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The Share of Communication Errors in Aircraft Accidents and Artificial Intelligences That Can Be Developed Based on Communication in Aviation

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Abstract

In the history of civil aviation, there have been many fatal accidents due to different reasons. Most of the accidents occurred as a result of human error. Especially for the accidents that occur as a result of malfunctions in the aircraft engine or the systems on the aircraft, a large amount of accidents have been prevented by making use of new technologies. Despite these, accidents caused by human error continue to exist today. Aircraft accidents caused by communication errors are especially important. Due to misunderstanding, misinformation about flight rules, giving incorrect instructions, misunderstanding or misinformation as a result of not having sufficient command of the language used and not providing the necessary information, communication errors occur and as a result, fatal plane crashes occur. In addition to human errors in communication, problems may occur due to the systems used. In particular, the old radio systems used and the problems that occur during the transmission of data also cause accidents. For the same reasons, it is necessary to develop new technologies and use them in the aviation industry in order to avoid accidents. Since the number of people working in the sector cannot be reduced to zero, these technologies should be used and human error should be minimized. The purpose of this research; is to examine and determine the share of aircraft accidents caused by communication errors and to examine the artificial intelligence that can be used in the subject. In the study, the 20 deadliest plane crashes in the history of civil aviation were examined. In addition, the example of Tenerife Accident is given because it is related to the subject. According to the information obtained as a result of the study, it was determined that 7 of the 20 deadliest accidents in the history of civil aviation were caused by communication errors. Within the framework of the study, Document Analysis was conducted to determine the degree of relationship between the number of deaths in accidents and the causes of accidents.

Keywords: *Communication, Artificial Intelligence, Airplane Accidents, Tenerife Accident*

Jel Classification: *L63, O33, R41*

Uçak Kazalarında İletişim Hatalarının Payı ve Havacılıkta İletişim Odaklı Geliştirilebilecek Yapay Zekâlar

Özet

Sivil havacılık tarihinde farklı nedenlerden olmak üzere birçok ölümlü kaza yaşanmıştır. Yaşanan kazaların büyük kısmı ise insan hataları sonucunda olmuştur. Özellikle uçak motorunda veya uçaktaki sistemlerdeki arızalar sonucunda yaşanan kazalar için yeni teknolojilerden yararlanılarak büyük miktarda kazaların önüne geçilmiştir. Bunlara rağmen insan hatası kaynaklı kazalar günümüzde varlığını sürdürmektedir. Özellikle iletişim hatası kaynaklı uçak kazaları önem arz etmektedir. Yanlış anlama, uçuş kurallarına ilişkin yanlış bilgilendirme, hatalı talimat verme, kullanılan dile yeterince hâkim olmama sonucunda yanlış anlama veya yanlış bilgilendirme ve gerekli bilgilendirmeyi yapmama gibi nedenlerden dolayı iletişim hataları meydana gelmekte ve sonucunda ölümlü uçak kazaları gerçekleşmektedir. İletişimdeki insan hatalarının yanında kullanılan sistemlerden dolayı da sorunlar meydana gelebilmektedir. Özellikle kullanılan radyo sistemlerinin eski olması ve verilerin iletimi esnasında oluşan sorunlar da kazalara neden olmaktadır. Aynı nedenlerden dolayı kazaların yaşanmaması için yeni teknolojilerin geliştirilmesi ve havacılık sektöründe kullanılması gerekmektedir. Sektörde çalışan insan sayısı sıfıra indirilemeyeceği için bu teknolojilerin kullanılması ve insan hatasının minimize edilmelidir. Bu araştırmanın amacı; İletişim hatası kaynaklı uçak kazalarını inceleyip payını tespit etmek ve konu özelinde kullanılabilecek teknolojiler incelemektir. Çalışmada sivil havacılık tarihinde yaşanmış en ölümlü 20 uçak kazası incelenmiştir. Ayrıca konu ile ilgisi olduğu için Tenerife Kazası örneği verilmiştir. Çalışma sonucunda elde edilen bilgilere göre sivil havacılık tarihinde yaşanan en ölümlü 20 kazanın 7'sinin iletişim hatası kaynaklı olduğu tespit edilmiştir. Çalışma çerçevesinde kazalardaki ölüm sayıları ve kaza nedenleri arasındaki ilişkinin derecesini tespit etmek amacıyla Doküman Analizi yapılmıştır.

Anahtar Kelimeler: *İletişim, Yapay Zekâ, Uçak Kazaları, Tenerife Kazası*

JEL Sınıflandırması: *L63, O33, R41*

Araştırma ve Yayın Etiği Beyanı: *Bu çalışmada, araştırma ve yayın etiği kurallarına uyulduğu yazarlar tarafından taahhüt edilmektedir.*

Yazar Katkı Oranları: *Birinci yazarın katkı oranı %50; İkinci yazarın katkı oranı %50*

Çıkar Beyanı: *Yazarlar açısından ya da üçüncü taraflar açısından çalışmadan kaynaklı çıkar çatışması bulunmamaktadır.*

1. Introduction

Airplane accidents may be caused by a range of factors, including engine failure, bird strikes, faulty gauges, terrorist attacks, pilot error during emergencies, equipment malfunctions, miscommunications from air traffic controllers, errors made by ground personnel, fires, adverse weather conditions, turbulence, and communication failures. The Tenerife accident, which resulted in the deaths of 583 people and is considered the deadliest aviation accident to date, was also attributed to a communication error due to human error (McCreary et al., 1998, p. 26). This incident is not an isolated case, as numerous accidents have been caused by communication errors. As such, the contribution of communication errors to aircraft accidents is significant.

Many fatal accidents have occurred in the history of aviation since air passenger transport began in 1912 with Graf Von Zeppelin's "Delag" airship. Between 1920 and 1970, 410 accidents with loss of life or property were reported. In these accidents, it has been observed that the accidents due to hitting another plane constitute 9.5% of the total accidents, 8.5% of the accidents due to meteorological conditions, and 12% of the accidents that occur during approach and landing. When these accidents are examined, it is seen that 30% of the accidents are caused by the lack of smart technology (Şen et al., 2020, p. 165). On the other hand , more than 11,000 plane crashes took place from 1970 to 2021 all over the world and more than 85,000 people lost their lives in these crashes (B3A, 2022). The share of human error in aircraft accidents is 70%. (Lee, 2009). Aircraft accidents are not usually due to a single reason such as communication. The best model to illustrate the formation of a cauldron is James Reason's Swiss Cheese Model. The model briefly states that more than one cause must be combined for an accident to occur (Metin, 2014, p. 22).

As a result of aircraft accidents, lessons were learned from the accidents and even though some situations were corrected and precautions were taken with the help of technologies, the human factor has been a problem for aviation operations from past to present. Human behavior and performance are cited as the main cause of most aircraft crashes. In order to reduce accident rates in the aviation industry, human factors should be analyzed and better understood. The development of human factors awareness is also important in ensuring safety and security, which is the primary goal of the aviation industry (Tamer, 2021, p. 4). "Communication" constitutes the majority of human errors.

Although lessons have been learned from mistakes and precautions have been taken, the subject of communication still includes the human factor to a large extent. Although aviation personnel are given the necessary training, there will always be a margin of error. In order to minimize this margin of error, the ratio of people working in aviation operations should be replaced by artificial intelligence technologies as much as possible.

SANDRA, GC3, AeroMACS and Data Comm projects that are directly or indirectly related to communication will be examined in this research. In order to get an efficient result, artificial intelligence technologies must be used in an integrated manner. The motivation of the study is that possible plane crashes can be reduced by artificial intelligence and that both a life tank and an economic loss can be prevented as much as possible.

The aim of the research is to examine the 20 most fatal plane crashes in order to emphasize the seriousness of plane crashes caused by communication errors and to draw attention to the share of communication errors here. It is known that communication problems cause accidents in aviation, but when we look at the accidents with the highest number of deaths, the importance of the issue is understood more clearly. Looking at the literature, it has been found that there are many studies dealing

with the subject of communication in aviation. However, in the studies dealing with the same subject as the study we will conduct these investigations, one or two accident examples are given by referring to the communication issue. In addition, it has been observed that the subject of technology has not been adequately examined in communication-oriented studies. Our study aims to provide a better understanding of the subject by bringing together these topics that have been treated piecemeal.

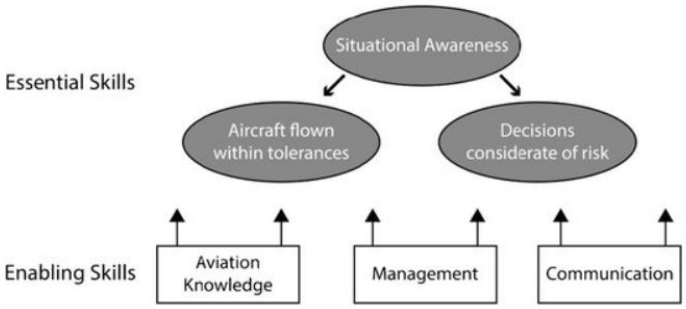
In the first chapter of the study, after giving general information about the subject, the place of communication in aviation operations is mentioned. Afterwards, Tenerife Accident was investigated as it was the most fatal accident due to communication error. In the second chapter, we give the background of the subject and discuss the studies on communication in aviation. In the last chapter, we will analyze the 20 deadliest plane crashes, which constitute the sample of the study, with "Document Analysis". Then, we will examine the technologies that can improve the communication problem in aviation and discuss all the findings we have obtained in the conclusion part.

2. Communication in Airline Operations

While communication is critical for the continuation of operations in all areas, it is a vital issue especially for the aviation industry. Communication errors in aviation can lead to serious consequences, especially loss of life. Communication-oriented accidents in aviation occur due to problems in the cockpit and communication between the pilot and the controller, misunderstanding, misinforming about flight rules, giving incorrect instructions or not giving the necessary information (Akça, 2020, p. 255). As sub-branches of communication, in-cockpit communication and communication between controller and pilot are examined.

The concept of assertiveness related to in-cockpit communication should be examined. Assertiveness can be explained as expressing what one knows in an appropriate language and standing behind it (Şekerli, 2006, p. 58). It is one of the most important elements of communication in the cockpit, and the co-pilot should stand firm against the captain pilot on an issue that he knows right, regardless of the hierarchical situation. It is an expression of authority in the cockpit, where the personalities of the captain and co-pilot clash in terms of relative power and violence. For a safe flight operation, this degree of authority between the master and co-pilot should neither be too strict nor too soft (Aktaş & Tekarslan, 2013, p. 282).
There are two personality types as A and B, and these personality types are behavioral characteristics that show how one responds to the environment (Spector & O'Connell, 1994, p.4). Type A personality, while being aggressive, success-oriented, competitive, assertive, impatient, ambitious and hasty (Darshani, 2014, p.2), type B personality; has capable of forgiving mistake, non-perfectionist, tolerant, calm, spare time, open to criticism and controlling their anger (Kirkcaldy et al., 2002, p.1362; Darshani, 2014, p.2). Working with people with type A personality can be more difficult than working with people with type B personality. Therefore, it is a matter to be taken into account that the leaders have A-type personality or the employees who are led have A-type personality (Durna, 2010, p. 277). Person types should be taken into account, especially in in-cockpit communications or activities. Another issue for in-cockpit communication is the harmony of the personalities of the pilots. In their study, Mavin and Dall'Alba (2010) stated the importance of skills such as situational awareness, decision-making, teamwork, communication along with technical skills, and the necessity of articulating technical and non-technical skills.

Figure 1: The model of assessment of pilot performance (MAPP)



Source: Mavin&Dall'Alba, 2010

Then they divided it into two as main skills and sub-skills. The main skills are divided into situational awareness, decision-making and flight skills, while sub-skills are divided into technical knowledge, management and communication (Mavin & Dall'Alba, 2010, p. 9). The compatibility of the personalities of the pilots increases the effectiveness of communication. In the event of a mismatch, the pilots will not be able to respond correctly, perhaps because they were arguing during the emergency.

It is also necessary to mention the communication between the cockpit and the controller. Many fatal accidents have occurred in aviation history due to communication errors between the cockpit and the pilot. The most basic example of these accidents is Tenerife Accident (Ergül, 2009, p. 101). Among the causes of communication errors, problems in communication, misunderstanding, erroneous information and failure of one of the parties to fulfill their duties can be given as examples. According to studies, only 61% of verbal communication is understood. Many accidents and crashes have occurred due to communication errors between ATC (Air Traffic Controllers) and aircraft. Most of these are the problems experienced in receiving-repeating the instruction (Karakuş, 2006, p. 74). Different communication methods can be tried here, communication does not always need to be done verbally. For example, in a noisy air traffic control room, it would be more convenient and appropriate to use text messages or telephones instead of talking to another controller. A sent message may be distorted and changed due to some obstacles called noise in the communication process (Ergül, 2007, p. 60).

2.1. Tenerife Accident

The Tenerife Accident of 1977 is widely regarded as the worst aviation disaster in history due to a communication error. The incident involved the collision of two planes that were originally intended to land at Gran Canaria International Airport, but were redirected to Los Rodeos Airport in Tenerife due to a bomb explosion at the former airport and a subsequent bomb threat. Los Rodeos Airport has a limited capacity and was experiencing heavy fog at the time, resulting in poor visibility. The influx of diverted planes led to overcrowding and planes being parked on taxiways. The sequence of events leading up to the accident included Pan Am Flight 1736 taking off from the runway after the KLM aircraft and passing behind it before also attempting to take off. The visibility at Los Rodeos Airport was severely reduced to 300 meters due to the presence of fog. The air traffic controller instructed the crew of the KLM flight on the procedures to follow after takeoff, and this communication was also heard by the crew of the Pan Am flight. The controller then informed the KLM aircraft that they were required

to wait for clearance before taking off, but the KLM pilots disregarded this instruction and proceeded to take off. At the same time, the Pan Am plane was still on the runway. Upon realizing that the KLM plane was approaching, the Pan Am pilot attempted to accelerate and take off, but was unable to prevent the collision. The collision resulted in the deaths of 583 people. (Tamer, 2021, p. 37-40). The accident is an example of the misunderstanding found among communication errors.

3. Literature Review

The aviation industry is faced with many emergencies due to its dynamic structure. Aviation has a dynamic structure due to many reasons such as being constantly in motion, preparing the aircraft for a new flight immediately after landing, weather events, human factor and no room for error. In the study published by the General Directorate of Civil Aviation "Airport Emergency Planning", airport emergencies; It is divided into "emergencies involving aircraft" and "emergencies not involving aircraft" (SHGM, 2012, p. 5-6). He mentions that airports should have emergency departments for emergencies. He says that although small airports do not have this department, some large airports have a department called FEMA (Price & Forrest, 2016).

In the study conducted by Demir (2018), it was stated that the faster the emergency situations encountered in airline operations are intervened, the less the time and therefore the monetary loss of the airline company. In the same study, it was stated that the number of flights in Turkey is increasing and the probability of encountering emergencies increases at the same rate in places where landing and take-offs are high, and the importance of the issue for Turkey has been mentioned (Demir, 2018, p. 82). In airline operations, the response to an emergency differs from airport to airport. This level is even lower, especially at local airports (Schafer et al., 2008, p.1).

On the other hand, in his article emphasizing the communication in emergency situations in airline operations, Ergül (2009) mentioned the importance of the human factor, which is the main element of communication to be established during an emergency. The reason for this is that “The actual realization of other human factors among the members of a team or team, such as collecting and sharing information, planning, leadership, decision making and identification, management of errors and problems, is typically through communication (Nevile, 2006, p. 5).” Additionally, Price and Forrest(2019) state that " The Airport Manager must ensure that adequate communication systems are in place for normal and emergency operations. In extraordinary situations, such as a large-scale community disaster, some organizations such as the Radio Amateur Civil Emergency Service (RACES) and the Radio Emergency Joint Communications Team (REACT) may be available to support emergency communications (Price & Forrest, 2019, p. 432).

Dönmez and Uslu (2016) also supported Ergül (2018) in their research on communication-related accidents and incidents. They supported their views by giving an example of an accident in the article. In the mentioned accident, there is a descent and light problem during the descent. Tower contacts the pilot and asks if everything is all right. The pilot, on the other hand, thinks it's about the light problem and says "OK". The main problem is with descent and the plane crashes 30 seconds after this conversation. As seen in the accident, communication is one of the reason that can be cause of the accident in emergency situations (Dönmez & Uslu, 2016, p. 1075).

In their study, Turhan et al. (2020) discussed the emergencies in aviation from the perspective of air traffic controllers, stated that most of the accidents were human-induced and emphasized the importance of the training received in case of emergency. They argue that due to the increasing air traffic volume, the training of air traffic controllers should be improved and simulations that can simulate all scenarios

should be used during the trainings about communication. In order to support what was said in the study, the example of the Tenerife accident, which is considered the greatest disaster in the history of civil aviation, is given (Turhan et al., 2020, p. 149).

Lee (2009) mentioned the different error factors of aircraft accidents related to pilot error in his study and these factors; Emotional-Perceptual Factors, Medical and Physiological Factors, Knowledge or Skill Factors, Personality and Safety Attitude, Risk Assessment/Decision Factors, Communication/Team Coordination Factors, Design/System Factors and Controlling Factors. Regarding the subject, Communication/Team Coordination Factors are divided into 9 different categories within themselves. These are; inadequate crew or cross-check problem, misunderstood or disapproved communication, failure to use standard language, failure to communicate plans or intentions, crew deliberately withholding vital safety data, inability to lead, failure of the captain to use all resources, interpersonal conflict or team discussion, and inadequate mission plan or short preflight (Lee, 2009).

Orhan et al. (2010) stated in their study that the decisions made in a short time in emergency situations encountered in the airline environment may not be very high-quality decisions sometimes. They argue that these implemented decisions are partial solution-oriented and that more suitable solutions should be searched for, which can then be switched from partial solution to long-term plans (Orhan et al., 2010, p. 188) Nacaklı and Eginli (2020) conducted a study on the use of artificial intelligence on this subject. As a result of this study, he says that obtaining information about a subject may not be enough to bring about a change in behavior and that the information that is desired to be transformed into behavior, especially in emergency situations should be perceived by the learner, reinforced with experience and recorded in the long-term memory. They also mention that the use of artificial intelligence in airline operations can seriously intervene in events quickly (Eginli & Nacaklı, 2020, p. 72).

4. Methodology

This research includes aircraft accidents in civil aviation between 1970-2021 all over the world. In the research, 20 fatal accidents that took place within the specified date range were examined. Tenerife Accident has been studied because it is a suitable example to explain the subject and because of the wide access to accident reports and accident-related information. Examined accidents were reached by examining the "Death Rate per Year" and "Crash Rate per Year" pages under the website named "Bureau of Aircraft Accidents Archives" and as a result of the literature review (B3A, 2022).

Document Analysis, which is among the Qualitative Research Methods, was used as the analysis method in the study. Document Analysis is a qualitative analysis method in which the contents of written, visual and audio sources are meticulously and systematically examined and analyzed, meaning is extracted from the sources, and data is examined and interpreted to develop empirical knowledge (Wach, 2013, p.1; Corbin & Strauss, 2008, p.14). Stages of Document Analysis; finding the appropriate documents, checking the originality of the documents, creating a systematic about coding and cataloging, and finally performing data analysis (Merriam, 2009, p.203). In the study, this process was taken as reference and applied.

In this study, the number of people killed in plane crashes and communication error variables were used and the direction and severity were discussed as a result of the analysis. As a result of the analyzes made, the research showed the severity of aircraft accidents caused by communication errors. With the developing technology, many artificial intelligences are emerging. The field of communication is one of them. In the study, communication technologies that can be used to reduce this margin of error were examined.

Also in this research, 20 accidents in which the most people lost their lives in the history of civil aviation were examined and these accidents are shown in Table 1. Also, the research, it was aimed to determine the place and severity of the plane crashes caused by communication errors, among the 20 most fatal accidents.

5. Findings

According to the findings, it has been seen that the accidents that occur due to communication errors have a large share among the 20 accidents with the highest number of deaths. Although it is known that communication-based accidents are important in the aviation industry, seeing their place among the accidents with the highest number of deaths has been effective in emphasizing the importance of the subject.

Table 1: 20 Airplane Crashes with the Most Deaths

Flight Number/Crash	Number of Deaths	Cause of Accident	Model of Aircraft	Year of Accident	Total Number of Passengers and Crew
Pan Am Flight 1736 and KLM Flight 4805	583	Communication Fail	B747-121/B747-206B	1977	644
Japan Airlines Flight 123	520	Maintenance Error	B747	1985	524
Saudi Arabian Flight 763 and Kazakhstan Airlines Flight 1907	349	Communication Fail	B747/Ilyushin II-76	1996	349
Turkish Airlines Flight 981	346	Maintenance Error	DC-10	1974	346
Air India Flight 182	329	Terrorist Attack	B747-237B	1985	329
Saudia Flight 163	301	Fire	L-1011 TriStar	1980	301
Malaysia Airlines Flight 17	298	Missile Attack	B777-200ER	2014	298
Iran Air Flight 655	290	Missile Attack	A300-200	1988	290
American Airlines Flight 191	273	Maintenance Error	DC-10	1979	271
Pan Am Flight 103	270	Terrorist Attack	B747-121	1988	259
Korean Airlines Flight 007	269	Missile Attack	B747-230B	1983	269
American Airlines Flight 587	265	Turbulence	A300	2001	260
China Airlines Flight 140	264	Communication Fail	A300B4-622R	1994	271
Nigeria Airways Flight 2120	261	Communication Fail	DC-8-61	1991	261
Air New Zealand Flight 901	257	Communication Fail	Ilyushin II-76	2018	257
Arrow Air Flight 1285	256	Icing on Plane	DC-8	1985	256
Malaysia Airlines Flight 370	239	Unknown	B777-200ER	2014	239
Garuda Indonesia Flight 152	234	Communication Fail	A300B4-220	1997	234
TWA Flight 800	230	Maintenance Error	B747-131	1996	230
Swissair Flight 111	229	Fire	MD-11	1998	229

Source: B3A, 2022

In Table-1, the number and name of the flight, the number of deaths, the cause of the accident, the model of the aircraft, the year of the accident and the total number of passengers and cabin crew on the aircraft are given. It seems that the number of deaths in some accidents is higher than the total number of passengers and cabin crew. The reason for this is that people living in the area where the plane crashed also lost their lives in the mentioned accidents. As seen in the table, there were no survivors in most of the accidents. This shows the seriousness of plane crashes. In addition, the high number of deaths indicates the weight of the consequences of mistakes.

Table-2. Causes and Numbers of Accidents According to Loss of Life in the Range of 200-300, 300-400 and 400-500

	Communication Fail	Maintenance Error	Terrorist Attack	Fire	Icing	Missile Attack	Unknown	Turbulence
200-300	4	2	1	1	1	3	1	1
300-400	1	1	1	1	-	-	-	-
500-600	1	1	-	-	-	-	-	-

In Table-2, as a result of categorizing the loss of life at 100 intervals, the causes of the accident in that interval are shown. The accident with the highest number of fatalities is Tenerife, which occurred due to communication error. In addition, among these 20 accidents, communication errors are the most common cause of accidents.

Table-3. Total Number of Deaths by Cause of Accident

Cause of Accident	Number of Deaths	Percent
Communication Fails	1948	32,12
Maintenance Error	1369	22,57
Missile Attack	857	14,13
Terrorist Attack	599	9,87
Fire	530	8,74
Turbulence	265	4,37
Icing	256	4,22
Unknown	239	3,94

Table-3 shows the total number of casualties according to the causes of the accident. A total of 6063 people lost their lives in 20 accidents. The cause of the accident with the highest number of casualties was communication error, which was 32.12% of the total rate with 1948 per cent. Although there is data supporting Table 2, Table-3 showed that almost one-third of the deaths in 20 accidents were caused by communication error accidents. The most immediate cause of accidents following communication errors is maintenance errors with 22.57 percent. Both causes of accidents are causes of accidents involving people.

Table-4. Frequency of Accident Causes in 20 Accidents with the Most Fatalities

Cause of Accident	Frequency	Percent
Communication	6	30
Maintenance Error	4	20
Missile Attack	3	15
Terrorist Attack	2	10
Fire	2	10
Turbulence	1	5
Icing	1	5
Unknown	1	5
TOTAL	20	100

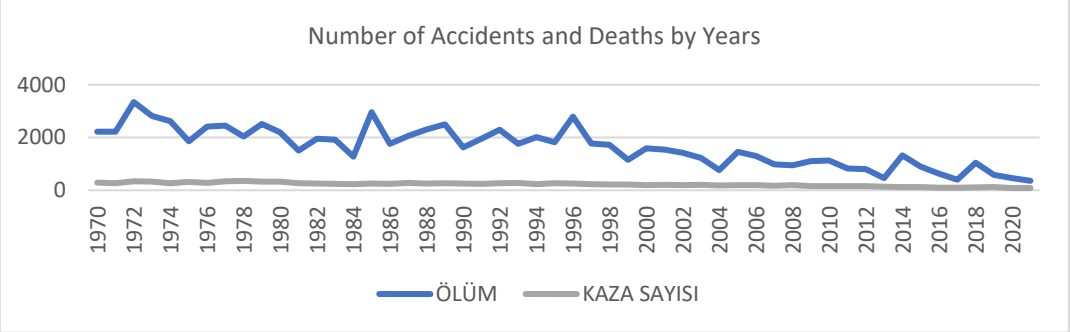
In Table-4, communication errors were the most common with 6 as the cause of the accident, and 30 percent of the accidents were caused by communication errors. Communication-related accidents due to reasons such as misunderstanding due to language differences and giving wrong instructions are an issue that needs to be examined. Although improvements have been made in preventing accidents thanks to the measures taken and the developing technology, unfortunately, accidents still occur due to human

error and communication error. Since maintenance errors and icing on the aircraft are also due to human error, it is seen that 55 percent of the accidents are caused by human error. In order to prevent human error, it is necessary to remove the human from the operation process as much as possible. Technological developments were able to provide a better understanding of the machine from the human-machine relationship, to examine it and to take corrective actions, but the human factor could not be examined so much and the protective measures taken could not show the reduction in machine -related factors for the human factor (Ödemiş, 2013). The use of new technologies in this regard will have a positive effect on the subject.

6. Technologies That Can Be Used in The Aviation Industry

The aviation sector is a sector that constantly uses new technologies and brings new regulations by learning from mistakes. Although new technologies are used, the human factor is still an unpredictable factor. In order to minimize the margin of error, it is necessary to use artificial intelligence as much as possible.

Figure 2: Number of Accidents and Deaths by Years



Source: B3A, 2022

As can be seen in Table 4, the number of accidents and deaths in civil aviation shows a decreasing trend. The statistics for the years 2020 and 2021 in the last part of the graph do not provide realistic data, as the number of flights decreased by 42% compared to 2019 due to Covid-19 (flightradar24, 2021). While the number of deaths in plane crashes was almost 3500 in the 1970s, it decreased to 500 in 2019, and the number of accidents decreased from around 300 to 125. In addition, while the number of passengers carried annually was 310 million in 1970, it reached 4.5 billion in 2019 (1.8 billion in 2020) (Bank, 2021). The increase in the number of passengers carried by almost 14.5 times indicates that the number of flights has also increased considerably. Considering that the number of passengers carried and the number of flights has increased so much, the great decrease in the number of accidents and deaths shows that the innovations and improvements made in the field of aviation bring very positive results.

Aircraft engines, apron technologies and equipment used have also been improved and corrected, but human errors still cause accidents. For this, it is necessary to minimize the possibility of error by using new technologies in the field of human factor, especially in the field of communication. There are new technologies that can be used within the scope of communication technologies and integrated into aviation. Especially the problems caused by the radio systems used today cause errors. There are new technologies developed in this field in the field of aviation. The technologies being worked on are as follows;

6.1. SANDRA Project

It is able to provide the communication service for the needs of each aircraft, which can transmit digital and high-speed data directly to the ground and via satellite over multiple datalinks, each with its own unique service quality and without interruption. Detailed information such as weather or traffic conditions can be exchanged quickly and reliably between the control tower and the aircraft, thereby increasing air traffic safety. SANDRA also typically allows hardware-implemented radio communication system components (e.g. mixers, filters, amplifiers, modulators/demodulators, detectors, etc.) to be run in parallel as software on a computer, thus operating different radios in parallel as independent software bits (waveforms) on co-processors. gives. This would be a huge step forward in the same way that "integrated modular avionics" revolutionized airborne electronics (SANDRA, 2020).

6.2. Global Cross-Channel Communication (GC3)

GC3 is a Spidertracks-branded network that leverages the power of various channels to provide operators with comprehensive, continuous coverage worldwide. This means that aviators do not have to rely on traditional communications infrastructure. It is more reliable than radio and does most of what ACARS does, but at a significantly reduced cost (spidertracks, 2019).

6.3. Aviation Mobile Aircraft Communications System (AeroMACS)

The Aviation Mobile Aircraft Communications System will allow Federal Aviation Administration (FAA) personnel at control towers to send safety-critical information digitally and securely, resulting in shorter wait times on the runway. AeroMACS will eventually phase out the use of voice communications as the primary method of information sharing for airport ground operations. New, encrypted, high-speed digital data networks will facilitate communication between ground crews and air traffic controllers, and will include text instructions for runway navigation, gate assignment details and surface navigation instructions, as well as messages, diagrams and GPS-style maps sent to the pilot after the aircraft has landed. In this family of hardware, any sensors called subscriber stations will collect, transmit and receive data. Telrad creates the base station that performs the same function as in a cellular network, routing transmissions with GPS and providing timing for the network (NASA, 2020).

6.4. Data Comm

Data Comm is an FAA technology that revolutionizes communication between air traffic controllers and pilots. Controllers have traditionally used radio voice communications to issue permits and other flight information to pilots. Voice communications are time-consuming and labor-intensive, slow processes and can lead to miscommunications between controllers and pilots known as "talk back, read back" errors. In turn, Data Comm gives air traffic controllers and pilots the ability to communicate flight plans, clearances, instructions, recommendations, crew requests, reports and other important messages at the touch of a button. Voice-to-text switching not only speeds things up, but also improves security, which reduces the chance of re-read errors when transferring information. Additionally, it allows controllers to send text instructions to several aircraft at the same time; this is a much more accurate and efficient process than making multiple calls. Data Comm also reduces travel delays. For example: Two planes are in line for takeoff when a storm requires air traffic controllers to reroute them. Aircraft using voice must wait for new instructions and use existing two-way voice communication. This process can take 15 to 30 minutes or longer, depending on how many planes are in line for takeoff. However, the flight crew on the aircraft using Data Comm receives the new flight plan via text from an air traffic

controller directly to the flight crew. The crew reviews the new clearance and accepts the updated instructions at the push of a button. The aircraft remains on the take-off line or can even be picked up and sent directly to the runway before other non-equipped aircraft. The plane takes off on time; It saves countless minutes of delay on aircraft not equipped with Data Comm (FAA, 2021).

7. Conclusion

The aim of the article is to determine the share of communication errors after examining the most fatal accidents, to emphasize their importance and to examine the artificial intelligence that can be used in communication. As a result of this, it is to offer suggestions that can take precautions against accidents that may occur due to the same reasons in the future. Document Analysis was performed in order to determine the direction and severity between the number of deaths and the causes of the accident. Among the 20 deadliest plane crashes examined within the scope of the research, the rate of plane crashes caused by communication errors is 30%. The rate of plane crashes due to human error is 55%.

There are many different causes of fatal accidents in the history of civil aviation. It is seen that the main reason for most of accidents is caused by human factors, especially factors related to interpersonal communication. Developing technology and taking advantage of these technologies are important in reducing accident and death rates. The aviation industry has always followed and used technological developments closely. According to data, the number of accidents and deaths has shown a decreasing trend. Considering the fact that the number of flights has increased in large amounts and therefore more passengers are carried, it is seen that the effect of technological developments in aviation is positive. Despite the developments, the human factor has always presented a problem. With the development and more intensive use of systems that inform the pilot, such as the collision warning system, ground proximity warning system, and cockpit resources management system, accidents due to pilot error have tended to decrease (Akça, 2020, p. 259). As such, many systems are used that can prevent accidents. Misunderstandings in communication, misinformation regarding flight rules, giving incorrect instructions or not providing the necessary information have not been prevented yet. In emergency situations, misunderstandings, especially during verbal communication, lead to irreversible mistakes.

The human factor cannot be completely eliminated. Passengers also do not trust artificial intelligence enough to prefer to board a pilotless and computer-controlled plane, but artificial intelligence should be replaced as much as possible in order to avoid mistakes made. Considering that air traffic will increase further in the coming years, communication becomes more complex. Therefore, the need for new communication technologies is increasing. Today's communication technologies are not at a level to meet this need. SANDRA, GC3, AeroMACS and Data Comm projects are projects that work on preventing misunderstandings in communication in general. In addition, the projects aim to reach the transmitted and received data in communication systems quickly and reliably. In this way, at least the transmitted data can be reached safely and without errors. As a result of the general use of the systems, it is possible to prevent accidents caused by communication errors to a large extent.

As a result, the aviation industry has continued its development since its inception. As can be understood from the phrase "Aviation rules are written in blood," lessons have been learned as a result of accidents and deaths, and both innovations have been made in the rules and new technologies have been used in aviation. The human factor is still an unpredictable factor for the aviation industry, which can provide solutions to many situations. Communication, on the other hand, has a great impact on human-induced errors. Errors occur frequently, especially in verbal communication. As a result of misunderstandings, many accidents have occurred and many people have lost their lives. Therefore, it is necessary to prevent

misunderstandings by using new technologies in the field of communication. As a result of the effective use of SANDRA, GC3, AeroMACS and Data Comm projects, it is possible to solve the problems related to communication to a large extent.

If relevant data are obtained in future research on the subject, in order to examine the positive effect of communication artificial intelligences used so far, it will be useful to understand its importance by looking at the number of plane crashes before and after its use. In the light of the results obtained, understanding the benefit of communication artificial intelligence used in civil aviation will also help in adopting the seriousness of the situation.

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