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The Impact of Crew Resource Management on Reducing the Accidents in Civil Aviation

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Abstract

In the first years of aviation, most of the accidents occurred due to technical problems of the aircraft. In parallel with the technological developments, making safer and safer planes caused a significant reduction in aircraft accidents, but complexity of the systems developed increased the importance of human factor as the position of a pilot has changed from a worker who uses his mind and physical power to a system administrator. For this reason, Crew Resource Management programs have been developed to ensure that all resources, including the environment, software, hardware and information, which are available both inside and outside the aircraft, and all of which are the basis of the human being, can be used safely and effectively. In this scope, the purpose of this study is to emphasize the role of CRM to minimize the civil aviation accidents resulting from human factor benefiting from related studies in literature and aircraft accidents in history. The study is expected to contribute to literature well, as it attempts to update the literature regarding the CRM with the latest improvements in the field.

Keywords: CRM, Civil Aviation, Human Factor

JEL Classification: L91, L93, Y80, M12

EKİP KAYNAK YÖNETİMİNİN SİVİL HAVACILIKTA KAZALARI AZALTMA ÜZERİNE ETKİSİ

Öz

Havacılığın ilk yıllarında, uçak kazalarının çoğu teknik sorunlar nedeniyle meydana gelmiştir. Teknolojik gelişmelerle beraber daha güvenli uçaklar yapılmış ve kazalarda önemli ölçüde azalmalar olmuştur, ancak geliştirilen karmaşık sistemler pilotun uçak içindeki rolünü; zekasını ve fiziksel gücün kullanan işçiden, sistem yöneticisine dönüştürdüğü için insan faktörünün önemini arttırmıştır. Bu nedenle, Ekip Kaynak Yönetimi-EKY programları, uçağın içinde ve dışında bulunan ve insan temelli; çevre, yazılım, donanım ve bilgi gibi tüm kaynakların güvenli ve etkili bir biçimde kullanılmasını sağlamak için geliştirilmiştir. Bu

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kapsamda çalışmanın amacı, literatürdeki çalışmalardan ve tarihteki uçak kazalarından yararlanarak insan faktörünün neden olduğu sivil havacılık kazalarını en aza indirmede EKY'nin rolünü vurgulamaktır. EKY ile ilgili literatürü en son gelişmelerle güncellemeye çalıştığından, çalışmanın literatüre katkıda bulunması beklenmektedir.

Anahtar Kelimeler: EKY, Sivil Havacılık, İnsan Faktörleri

JEL Sınıflandırma: L91, L93, Y80, M12

INTRODUCTION

Throughout history, human beings have always kept the idea of flying alive in their dreams and made many attempts to solve its mystery. For centuries, scientists, magicians, soldiers, adventurers, many people sought ways to go up to the sky. In the last 100 years, with the realization of an unattainable dream, airplanes and aviation technology have continued to develop rapidly. Once reaching the sky, human beings continued to dream of flying faster, higher and more comfortable, and the simple plane of the Wright brothers reached modern aircraft equipped with today's high-tech devices. In parallel with these developments in aviation technology, there has been an increase in aircraft accidents.

Aircraft accidents have many causes such as technical failures, bird strike, meteorological conditions, human and management factors. During the early years of aviation and in the early years of commercial air transport, most accidents occurred as a result of technical problems with aircraft. The aviation industry has made great progress since the beginning of aviation. These advances in aircraft technology have made the aircraft no longer dangerous and have significantly reduced the number of aircraft accidents caused by technical failures. Although successful advances have been achieved in preventing aircraft accidents and incidents, this success achieved in the technical field with the more complex and detailed aircraft has not been sufficient to prevent aircraft accidents and incidents. As engineers gained more experience, aircraft and their engines became more reliable and flight safety was advanced. However, as a result of increased confidence in flight equipment, accidents and incidents caused by human error have increased. As a result of the analysis of air and ground accidents in the last 40 years, it has been determined that the factor causing the aircraft accidents and incidents is human and 70-80% of the accidents and incidents are caused by the human factor (Laukkala et al, 2018: 2-3).

Within the scope of efforts to improve human performance, prevention and control of human error has become one of the leading areas of aviation. Instead of the pilot error in the traditional approach, the concept of human error has been started to be examined by

approaching safety from a wider perspective. From this point of view, Crew Resource Management (CRM) training programs have been developed by accepting the approach that there will be an error in the place where the person is and that it will be the right way to reach the result by educating him instead of creating new pressures on the person in order to take this error to a minimum acceptable level.

Nowadays, CRM has started to play an important role in performing safe and high-performance flight missions. As long as a person works with machines, he/she sometimes clashes with himself, sometimes with other individuals and sometimes with the system and makes mistakes. The duty responsibilities of the individual who experiences these conflicts are safety, efficiency and economy. In order to fulfill these responsibilities, the individual has to play a role in the team and perform the role successfully.

In this scope, the purpose of this paper is to offer a comprehensive framework on the components of CRM with a view to the recent literature and developments in theory and practice, and to provide the readers with an up-to-date source of literature through an analysis of various examples that contributed to the development of contemporary CRM.

1. LITERATURE REVIEW

The roots of CRM are based on the "Cockpit Resource Management" project backed by NASA in 1979 in the United States, where the aviation industry has developed (Helmreich, Merritt and Wilhelm, 1999: 1). The research conducted within the scope of this project revealed that the major mistakes in the occurrence of human-induced accidents are in the areas of interpersonal communication, decision-making and leadership.

During this study and other subsequent studies, the development of CRM was initiated and the process of developing the education that should lead to a change in behavior that creates awareness in humans has begun. The first comprehensive training program was launched in 1981 by United Airlines. This seminar training was fully activated with the participation of psychologists.

In the 1990s, CRM included the characteristics of aviation culture and organizational culture was created and safety was brought to the forefront. The training programs therefore included cabin crew, maintenance personnel, air traffic personnel, and flight planning personnel. This was the cornerstone of CRM.

Nowadays CRM is a developing science in the progressive aviation industry. As the economic budgets allocated to the aviation sector contracted and resources decreased, civil aviation authorities began to adopt more ideas to reduce aircraft accidents and incidents. CRM has ought a new approach to the concepts of human factor in the previously known team collaboration in accidents and has given it different dimensions. There are many studies in literature which analyzed CRM (Crew Resource Management) in aviation or other fields as demonstrated in the following table.

Table 1. Studies about Crew Resource Management in Literature

Authors	Scope	Method	Result
Helmreich et al., (1999)	Civil Aviation	Descriptive Statistics	It is concluded in the study that CRM cannot be the mechanism to assure the total safety in a high-risk endeavor such as aviation. When human performance and complex systems are subjected, error to occur becomes inevitable. However, CRM can be accepted one of the tools that aviation can use to manage the error.
Salas et al., (2001)	Civil Aviation	Descriptive Statistics	The study concludes that the positive effect of CRM on the individual and the teams who have had the program is clearly seen. However, organization competing in aviation sector needs to work on the programs more and the long-term impact of the training in terms of sustaining safety in the skies needs to be monitored.
Helmreich & Wilhelm (1991)	Civil Aviation	Survey	The results of the survey in the study suggest dynamics of the groups in cockpit has a serious impact on the personalities of the individuals. For this reason, Organizations must directly face the issue of how to deal with CRM failures those crew members who are unable or unwilling to adopt CRM concepts
Flin, O'Connor & Mearns (2002)	Multi-disciplinary	Descriptive Statistics	The importance of CRM in aviation industry is stressed in the study. Furthermore, the development and implementation of the program has been appreciated being the significant example of team performance research translated into policy and practice. The study advocates that this program can be applied in other fields such as marine, the nuclear power, medicine, the offshore oil and gas industries.
Dunn et al., (2007)	Health Care	Descriptive Statistics	The study argues the need of applying CRM trainings in Health Care.
Pizzi et al., (2001)	Medicine	Descriptive Statistics	The existence and importance of CRM in aviation is stressed in the study. The applicability of the training programs in Medicine has been questioned and the outcomes have been noted as feasible.
Helmreich & Merritt (2017)	Aviation	Descriptive Statistics	The study discusses that embedding CRM in a more systematic and comprehensive structure will improve the efficiency of trainings in aviation.
Flin & Martin (2001)	Aviation	Survey	The study concludes that there exist many different practices in the design and implementation of behavioral markers system in CRM programs. However, there have been emerging discussions about the validity and reliability of those markers among the researchers and pilots.

Malec et al., (2007)	Heath Care	Empirical	The results of the study suggest that the MHPTS (The Mayo High Performance Teamwork Scale) provides high performance teamwork skills for the targeted CRM trainees in medical settings, thus can be reliably used even by the participants who has no CRM experience.
Kemper et al., (2016)	Health Care	Empirical	As a result of the experiment applied in the study, it is concluded that CRM does not change behavior or patient outcomes by itself yet changes how participants think about errors and risks.
Hefner et al., (2017)	Heath Care	Empirical	The study tries to find an answer to the question whether it is possible to have a culture transformation after implementation of CRM trainings and the result has been found to be positive.
Wahl, & Kongsvik (2018)	Maritime Industry	Descriptive Statistics	As a result of the literature review in the study, it has been found out that four main topics; leadership, decision making, situational awareness and team communication are predominant in the content of CRM.
Gross et al., (2019)	Heath Care	Descriptive Statistics	The study aims to provide an overview of topics covered in CRM trainings, the design and duration of training, and the evaluation methods. It also demonstrates that CRM training is not just a simulation and more importance should be attached in Health Care industry.
Kanki (2019)	Multidisciplinary	Descriptive Statistics	Importance of communication being part of CRM training has been demonstrated in the study.
Mempin et al., (2019)	Health Care	Empirical	Teaching teamwork skills is highly important for CRM trainings. However; it is found that didactic lectures do not contribute to CRM skills of trainees positively.
Gross et al., (2019)	Health Care	Empirical	As a result of the study, it is concluded that it is efficient to deliver CRM trainings to small groups with shorter periods and the form of didactical presentation caused a difference in learning success between groups: a traditional lecture was outperformed by an instructional video demonstrating a practical example.

When the studies regarding CRM in the literature have been into consideration, it can be concluded that although CRM came out as a training idea to prevent accidents in aviation, other disciplines especially health care seems to adopt the efficient CRM trainings in order to minimize the errors and make the team soul effective in the working area.

2. THEORATICAL FRAMEWORK

2.1. Accidents in Aviation

An accident is a bad event that causes loss or damage to life or property. Accidents that cause loss or damage to life or property due to human, material or natural origin. How it will happen or develop, where it will occur, how severe, or damage, how many people and how much damage are not known with certainty (Valdés & Comendador, 2011: 787).

It is almost impossible to think of a completely free environment to prevent accidents. To prevent accidents, it is necessary to recognize the sources of accident potential and to

eliminate the threat posed by these sources before the dangerous situation occurs. By careful analysis of past accidents and incidents, the real cause can be found to prevent it from re-creating accidents and incidents. However, when the analysis of accidents and incidents are taken into consideration, it can be said that the causes of accidents and incidents are not connected with each other in each case, sometimes it can be seen that a single reason can occur randomly. Although the sources that cause the accidents are determined and the dangerous situations that may cause an accident are controlled and how much the dangers are tried to be controlled, there is always the possibility of an error or a failure to occur depending on the risks taken at the place where the person is. Whether the task is complex or simple also determines the level of probability. The likelihood of errors or malfunctions during the fulfillment of a dangerous task and therefore the likelihood of accidents and incidents is also directly related to the level of risk taken (Valdés & Comendador, 2011: 789)

An aircraft accident refers to a certain degree of damage or injury to an aircraft in relation to its flight. An accident rarely has one reason. While the machine does not stop by itself, it usually has a human effect. The first reasons that come to mind in the accident investigation are pilot error or material error. Accidents are typically a combination of many different causes. Taken alone, each cause can often be seen as insignificant. However, when combined with other reasons, it may complete the chain that seems to be irrelevant, causing an accident. Safety or accident prevention programs aim to identify and eliminate these causes before the chain of events is completed. When asked if it is possible to reduce accidents to zero, the truth is that even if theoretically possible, this is not something achievable in practice as it has been seen in the several accidents and incidents in history (Li, Harris & Yu, 2008: 427-429)

In the event of an accident, it has been found out that the aircraft was either insufficiently designed or improperly manufactured, not properly used by the pilot, or improperly maintained. There are four factors that are consistently in a flight environment. These four factors are called 4M factors. These are Man, Machine, Medium, and Mission. It is necessary to reveal the importance of the mutual interaction between them. The characteristics associated with each of these factors provide a tidy way and procedure for defining a flight mission. Accidents usually occur as a result of the interaction between all factors such as man, machine, environment, task and their management. Incorrect direction

information given, a counter wind, a malfunctioning tool, or an obstacle on the runway may cause an accident.

When Management factors, which are closely related to whether a flight can be safely finished, is includes in the group, the factors that produce an accident in aviation can be subject to a general definition as the 5M factor.

2.1.1. Human Factors in Accidents

Accidents occur when one or more of the crew members who provide the flight have reduced control over their duties. In exceptional circumstances that may cause an accident, the only person who will take corrective action is human; therefore, in the case of aircraft, this person is often the pilot. Accidents often consist of threats that pilots do not know the way out of their weaknesses and that cognitive skills are not used well enough.

Today, the human element acts as a central coordinator for 5M factors, which have a wide range of applications in the investigation of aviation accidents. Due to the interaction and relationship between the factors, each new situation influences the other factor and responds itself. The system is a balanced system as long as the desired answers are received. If the desired response cannot be obtained in certain situations, the system is broken, and the balance must be restored through different information and answers. The system has a certain capacity. Overloads or mixed loads can cause loss of control. Human is the most complex element in the system. Two factors interfere with human reliability; the load capacity, which determines the acceptable workload limit that can make rational decisions in the face of events, changes with complex and previously unknown factors, and the instantaneous capacity that determines the workload and functionality. These two reasons make “human” the first reason factor in accidents.

2.1.2. The Role of Machine and System in Accidents

If a person is going to fly, he needs a machine that can fly. The characteristics of this machine are mainly determined to improve flight safety. The details of the machine are interesting for people who want to study human performance and accident prevention. What is the type of machine? What is the maintenance status? How much does it weigh? How much fuel is there? What is the minimum and maximum speed? These and similar questions are a few of the many questions that come to mind when trying to understand an accident. A person who studies aviator behavior must know the details of the aircraft being flown in order to evaluate the behavior.

As the technology of an airplane increases, the devices used become more detailed and complex. Despite advances in technology, many hazards remain in the area of design, production or maintenance. In order to achieve the desired level of safety, it is necessary to develop appropriate maintenance and inspection programs. During the life of a part of the aircraft, malfunctions normally occur in three specific phases;

- Initial failures due to inadequate design and production, usually occurring in the first days of life.
- Unforeseen failures, usually reducing the useful life, due to the suitability of the part to the unit or use.
- Defects caused by wear of a part (Kelly & Efthymiou, 2019: 162).

2.1.3. Environmental Impact on Accidents

Airplanes operate in the air, on land and at sea. Each environment has properties that affect flight. A runway may be rugged, poorly lit or incorrectly marked. The sea can be turbulent and strong. The weather can be sunny or cloudy, windy, with more or less temperatures, day or night. Pilots can, of course, not plan any flight missions without considering wind, weather, terrain and other environmental characteristics.

Accident-producing factors such as the environment, natural and man-made are considered in two ways. Natural environment, weather, land structure and other natural events. The heat generated by the natural environment, wind, rain, and so on. It is completely out of human control. Since these cannot be prevented, the environments to be avoided should be chosen. The human structure is divided into physical environment and non-physical environment. The physical environment includes the human-made facility and the material. Non-physical environment is the order that determines how the system should work, instruction, procedures. Environmental factors play an important role in accidents because people do not want to adapt to changes due to their natural structures or because they are not motivated to take the necessary measures (Adkins et al., 2015: 282-284).

2.1.4. Task Related Factors in Accidents

Every flight has a purpose. They aim to accomplish a business, whether it is carrying passengers, carrying cargo or performing a military mission. A thorough understanding of the flight requires a thorough knowledge of the mission. In order to prepare a task, it is necessary to know the details of the task and analyze the threats affecting the task and evaluate the risks posed by the hazards.

Execution of the task with maximum safety and effectiveness is directly linked to the organization's philosophy and safety culture, and it is the senior management of the organization that decides how much risk is acceptable in the performance of a task. The effectiveness of a system depends on its desired safety. Increasing the load on people and machinery above a certain level has a negative effect on a safe system. When we consider aviation, from this level, during the flight, human reasoning errors, material malfunctions and damage is likely to occur. As the hazards posed by threats during the planning of the mission and the management of the risks taken by the acceptance of these hazards for the benefit of the organization will have a direct impact on the performance of the task, the excessive risk taken will also affect the possibility of an accident.

2.1.5. The Role of Management in Accidents

The responsibility for safety and accident prevention in an organization is also in management, since only management can allocate resources. Management is responsible for managing many factors such as appropriate working environment, adequate training and control, correct facility and equipment, motivation within the framework of management functions. Safety is the job of everyone in an aviation organization. Everyone needs to be aware of the consequences of their own mistakes and make efforts to avoid them. It is not only the person who does the work, but also the managerial, that the management is responsible for fulfilling this basic motivation for everyone in the organization to realize safety (Orlady, 2019: 554-558).

The management needs to work towards a safety culture to prevent accidents. Safety culture is not an individual, it is a system of values and behavior, a way of living. It is created and shared by management and employees. Shared habits and adopted behavior, attitudes and values are the culture of that organization. This safety culture in the organization will create a common understanding of the decisions to be made whether the task is performed or not. As the management approaches the pilots at an equal distance in terms of the results of the pilot decisions concerning the organizational interests, the accuracy of the decisions freely made by the pilots will contribute to the reduction of accidents.

2.2. CRM – Crew Resource Management

In order to increase the safety and effectiveness of a flight mission, CRM aims to improve the team performance and prevent aircraft accidents and incidents by taking the

precautions to minimize errors with maximum team coordination and optimum risk management.

In order for a flight mission to be carried out safely, it is necessary to use existing resources consisting of people, equipment and information effectively. CRM is the term that describes the coordination and communication of the team, all resources inside and outside the cockpit, and the authority provided by the captain with the support of other team members. CRM is the efficient management of all resources on a plane consisting of hardware, software, personnel and information in order to achieve a flight operation efficiently and safely. Each mentioned resource contributes directly or indirectly to flight activity and has a certain effect on the flight activity (Helmreich & Foushee, 2010: 35-42).

Factors affecting the success and failure of a flight mission can be obtained by analyzing data from multiple sources such as accident investigation, aircraft incident reporting systems, incident analysis, simulator studies, job analysis, interviews, surveys, target groups, and cultural review. Behavioral marking method provides important benefits by identifying observable behaviors clearly, lack of attitudes and personality traits, providing the presence of talent and knowledge in behaviors, showing the results with causal relationships, reflecting a specific language related to the environment in which it is located, including simple terms and making clear definitions, and making clear definitions of the CRM skills.

The skills required for an effective Crew Resource Management are listed below;

2.2.1. Situational Awareness

This concept was used by Oswald Boelke for the first-time during World War I, to be aware of the situation before the enemy and thus gain superiority. Oswald Boelcke was one of the great pilots of German aviation history who won more than 40 victories during World War I. Oswald Boelcke is still adopted by aviators and aims to give situational awareness to war pilots. During World War I, many German pilots were trained with the principles of Boelcke, the most famous of which was Manfred Von Richthofen (better known as the Red Baron).

This concept, which did not attract much interest in academic circles until the 1980s, has been re-introduced since the 1980s, especially when it became clear that air traffic controllers needed better awareness of the situation. Later, it became the subject of work safety, human life and international relations.

Situation awareness is a mind work rather than a body ability. It is the process of reasoning. The main elements of this process are perception, information gathering and trust in intuition. It can also be defined as the perception and meaning of the elements in your environment in terms of place and time, and evaluation of their status regarding the future (Cetinguc, 2016: 410).

For aviation, situational awareness is the mental model of the processes that the pilot is aware of what is happening in and around him, his plane and his environment, planning and deciding on the next developments. The elements that pilots must constantly monitor and be aware of are the following;

- airborne position and movements,
- important objects such as runway, mountain, river, sea, tower,
- indicators of the aircraft, such as altitude, speed, fuel and heat,
- changes in weather,

pilots should take into account the current status of these variables as well as the possibility of future change. Components of situational awareness are environmental awareness, task awareness, system awareness, individual awareness and temporal awareness (Cetinguc, 2016: 411).

2.2.2. Communication skills

Communication has become such a widely used concept in recent years that the era we are in is called “Communication Age”. Communication means that the generated information is a sharing process. Parties are always important ends of communication as two different systems. Communication is a process which requires the transfer of any information in any environment, from a sender to a recipient. The main thing in communication is understanding. This process of information exchange requires a common language.

Communication constitutes: Source (Sender), Recipient (Destination), Message (Message), Context (Media), Feedback (Feedback), Channel (Sending format). Communication is an extremely critical phenomenon in human interactions. It plays a critical role in aviation as well as in human activities. Communication is the leading factor, especially in aviation safety. There are many findings that show that there is no more important phenomenon in aviation safety than communication. Particular emphasis can be placed on this issue: The most important task that should be done in order to keep safety in aviation as high as

possible and to prevent accidents is to improve communication in air transportation operations (Krivonos, 2007: 2).

Communication has an important role in aviation accidents and incidents. Therefore, communication is particularly critical in aviation. Because information gathering and sharing, planning, leadership, decision-making and identification, error and management of problems such as the management of members of a team or other members of the team actually occurs through the communication (Ford, Henderson & O'hare, 2014: 49-51).

Communication problems have directly or indirectly caused aircraft accidents in history, which can be described as catastrophes. In many analyzes conducted for accidents, the main factor of the accidents was revealed to be communication deficiencies such as complex and confusing freiology, similar aircraft call names, uncertainty and interruption. In addition to these problems, the lack of English, heavy accent or linguistic problems such as self-expression has been shown to contribute to accidents

2.2.3. Team Resource Management

Today, rapidly changing organizational and technological conditions have made it impossible for employees to do a job alone. Employees are also not happy to do their jobs without using their creativity in line with the directives they receive. Organizations need to use their manpower at the highest efficiency in order to achieve their goals in the desired competitive environment.

Teams are communities in which employees with different skills, training and opinions combine their creative power, effort and knowledge to achieve their goals effectively. Elements of teamwork in aviation; pilots, cabin officers, technical-maintenance personnel, controllers, dispatchers, apron officers, doctors and managers.

Elements of teamwork in aviation include pilots, cabin officers, technical-maintenance personnel, controllers, dispatch, apron officers, doctors and managers. Multiple teams working together is an extension of CRM and requires separate training. Because the cockpit environment is narrow in aviation, communication is relatively easy and face-to-face. Since English is used in ATC (Air Traffic Controller) conversations, problems are low although there is a risk of misunderstanding due to misbehavior. However, in very urgent situations where seconds are vital, errors in understanding and speaking can lead to fatal consequences. In relation to language problems, cooperation, order and leadership problems may occur in environments where local and foreign teams work together. As the

number of teams increases, coordination problems may arise, and trainings are conducted in this direction (Kolander, 2019: 410).

Today, even the people of the same nation, who speak the same mother tongue, who are of military and civilian origin, and who are subordinate and high status, have problems of communication and hierarchy. There is no realistic way to solve these problems other than digesting professional aviation culture, controlling egos and applying SOPs (Cetinguc, 2016: 421). Another problem that may be experienced in aviation can be groupings. There may be conflicts between groups. People in the leadership position need to recognize the conflict and take action.

2.2.4. Leadership

Leadership is the ability of people to make others follow with a certain power and skill. A leader is a person who assigns tasks and delegates authority, determines everyone's tasks and goals, develops plans, makes decisions, tries to solve problems, accepts changes and corrects mistakes. In other words, they are the ones who make excellent use of resources. Leaders see the holistic picture and articulate this broad perspective with others. Thus, the work of people in a coordinated way harmoniously create a common goal. Communication, situation assessment, team leadership and compliance with the leader, decision-making, and personality type are important leadership skills (Terzioğlu, 2007: 117).

Leadership in aviation is the ability to identify, guide, and encourage flight crews to work as a crew. A leader is responsible for the performance of his crew and directs and coordinates the activities of the crew, makes assignments, and makes sure that the crew understands what is expected of them. He/ She dominates the critical points of the mission, equips the crew with mission information, asks the crew for the necessary information about the mission, provides feedback to the crew on performance, provides and maintains a professional environment.

In CRM, every member of the team should understand that having leadership responsibility is very important for effective decision making. Every individual within the team should know that he / she has the responsibility to make decisions (Kern, 2001: 56). Leadership is not just an official task. Everyone in the team can take on this task, depending on the situation. It is important to learn how to be a leader in a position, not a

position in the team. For a safe flight to take place, there are guidelines that the leader must follow. These are;

- Editing the information flow,
- Directing and coordinating the duties of the crew,
- Motivating the crew,
- Decision-making

The authorization of the captain pilot by assigning tasks to other team members does not mean that the responsibility is also delegated. Democracy that exists in the aviation environment and in the cockpit of an aircraft is never real democracy. Captain pilot is always the last authority. However, the effective use of resources and the information and potential solution suggestions from the other team members provide guidance for the final decision. Good leadership, such as a cockpit, in an environment where there is no real democracy to create a synergy by combining forces (Kern, 2001: 56-59)

2.2.5. Decision Making

The most common pilot errors in aviation are weak judiciary and decision-making errors. Most of the accidents are the result of weak, inadequate, ineffective decisions (Schwartz 1997: 170). Effective decision-making means the ability to select the direction of activity based on the available knowledge, through logical and purely assessment. In order to make effective decisions, it is necessary to evaluate the problem, to verify the problem, to define the problem, to predict the results of the decisions, to inform the other team members about the decisions and to evaluate the decisions.

Teamwork, extra time for decision making, availability of flight crew, decision strategies and experience are factors that influence decision making. Good decisions add power to risk management, minimize mistakes, and bad decisions increase risk. Poor assessment or decision-making is the biggest mistake in completing the task. Time, inaccurate or ambiguous information, performance pressure, rank difference are barriers to decision-making. To overcome them, SHUs should be used, and the best decision based on available knowledge should be selected, cross-checked, assessment of conditions for decision making, and self-confidence behaviors.

Aeronautical industry leaders are working hard to improve decision making in the cockpit. Since decision-making requires a mental energy expenditure and people are not always able to make the most appropriate decisions, aircraft manufacturers and user organizations

are striving to reduce decision-making as much as possible. For this reason, although not the only reason, automation in aircraft is increasing and procedures are being developed to include the prevention of unexpected abnormalities and include them in checklists. With the help of the automation systems developed, it is necessary to train the teams to make effective decisions in difficult situations as it helps to reduce the error, but it is not possible to reduce the error to zero. The question that is difficult to answer in these trainings is what skills are taught and how to do this. CRM trainings are a guide for this. Decision making is not an event alone. Teams can make different decisions, which may include alternative decisions and risks. The decision to abandon a take-off may require evaluating an abnormal situation warning or making different decisions between system failure and failover. Decision-making is influenced by factors such as familiarity with the problem, the need to react, and the limited time. Nobody has the magic wand to help the flight crew make a better decision (Terzioğlu, 2007: 174).

No matter how experienced and knowledgeable a pilot may be, the team's decision-making may be superior in terms of the accuracy of the decision, if the circumstances permit. A decision made by the team is a decision of more than one person. Although the captain is the person responsible for making the decision, the team's support of the captain's decisions will reinforce its accuracy. Teams can make better decisions than individuals. Multiple eyes, ears, hands and intelligence increase the capacity and allows better decision. Teams can look at a wider angle, generate different ideas, transfer more information. It can share workload and eliminate traps. Teams can sometimes make worse decisions than individuals. Weak communication problems, lack of understanding or sharing or finding solutions can lead to this result. Errors can cause panic and may show poor performance due to individual conflicts.

2.3. Critics of CRM

When the CRM trainings first started, some of the pilots opposed it, arguing that they were played with their own people and tried to change their personalities. Working in a team may not be suitable for everyone. If the individual's power distance is too high or too individualistic, this person may not be motivated in teamwork. Because, one will want to achieve individual achievements and it will be more important for him to do his duty in subordinate-parent relations or to get a promotion in the future. Therefore, it may not be easy to implement it with people who have been accustomed to working in traditional ways

for a long time, even if teams are considered to improve quality in work life or to be a very important way to increase productivity.

Since teams are composed of individuals with different experiences and expertise, they are more successful in tasks requiring creativity than a single individual can. In addition, more information exchange, which is proportional to the large number of members in the teams, helps to increase innovative proposals and make better decisions. Therefore, this new structure, called a team, plays an important role in increasing the motivation of the team by providing tolerance and flexibility in the non-democratic flight environment. Because as long as people are empowered to make decisions and have a say in the solution of problems, they become more engaged in their jobs and do more quality jobs and increase their productivity and productivity.

However, forcing people who are not suitable for this environment to work in this environment may not be the right decision. Therefore, teams are only attractive to those willing to participate in decision-making, as they will have the opportunity to satisfy their motivation by taking the opportunity to participate in teams. In addition, teams can increase the motivation of individuals by creating an environment to meet the motivations of belonging to a group, that is, socialization. As a result of many researches on the effect of teams on work efficiency, positive contributions of the teams have emerged, and it has been seen that the teams increase job satisfaction and loyalty.

In spite of all the positive effects mentioned above, building teams is not an easy process because it is not easy and time consuming for people to give up their old habits and values. People's personal cultural values can cause them to resist teamwork. In addition, this resistance may stem from the cultural elements that have been adopted in the past. Because in the past, there is a transition from a system where personal achievements are rewarded to a system where collective achievements are cared and rewarded, and it may be necessary to teach and teach people about this change. Since being a good team player in teamwork is more important than personal success, pilots should learn to communicate openly and honestly, to deal with differences between individuals, to work to find solutions to frictions, and to keep group goals in front of personal goals.

3. METHOD

Along with the literature reviews which includes studies about CRM applied in different sectors from Aviation to Healthcare in history, the study analyses some of the major aviation accidents to exemplify the accidents resulting from the lack of CRM.

Civil Aviation CRM Accidents in History

There are several aviation accidents which have been known to be caused by CRM mistakes in history. Some of them are;

28th December 1978

United Airlines' Mc Donnell Douglas DC-8-61 turbofan engine crashed into a wooded suburban area as it approached Portland International Airport in Oregon on December 28, 1978, before departing from New York JFK Airport to Denver and then to Portland. Of the 189 passengers and crew, 10 were killed and 23 were seriously injured.

The pilot received a landing gear failure sign during the approach to the airport but was unable to determine whether the landing gear had been opened. The flight crew chose to wait at an altitude of 5,000 feet (orbit) to solve this landing gear anomaly and prepare the plane for an emergency landing. During the waiting period, the team spoke little about the amount of fuel available on the aircraft and what needs to be done to complete the approach. About an hour after the moment of waiting, the aircraft ran out of fuel and crashed into the airport about 6 miles southeast of the airport.

The NTSB has identified this as the likely cause of the accident, as the pilot did not properly check the aircraft's fuel condition and did not respond correctly to the team members' recommendations regarding the fuel situation. This caused all aircraft engines to stop due to lack of fuel. This carelessness of the captain stems from a possible emergency landing preparation with a landing gear failure. The contributor to the accident was the failure of the other two team members to fully understand the criticality of the fuel situation, or to communicate their concerns to the pilot.

In this accident, the captain pilot's focus on landing gear failure and emergency landing (fixation) is reduced due to situational awareness, so that the attention to the fuel situation is reduced or dispersed attention. In this process, the second pilot and flight engineer contributed to this accident by not being sufficiently assertive (Li et al., 2008: 426-434).

19th October 1976

The flight number 452, which makes the Istanbul-Antalya flight belonging to Turkish Airlines, crashed into the Taurus Mountains. Boeing727 Antalya, the most popular and well-known aircraft of its time, had just joined the Turkish Airlines fleet. When the pilot got tired and left his place in the cockpit to the second pilot, events began to take place. The co-pilot, who got the wrong chart, thought the lights of Isparta city to Antalya and started to descend.

It has been one of the rare and distressing accidents of Turkish Airlines. As a result of the descent error, the plane hit the foothills of the Taurus Mountain and caused the death of a total of 154 people.

It is obvious that the accident is caused by the pilot's loss of situational awareness. This event shows how important CRM errors are and It is interesting to note that the failure of the aircraft engine to stop, the wing to be broken or sabotaged would not create a greater disaster than this (Cetinguc, 2018: 435).

25th January 1990

On January 25, 1990, an old Boeing 707 from Colombia's Avianca Airlines was approaching the end of a Bogota-New York flight. Due to foggy weather and heavy traffic in New York, the landing of the plane was delayed, and the fuel level was critical. The contact person with the tower was FO. Because the captain pilot did not speak English. The FO informed the tower that their fuel was running low and demanded priority. This should have been a sufficient warning, although he did not make any mine calls. For American controllers, the word priority did not convince the situation was urgent enough. The emergency words stipulated by the parties to the incident were different and this was due to different levels of English. As a result, the airless plane crashed and killed more than 70 people. The culprit was evident, the captain did not speak English and the co-pilot's inadequate English level. If the English levels of one of the two had been sufficient, the urgency of the situation would have been transferred to the tower and probably the plane would not have fallen. In this case, the importance of communication being one of the components of CRM has been understood (Velazquez, 2018).

27th March 1977

The Tenerife tragedy was an accident on March 27, 1977, when two Boeing 747 planes crashed at the Los Rodeos Airport (also known as Tenerife North Airport) on Tenerife

Island, Spain. 583 people died in this biggest accident in the world aviation history. The collision was largely caused by lack of communication.

Immediately after the collision, KLM took off completely. But as a result of a collision with Pan Am, the right outer engine was completely destroyed, all parts of it were swallowed by the right inner engine, and the wings were severely damaged. After 150 meters past the collision point, KLM dived, suddenly lay on the side and hit the runway, dragging more than 300 meters. The fuel in the fully loaded tank, which caused the aircraft to wake up late, caused a fire that could not be seized for hours immediately after the crash.

Both planes were destroyed. All 234 passengers and 14 cabin crew on the KLM jet were killed. Likewise, 326 passengers and 9 cabin attendants on the Pan Am jet lost their lives as a result of fire from the spilled fuel. Seven cabin crew members, including the remaining 54 passengers and pilots, were able to get out of the shaved cabin by KLM, leaving the left wing still in place. Even minutes after the accident, Pan Am's engines were running. If they wanted to shut down the engines, the control cables and keys in the cabin destroyed by KLM left the pilots helpless. No system of the aircraft was working. The survivors waited for help. But the aid team did not know that two planes were involved in the accident. Firefighters were interested in KLM at the other end of the track under heavy fog.

The reason for the accident was the misunderstanding of the tower's message in the haste of departure within the scope of CRMm (Zhu et al., 2018: 119-125).

3rd March 1974

Turkish Airlines' Istanbul-Paris-London flight DC-10 airplane TC-JAV, (commercial name ANKARA), had landed at the Paris Orly airport. There, 50 passengers landed, from Paris to London (Heathrow) would fly with 117 passengers. But British Airways was on strike, France-England rugby match for passengers who came to Paris could not find a plane to return to London. THY plane with 117 passengers was an opportunity for those who wanted to go to London. The plane left Paris 346 lives.

16 minutes after the plane took off, there was an explosion in the cargo area due to the sudden pressure difference in the cargo area. When the passengers started to run to the front of the plane with the panic, the balance of the plane deteriorated.

The door was opened outwards, while the aircraft manufacturer firm had to open it normally because of the wrong design of the cover in the cargo area of the aircraft. In addition, the planes delivered to Thy should have a steel plate when the pins in the door did not fit into the DC-10s, but this was not the case. After the accident, it was also found out that responsible person for loading the cargo did not know English and could not understand the manual and forced the door trying to close and broke the pins of the door which underline the importance of language and communication in aviation one more time (Cetinguc, 2016: 434).

6th February 1996

The Birgen Airline plane was hired to take passengers from the Caribbean Islands to Germany. First of all, the plane had been waiting in the hangar for 25 days, and no sheath was inserted to protect the pitot tubes. Speed indicators between the captain pilot and his assistant during the departure of the flight showed the possibility to give up the different V1 did not arrive, the captain pilot made a wrong decision and one of the two indicators was correct and continued to fly. While the pilot's speedometer was 350 knots, the aide's pilot was 220 knots. In fact, the required pilot's indicator was the value of the pilot's pilot. Therefore, the captain pilot reduced the speed of the aircraft based on the value on the wrong display and the plane remained stalled. The plane began to lie to the right and began to fall rapidly and eventually died 189 people. Another mistake was that the pilots had never contacted the tower from the moment the problem started. First, the aircraft was not put in place to protect the pitot tubes while waiting in the hangar, then the departure of the aircraft despite the difference in speed indicators were not abandoned, the engine's power was cut as a result of the wrong decision and the stall remained. For the remaining aircraft in Stall to regain speed, the aircraft had to give the nose down and then give the engines full power. But the captain only wanted the engines to be fully powered, which was a decision and situational awareness error. The FO stated that the nose of the aircraft was up but was afraid to do what it should be by taking the controls (Cetinguc, 2016: 434).

7th April 1999

Thy-Boeing 737-type aircraft that would make the Adana-Jeddah flight, fell 8 minutes after takeoff, and all 6 crew members were killed in the empty plane. According to the accident report, the system that warns the pitot tubes measuring the speed of the aircraft was not activated before the flight, although the system warned the situation was not noticed by the pilots. Because the speed of the plane was measured incorrectly, the pilot

gave its nose down to speed up the plane and entered a violent storm at the same time. Combined overspeed and turbulence, the plane lost control. There was power distance in this accident and the hierarchy was reversed. The co-pilot was of military origin and did not have enough flight time. The captain pilot abstained from intervening in an emergency (Gok, 2018: 181).

8th January 2003

When the THY-RJ 100 airplane was flying to Istanbul Diyarbakir airport in 2003, there was a heavy fog and the military airport had no ILS systems and pilots were forced to land by seeing. However, although the captain could not see the pilot runway, he insisted on landing and went below the minimum and made a mistake both in situational awareness and in the decision. The co-pilot confirmed the situation and did not issue any warning. Although the ground approach system gives a warning, the pilots could not react properly.

Because of lack of situational awareness, wrong decision and persistence, and co-pilot's acceptance of the situation and lack of assertiveness ,75 people died (Gok, 2018: 205).

4. FINDINGS

As it is clearly shown in the aviation accidents in history, the dangers in aviation are caused by problems in the interfaces of several factors, and accidents usually occur as a result of a chain of errors. The chain of errors can be divided into two parts: operational factor and human factor. Flight crews without knowing the events that will cause the formation of the accident have the chance to prevent the incidents. However, flight crews sometimes deliberately add new rings to this chain. Even if flight crews are trained to recognize rings in the chain of errors and know what to do, the likelihood of previous accidents is not the same. Capturing even one ring of this chain can completely change the development of the event. One or more fault rings that can be defined can provide the environment for the identification of the entire chain of errors. From this perspective, it can be stated that human factor has vital place in the aviation accidents.

5. DISCUSSIONS AND CONCLUSION

In the first years of aviation, most of the accidents occurred as a result of the technical problems of the aircraft. In parallel with the developments in aviation technology, as a result of the increased confidence in aircraft, the causes of accidents started to be caused by human error rather than technical reasons and accidents and incidents caused by human

error increased. As a result of the investigations, it was clearly seen that in many aircraft accidents, the planes were structurally flyable before they hit the ground, but the accident could not be prevented due to human misconduct. In the beginning, the human error, which is defined as pilot error, was started to be emphasized more and the causes of the error were emphasized rather than the results of the error. As a result of these searches, a significant progress has been made in flight safety with CRM programs.

In the execution of a flight mission, it may be possible for all those who perform and support the mission to gather around the same belief with a common safety culture in which everyone participates. The safety culture of the organization adopted by the whole team will contribute to the establishment of the CRM culture in the organization. It is important to recognize the transformation from independence to dependence and interdependence for the development of a safety culture. Trust is important, but not enough. It is not enough that the person tries to prevent himself / herself from being harmed. One should be aware of the dangers that affect both himself and others and take corrective measures. Safety culture is not visible, but common values make it visible. Safety culture is built with facts, beliefs, values and norms. CRM contributes to the learning of thinking, feeling, and living common values for employees in the shared safety culture shared for the execution of a flight mission, learning acceptable standards of conduct for the execution of the mission.

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