentation, financial, and fatigue risk management system (ICAO, 2018). In order to integrate the SMS with other management systems, it is necessary to increase the support provided to it (SHGM, 2017).

There are some benefits and challenges of integrating management systems. Benefits include reducing cost by reducing duplication, balancing potentially conflicting responsibilities and relationships, increasing profitability by reducing risks, and successfully monitoring and managing performance. Among the difficulties are the presence of managers and personnel who resist integration, the impact on the safety culture within the enterprises, the different expectations of the enterprises and the need for additional studies because each management system has different needs in the integration phase (ICAO, 2018).

2.4. Operation and Implementation of the Safety Management System

The next stage after the establishment of the SMS is the operation stage. In this context, safety risk management, which is the first step, includes hazard identification, risk assessment and mitigation, and ensures that the safety risks of the consequences of hazards can be brought to a reasonably low level at the point of providing services in the aviation industry. The most important task of safety assurance, which is the next stage, is to provide control. Safety assurance control is also carried out by auditing and measuring the results of the activities that the operational personnel will participate in during the provision of services. Protecting the sources of safety information is important to prevent reluctance in reporting and to create an effective safety reporting environment. In the operation phase of the system, then the management of the change within the scope of the SMS and continuous improvement comes. At the same stage, the identification of hazards and the assessment of safety risks are provided by safety risk management. With the effective promotion of safety, which is the last stage, the effectiveness of safety performance increases significantly (SHGM, 2011).

Implementation of the SMS can be done with any of the traditional safety management approaches, incremental approaches, and next-generation approaches. A traditional safety approach is an approach based on taking into account the safety problems experienced in the past and, accordingly, the creation of the necessary rules for new measures. The phased approach provides manageable steps to implement the SMS and allocate resources. In addition, the phased approach is an approach that effectively manages the workload related to the implementation of the SMS (SHGM, 2011). Finally, the new generation approach means identifying errors and violations together with their root causes and taking new measures to avoid encountering them again (Bükeç & Gerede, 2017).

DISCUSSION AND RESULT

Although it is not possible to fully ensure safety in the face of mistakes and dangers in daily life, risks will always arise. It is not easy to ensure safety in environments such as aviation where risks, hazards, and accidents are common, and the cost is quite high. Therefore, safety management in aviation has an important place in the management process. In order to minimize human factor errors after increasing accident events, safety culture is created in all

establishments, facilities, and businesses affiliated with the aviation industry, and the zero-error principle is adopted (Eryılmaz, 2019). These rules have been standardized by international authority organizations (ICAO, IATA, etc.) by being handled in an international framework and prepared in a way that all stakeholders can understand in a common language.

It is very clear that the formation and establishment of a safety culture in organizations contribute to the reduction of errors and accidents in aviation. The adoption and support of the safety culture by everyone from the top to the bottom of the organization will ensure a healthier functioning of the process. A certain management style should be determined in order to establish a safety culture, measures should be taken against the risks. Besides, the dangers and threats encountered, the relationship between the safety management process and the organizational structure should be harmonized. Moreover, targets should be set in the same language and corrections should be made with feedback. Furthermore, in order to consolidate the safety culture, it is necessary to increase participation as much as possible by creating safe environments and putting the incentive system into use. As a result, since the aviation industry is a sector where risks, mistakes, accidents, and negative situations are always encountered, no negative situation will come as a surprise. However, it should not be forgotten that a small mistake or defect in aviation can cause irreparable costs. Because aviation is a sector that includes operations with advanced technology and high-cost vehicles. Considering the results of the formation of a safety culture and the adoption of this culture and its application by all stakeholders at the maximum level, it is clear that it will provide very positive contributions to the institutions, organizations, and businesses belonging to the sector.

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