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Research Article

Shared Perspectives of Aviation Safety Among Managers and Technicians

Ebru Yazgan[1], Cüneyt Ceyran[2*], Vildan Durmaz[3]

[1] Eskisehir Technical University, Faculty of Aeronautics and Astronautics, Department of Airframe and Powerplant Maintenance, Eskisehir, Türkiye
eyazgan@eskisehir.edu.tr - 0000-0002-6545-8536

[2] Turkish Air Force, Eskisehir, Türkiye
cuneytceyran@hotmail.com - 0009-0002-2435-0649

[3] Eskisehir Technical University, Faculty of Aeronautics and Astronautics, Department of Aviation Management, Eskisehir, Türkiye
vkorul@eskisehir.edu.tr - 0000-0003-3649-1780

Abstract

When compared to other transportation sectors, aviation is often listed among those with a noticeably higher risk ratio with regards to financial, environmental and operational issues although it is relatively safer, reliable and faster. In aviation, human factors play the most critical role in handling accidents and incidents. When existing risks are not properly and effectively managed they might result in considerable financial and operational losses. In this respect, this study deals with dirty dozen factors, which affect technician and manager performances in aviation organizations in terms of flight safety. For the purpose of the study, expert opinions were obtained from aircraft maintenance technicians and maintenance managers regarding the criteria leading to incidents, and the SWARA method was employed to determine the weights of the criteria. According to the findings, maintenance managers reported "the lack of situational awareness" as the most important criteria while "stress" was the most important criteria for aircraft maintenance technicians. The results of the current study revealed a significant difference between maintenance technicians and managers in terms of their perspectives on the main issues of aviation safety.

Keywords

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SWARA

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1. Introduction

How to design, manufacture and control air vehicles was the priority in the earlier phases of engine-powered flights. As the technical issues were gradually resolved, human factors in flights started to become more prominent. At the beginning, pilots were provided by certain mechanisms helping them to stabilize aircrafts. Later, automatic systems were integrated to aid the flight crew in certain tasks related to navigation and communication. Such interventions to supplement pilots' skills have led to the unavoidable emergence of human factor in aviation (CAA, 2002).

In this context, "human factors" can be defined as "examining employees' abilities and limits as well as the attempt made to improve safety through a harmonious interaction between activities they are involved in, groups or teams they belong to and systems they use. Thus, the aim of human factor discipline in aviation is to decipher the interaction between humans and the factors affecting humans and sustain safety at the desired level by maintaining harmony and balance (Gerede, 2018).

A general overview of aviation accidents shows that the reasons of aviation accidents can be grouped into three categories, Fig.1.



Fig.1. Reasons for aviation accidents.

*: Corresponding Author Cüneyt Ceyran, cuneytceyran@hotmail.com
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Accidents might occur at anytime in aviation, and most of these accidents involve human errors. The studies report that 70-80% of the fatal accidents in the aviation sector are due to human errors (Önen, 2022).

The factors listed under the term "human factor" causing accidents refer to any factor that might affect human performance. These factors include ergonomic, physiological, psychological and sociological factors.

Accordingly, human factor discipline covers a wide-range of disciplines and interdisciplinary studies (Gerede, 2018). Therefore, many models have been developed, implemented and currently employed to analyze human errors and the main reasons for these errors.

Among these models, the most commonly used is SHELL (Software, Human, Environment, Liveware), which is especially employed by ICAO. In addition to SHELL, there are some other methods that have been developed and are preferred such as Swiss Cheese, HFACS (Human Factors Analysis and Classification System), PEAR Model, PEEP Model and Dirty Dozen (Aksoy, 2006).

1.1. Dirty Dozen

A large number of studies investigating and modeling aviation accidents have been conducted so far to improve aviation safety. However, these studies have often dealt with the issue through generalizations. Advocates who believe accidents are caused by errors and rule violations, as well as those who argue that poor organizational processes are the root cause, have developed numerous hypotheses and models. Similarly, Gordon Dupont (1997), in an international congress, introduced a new framework called Dirty Dozen to describe human-related maintenance errors after he analyzed the reports of 2000 accidents and incidents that occurred between 1993 and 1997. This model was developed and introduced by a professional who was genuinely from the aircraft maintenance culture and avoided making generalizations. The significance of this model is to list factors that might result in human error and cause serious accidents and incidents. Moreover, Dupont claims that these 12 factors shown in Fig. 2 impel employees to make mistakes. According to the FAA, human factors consist of more than 80% of maintenance errors, which unavoidably lead to waste of time, injuries and even death. The model has been recognized since its introduction by the authorities in many countries, including Canada, Australia, Singapore, China, Netherlands, Sweden, England, Ireland, Portugal, the USA, and Hungary etc.

The model has been introduced during a conference organized by Dupon, the first president of The Pacific Aircraft Maintenance Engineers Association. Later, it has been employed in the trainings focusing on human factor in aircraft maintenance (Dupont, 1997). Fig. 2 displays these 12 factors causing accidents, and brief explanations of these factors are presented in Table 1.

Needless to say, these errors are not the only reasons causing accidents. In Circular 240- AN/144, ICAO reported more than 300 human errors (ICAO, Circular 240, 1993). In addition, a special team from the Canadian Armed Forces archived thousands of maintenance errors by collecting data involving maintenance errors. However, this dirty dozen consists of only the cluster of these errors. They have been ranked without any prioritizations and no information was reported about which of them cause more accidents or result in unsafe situations more (http-1).

1.2. The Research on The Dirty Dozen

Although the Dirty Dozen Method was initially developed for accidents caused by aircraft maintenance errors, it has been employed in many fields later on. The studies conducted by using the Dirty Dozen Method are presented below.

Bassett (2020) associated maintenance errors in the Electrical Wiring Interconnect System (EWIS), which was applied for more than 10 years in Naval Forces aircraft, with the Dirty Dozen Model. He administered a 47-item questionnaire to 131 people verified by the FAA and NAVAIR. The replies provided were analyzed and the most significant risk factors in the Dirty Dozen were determined, which proved the validity of the Dirty Dozen in military aviation as well as in civil aviation. The factors with the highest risks were ranked as stress, lack of knowledge and pressure.

Marquardt et al., (2015) applied the Dirty Dozen Model, which is used in aviation, to evaluate cognitive performance in operation rooms since the field of health care lacks a valid model to make such an evaluation. The researchers administered a questionnaire with 215 oculists to measure and evaluate cognitive impairment of surgery staff performance using the Dirty Dozen Model. The participant surgeons stated that the Dirty Dozen items in the questionnaire are highly relevant to the effects on cognitive performance, but no factor was dominant in performance decline.

The researchers Samad, Johari and Omar (2018) preferred the Dirty Dozen Model in their study focusing on human factor safety practice during an aviation-related training on awareness raising and effectiveness. They measured awareness raising and effectiveness levels of human factor safety practices in UniKL MIAT, an aviation school. Twelve items of the Dirty Dozen were administered to 120 students attending Malaysian Institute of Aviation Technology (UniKL MIAT) in Kuala Lumpur University in Malaysia, and the data collected were analyzed by employing qualitative research techniques. Out of these 12 items, 6 (lack of communication, lack of teamwork, norms, pressure, distraction and stress) were marked as "I agree" and the remaining 6 items were marked as "I am not sure" in regards to the awareness raising and effectiveness of the available human factor safety practices.

Nzelu et al. (2018) suggested that, just like in other fields, human factor plays a significant role in errors and misinterpretations in the field of cardiotocography (CTG) as well, and such errors and wrong decisions often result in death. The purpose of this research was to explore different human factors and how they contribute to misinterpretation of CTG. The author examined what causes errors and misinterpretations in CTG by employing the Dirty Dozen Model, which is also used in aviation and recognized as reasons and precursors of errors. As a result, in this article, it was discussed each of the Dirty Dozen and applied them to common CTG misinterpretation themes. The author was also discussed ways in which these might be mitigated or avoided in practice.

Carthey (2019) used the Dirty Dozen Model to ensure safety in dental surgeries and made some recommendations to the related organizations and institutions to minimize the problems caused by errors and implement necessary changes.

Yılmaz et al. (2018) carried out interviews with a group of senior managers in aviation sector based on the items of the Dirty Dozen, and used the data collected from these interviews to examine risk potentials of the dirty dozen items and created the risk matrix accordingly.

Ram, A. (2022) determined which incidents in their working environment negatively affect aircraft maintenance engineers' daily lives and how their daily lives affect human factors. In this study, a qualitative method was employed to find an answer to the question "How does a negative working environment in Ontario Canada's Air Transportation sector reduce aircraft maintenance engineers' performance?". The findings revealed that "organization culture" is the main factor affecting human performance, and that organization culture is the hidden 13th item of the Dirty Dozen.

As a result, despite the extensive research on human factors and the application of the Dirty Dozen model across various sectors, most studies have primarily focused on identifying and categorizing these factors rather than quantitatively assessing their relative impact on safety outcomes. In addition, limited research has explored how the Dirty Dozen factors manifest in specific operational contexts such as aviation maintenance operations. Furthermore, there is still a lack of empirical data revealing which of these twelve factors contribute most significantly to human error in real-world aviation environments.

Therefore, this study aims to fill this gap by analyzing the relative importance of Dirty Dozen factors among maintenance personnel and decision-makers through survey data and statistical evaluation. By doing so, the research provides a more comprehensive understanding of how these factors interact and influence safety performance in aviation maintenance operations.



Fig.2. Dirty Dozen Factors (Adapted from Mithul Chowdhury's Post-Linkedin)

Table 1. Dirty Dozen Explanations.

1. Lack of Communication Lack of communication might be either verbal or oral or both. It might result in misunderstandings among aircraft maintenance staff, human errors as well as damages to equipment, injuries, and even death.
2. Complacency Complacency can be defined as the feeling of self-satisfaction following the loss of awareness about potential dangers. This factor is believed to be responsible for 15% of all maintenance errors.
3. Lack of Knowledge In today's rapidly changing world, a lack of knowledge is a common cause of failures. The technological differences between various types of aircraft and the procedures followed make it hard to acquire the necessary knowledge to carry out a proper maintenance practice.
4. Distraction When one is interrupted or disturbed while working on a task, he/she is not aware of the fact that an activity or task is skipped or not fulfilled. This situation might result in distraction of maintenance technicians, which in turn might cause physical injuries or equipment damage.
5. Lack of Teamwork Since activities in the aviation sector often require staff to collaborate, teamwork creates a strong bond among employees. The more maintenance staff collaborate, the better they learn about their preferences, their likes/dislikes, their abilities and accept their weaknesses. This situation increases synergy and innovation while lack of teamwork might lead to incidents.
6. Fatigue Fatigue is an insidious factor since one is not aware of his exhaustion until it is extreme. Those who work are less aware of the effects of exhaustion. Fatigue is a significant human factor causing a lot of maintenance errors and accidents. It can be mental or physical as well as emotional, which also affects mental and physical performances. Fatigue occurs when a worker experiences impairment or breakdown in any of the following: cognitive ability, decision-making, reaction time, coordination, speed, strength and balance.
7. Lack of Resources Lack of resources may affect one's ability to fulfill a task due to lack of supply and support. Low quality products also affect one's ability to fulfill a task. Aviation maintenance necessitates the presence of suitable tools and spare parts to protect an aircraft fleet. Thus, lack of resources while trying to fulfill a maintenance task safely may result in both fatal and non-fatal accidents.
8.Pressure It refers to real or perceived forces demanding high levels of work performance in aviation sector.
9. Lack of Assertiveness Normally, an average aircraft maintenance employee is not an overly assertive person. However, there might be times when things do not go

well and one has to be assertive so as not to ignore a problem. One has to stand by his/her decisions. Assertiveness is the ability to express one's feelings, ideas, beliefs and needs positively and productively and should not confused with being aggressive.
10.Stress Stress is a biological reaction to a stimulus that disrupts one's physical balance or conflicts with it. It emerges when a situation or an incident is considered a risk and necessitates the implementation of practices exceeding one's normal workload. Stress is quite common in aviation sector and caused by physiological, psychological factors as well as external ones.
11. Lack of Awareness Lack of awareness is often faced by experienced maintenance personnel who do not think about the consequences of their actions. Although regularly updated manuals do not include some failures and unprecedented new situations, common sense and experience may resolve these new problems. In aviation maintenance practices, it is not unusual to carry out the same maintenance tasks again and again. Therefore, it is possible for technicians to be less careful and develop lack of awareness about what is going on around them.
12.Norms This last factor is one of the most influential reasons. Most people want to be recognized as a member of a crowd and norms are developed in such a group, which determines how an aviation employee should behave. Norms is the abbreviation of "normal" or "how things are done normally". They are the unspoken rules obeyed or welcomed by most institutions. Negative norms might deviate from the established safety standards and cause an accident. Norms are often developed to solve problems that have not been resolved until that time. Norms are defined as one of the dirty dozen in aircraft maintenance.

*Adapted from Yılmaz et. al. (2018)

2. Method

2.1. Step-Wise Weight Assessment Ratio Analysis (SWARA)

There are many factors affecting safety in aviation and causing accidents and incidents. The current study aims to provide an answer to the question "Do aircraft maintenance managers and technicians share a common perspective on the factors affecting safety in aviation and causing accidents and incidents?". The SWARA (Step-wise Weight Assessment Ratio Analysis) was used in order to determine the factors' weights of significance by aircraft maintenance technicians.

Despite the presence of various Multiple Criteria Decision Making (MCDM) methods to determine criteria weights, some methods stand out from others such as Analytic Hierarchy Process (AHP) (Saaty, 1980), Analytic Network Process (ANP), Entropy, FARE, and SWARA (Zolfani and Saparauskas, 2013).

The common practice in these methods is that an expert decision maker determines criteria and their weights or weights are determined by a group of decision makers after reaching a consensus among the members (Çakır, 2017).

SWARA, a MCDM method developed by Keršuliene, Zavadskas and Turskis (2010), is used while determining various factors' ranks of importance. In addition, this method was developed for evaluations requiring experts' knowledge, experience and opinions. An expert has a significant role in evaluations and measurement of weights; therefore, it is also known to be an expert-oriented method (Abdulvahitoğlu and Cengiz, 2022).

In the SWARA method, which is a common MCDM method, determining criteria weights when there is only one decision maker is much easier than the presence of multiple decision makers. Moreover, it can be applied in many fields such as staff hiring, product design problems, machine parts selection problems, location selection problems, supplier selection problems, investment prioritization, Research & Development projects selection, marketing problems and other similar selection problems (Adalı and Ayşegül, 2017).

The SWARA method allows decision makers to play a significant role in determining the importance of each criterion by taking existing environmental and economic conditions into consideration. By using this method, decision makers select criteria to be employed while solving problems and their indicators, determine and evaluate their degrees of importance (Durmaz and Yazgan, 2024). Accordingly, the SWARA method is a subjective criterion weighting method.

As a result the SWARA method was preferred in this study because it allows for a systematic yet flexible evaluation of expert opinions, which is highly relevant in contexts such as aviation maintenance where subjective judgments and professional experience play a critical role. Unlike methods such as AHP or ANP, which require extensive pairwise comparisons and consistency checks, SWARA enables experts to directly rank and weight criteria in a step-wise manner, reducing cognitive load and time requirements. Moreover, the method is particularly effective when the decision-making process involves qualitative assessments rather than purely quantitative data, as is the case with evaluating human factors like the Dirty Dozen. Therefore, SWARA was considered the most appropriate MCDM approach for analyzing the relative importance of human factor criteria based on expert judgment.

The steps followed in SWARA method are listed below:

Step 1: Criteria and decision maker(s) (DM) are determined.

Step 2: DM ranks the criteria starting from the most important one to the least important one according to his/her knowledge and experience.

Step 3: After DM does the ranking, *j* criterion is compared to the previous one *(j-1).*

Kerseliene et al. (2010) named this ratio "comparative importance of mean value" and used "*sj*" as the symbol. In the evaluation, experts assign 1.00 full point for the most important criteria and determine the values for other criteria between 0 and 1 in multiples of 5 (Abdulvahitoğlu and Cengiz, 2022). Means of comparative weights *(sj)* are calculated for each criterion after the calculation of means of comparative weights for each decision maker.

Step 4: A coefficient (kj), given in Equation (1), is calculated for each criterion. In the common ranking of criteria, the "kj" coefficient for the most important criteria is assigned as 1.

$$k_j = \begin{cases} 1 & j = 1 \\ s_j + 1 & j > 1 \end{cases} \quad (1)$$

Step 5: Significance vector (wj) is calculated for each criterion by using Equation (2)

$$w_j = \begin{cases} 1 & j = 1 \\ \frac{x_j - 1}{k_j} & j > 1 \end{cases} \quad (2)$$

Step 6: Importance weights of criteria (qj) is calculated by using Equation (3)

$$q_j = \frac{w_j}{\sum_{k=1}^{n} w_k} \quad (3)$$

2.2. Implementation of SWARA Method in Aircraft Maintenance

In this section, SWARA method was employed to explore the perceptions of maintenance managers and technicians about the Dirty Dozen, which is the precursor for maintenance accidents and unsafe situations, and to determine and evaluate whether they share the same perspective regarding the reasons of such incidents.

Step 1: Dupont (1997) determined the reasons for an accident and unsafe situation for aircraft maintenance staff as 12 dirty factors, which constitute the criteria of the present study.

As for the manager decision maker, a pilot with 20 years' experience in different departments of aviation sector including safety management was chosen. An aircraft maintenance technician (AMT) with 17 years' experience in different fields of the sector was selected as the technician decision maker.

Step 2: Criteria ranking was not performed by the decision makers. Five maintenance managers and five maintenance technicians were asked to rank the Dirty Dozen criteria in the order of importance. In this ranking, the most important factor was assigned 12 point and the least important factor with 1 point. Later, criteria ranking was done by calculating the mean value. The findings for AMT's and manager's are displayed in Table 2 and Table 3.

Table 2. AMT's rank of importance

DIRTY DOZEN CRITERIA	AMT'S RANK					Mean
	P1	P2	P3	P4	P5	
C1. Lack of Communication	11	7	9	6	11	8,8
C2. Complacency	8	1	8	12	12	8,2
C3. Lack of Knowledge	1	8	12	11	5	7,4
C4. Distraction	7	9	3	8	7	6,8
C5. Lack of Teamwork	12	5	7	5	4	6,6
C6. Fatigue	9	12	6	7	9	8,6
C7. Lack of Resources	5	6	4	4	3	4,4
C8. Pressure	6	10	1	10	10	7,4
C9. Stress	10	11	10	9	8	9,6
C10. Lack of Assertiveness	4	3	2	3	2	2,8
C11. Lack of Awareness	2	2	5	2	6	3,4
C12. Norms	3	4	11	1	1	4

Step 3: As shown in Table 4 and Table 5, pairwise comparisons of the criteria were evaluated by the decision makers, and means of comparative weights (sj) were calculated for each criterion.

Table 3. Manager's rank of importance

DIRTY DOZEN CRITERIA	AMT'S RANK					Mean
	P1	P2	P3	P4	P5	
C1. Lack of Communication	4	11	7	10	3	7
C2. Complacency	10	9	10	1	12	8,4
C3. Lack of Knowledge	12	2	11	12	2	7,8
C4. Distraction	9	4	6	9	10	7,6
C5. Lack of Teamwork	3	10	4	2	6	5
C6. Fatigue	8	5	5	5	1	4,8
C7. Lack of Resources	2	12	9	4	4	6,2
C8. Pressure	7	8	12	3	9	7,8
C9. Stress	6	3	3	8	8	5,6
C10. Lack of Assertiveness	5	1	2	6	5	3,8
C11. Lack of Awareness	11	7	8	11	11	9,6
C12. Norms	1	6	1	7	7	4,4

Table 4. Pairwise comparisons of the criteria (AMT)

PAIRWISE COMPARISONS OF THE CRITERIA (AMT)		
C9. Stress	0,70	C1. Lack of Communication
C1. Lack of Communication	0,05	C6. Fatigue
C6. Fatigue	0,80	C2. Complacency
C2. Complacency	0,30	C3. Lack of Knowledge
C3. Lack of Knowledge	0,10	C8. Pressure
C8. Pressure	0,50	C4. Distraction
C4. Distraction	0,80	C5. Lack of Teamwork
C5. Lack of Teamwork	0,30	C7. Lack of Resources
C7. Lack of Resources	0,60	C12. Norms
C12. Norms	0,10	C11. Lack of Awareness
C11. Lack of Awareness	0,60	C10. Lack of Assertiveness

Table 5. Pairwise comparisons of the criteria (Manager)

PAIRWISE COMPARISONS OF THE CRITERIA (MANAGER)		
C11. Lack of Awareness	0,8	C2. Complacency
C2. Complacency	0,4	C8. Pressure
C8. Pressure	0,6	C3. Lack of Knowledge
C3. Lack of Knowledge	0,8	C4. Distraction
C4. Distraction	0,8	C1. Lack of Communication
C1. Lack of Communication	0,8	C7. Lack of Resources
C7. Lack of Resource	0,2	C9. Stress
C9. Stress	0,8	C5. Lack of Teamworks
C5. Lack of Teamwork	0,1	C6. Fatigue
C6. Fatigue	0,9	C12. Norms
C12. Norms	0,5	C10. Lack of Assertiveness

Importance weights of the criteria evaluated by the decision makers were calculated by formulating the equations in Step 4, 5 and 6 in the Microsoft Excel program, which are displayed in Table 6 and Table 7.

The criteria's weights of importance and comparisons are presented in Table 8 and Fig. 3 relatively.

3. Results and Discussion

The importance levels of 12 factors introduced by Dupont as the causes of accidents, incidents and unsafe situations in aviation were determined by using SWARA method based on the evaluations by aircraft maintenance managers and aircraft maintenance technicians working in an aircraft maintenance facility located in Eskişehir. All data was collected between July

2024 and August 2024, and the method was applied by the author and according to the findings regarding the criteria's weight ratio, the final ranking for the aircraft maintenance managers was C11>C2>C8>C3>C4>C1>C7>C9>C5>C6>C12>C10 while this rank was determined as C9>C1>C6>C2>C3>C8>C4>C5>C7>C12>C11>C10 for the aircraft maintenance technicians. Accordingly, the maintenance managers reported lack of awareness (C11) as the most important factor that causes / might cause errors, accidents or incidents while the maintenance technicians opine that stress (C9) is the most important criteria.

Table 6. The importance weights of the criteria for manager

MANAGER DECISION MAKER					
DIRTY DOZEN CRITERIA	**RANK**	**sj**	**kj**	**qj**	**wj**
C11. Lack of Awareness	1		1	1	0,389
C2. Complacency	2	0,8	1,8	0,56	0,218
C8. Pressure	3	0,4	1,4	0,40	0,156
C3. Lack of Knowledge	4	0,6	1,6	0,25	0,097
C4. Distraction	5	0,8	1,8	0,14	0,054
C1. Lack of Communication	6	0,8	1,8	0,08	0,031
C7. Lack of Resource	7	0,8	1,8	0,04	0,016
C9. Stress	8	0,2	1,2	0,04	0,016
C5. Lack of Teamwork	9	0,8	1,8	0,02	0,008
C6. Fatigue	10	0,1	1,1	0,02	0,008
C12. Norms	11	0,9	1,9	0,01	0,004
C10. Lack of Assertiveness	12	0,5	1,5	0,01	0,004
TOTAL				2,57	1,00

Table 7. The importance weights of the criteria for AMT

AMT DECISION MAKER					
DIRTY DOZEN CRITERIA	**RANK**	**sj**	**kj**	**qj**	**wj**
C9. Stress	1		1	1	0,303
C1. Lack of Communication	2	0,70	1,7	0,59	0,178
C6. Fatigue	3	0,05	1,05	0,56	0,170
C2. Complacency	4	0,80	1,8	0,31	0,094
C3. Lack of Knowledge	5	0,30	1,3	0,24	0,073
C8. Pressure	6	0,10	1,1	0,22	0,066
C4. Distraction	7	0,50	1,5	0,15	0,044
C5. Lack of Teamwork	8	0,80	1,8	0,08	0,024
C7. Lack of Resources	9	0,30	1,3	0,06	0,019
C12. Norms	10	0,60	1,6	0,04	0,012
C11. Lack of Awareness	11	0,10	1,1	0,04	0,011
C10. Lack of Assertiveness	12	0,60	1,6	0,02	0,007
TOTAL				3,30	1,00

Similarly, maintenance managers believe that maintenance technicians' lack of situational awareness and complacency are responsible for the occurrence of unwanted incidents while maintenance technicians find maintenance managers or the institution responsible for the unwanted incidents highlighting the negative effects of external factors such as stress, lack of communication and fatigue.

Beehr and Newman (1978) defined stress as "a situation when one is forced to deviate from the normal procedures due to the changes in his/her psychological and physiological conditions". Likewise, Iqbal and Waseem (2012), in their study conducted with air traffic controllers, reported that stress is an important factor for air traffic controllers as well. These studies clearly prove the effect of stress on aviation employees and aviation safety, which is consistent with the findings of the current study.

The findings of the study by Bassett (2020), which show that stress, lack of knowledge and pressure are the most important factors in the Dirty Dozen, also support the findings of the present study. In addition, Yazgan, and Kavsaoğlu (2017) found that the most important factor affecting aircraft maintenance technicians' performance is stress.

It is clear that unwanted situations in aviation might occur due to various reasons that vary from situation to situation. The our present study shows that the factors affecting aviation safety are not approached in the same way by aviation managers and technicians or they do not speak in similar terms regarding the aviation safety issue.

Table 8. Comparison of the criteria

DIRTY DOZEN CRITERIA	**MANAGER**	**AMT**
C1. Lack of Communication	0,031	0,178
C2. Complacency	0,218	0,094
C3. Lack of Knowledge	0,097	0,073
C4. Distraction	0,054	0,044
C5. Lack of Teamwork	0,008	0,024
C6. Fatigue	0,008	0,170
C7. Lack of Resources	0,016	0,019
C8. Pressure	0,156	0,066
C9. Stress	0,016	0,303
C10. Lack of Assertiveness	0,004	0,007
C11. Lack of Awareness	0,389	0,011
C12. Norms	0,004	0,012

4. Conclusions

This study aimed to identify the differences in perspectives between aircraft maintenance managers and technicians and contribute to aviation safety through a proactive approach. Considering that management has a significant effect on safety culture, we can conclude that presence of a strong bond between managers and maintenance technicians and adopting a common perspective towards safety are essential for the realization of safer maintenance practices. In this respect, identifying which criteria might lead to human error in aviation safety will enable maintenance managers and technicians to take necessary steps to minimize unwanted incidents. In other words, the more effectively managers can foresee precursors to accidents and incidents, the easier it will be for them to ensure and manage safety procedures, which will allow them to optimize their profits to aviation institutions including staff performance in particular.

One limitation of this study is the relatively small number of participants involved in the expert evaluation process. Since the SWARA method relies heavily on expert judgment, the findings reflect the perspectives of a limited group of maintenance professionals rather than the entire aviation maintenance

community. Therefore, the results should be interpreted with caution, and future research could expand the sample size or incorporate a wider range of stakeholders to enhance the generalizability and robustness of the findings.

In conclusion, those who do not share the same perspectives cannot understand each other. Likewise, people will not see the same view if they do not look at from the same perspective. It is true that such differences in their perspectives will affect their opinions, and their opinions will affect their behaviors, which might in turn negatively affect aviation safety.

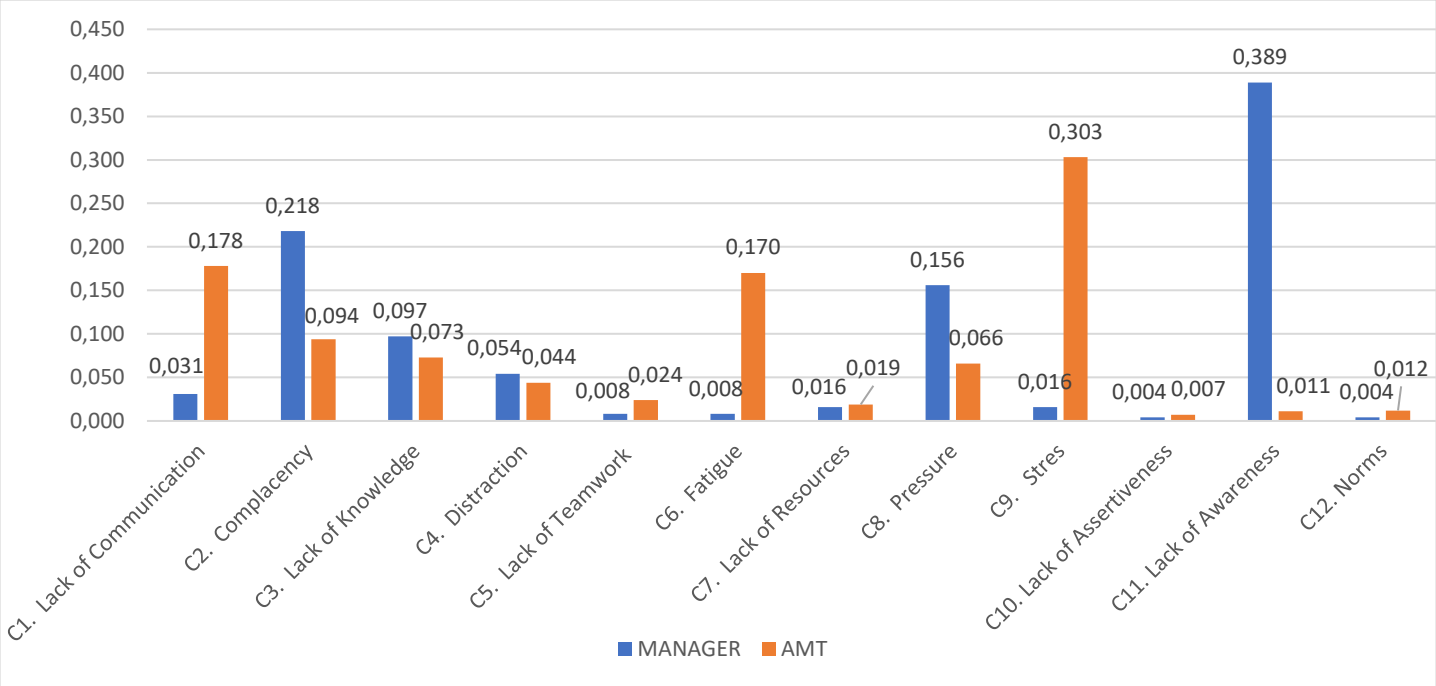


Fig. 3. Importance weights of criteria

Suggestions:

• Presence of a safety manager without a hierarchical status and being able to maintain equal distance to all employees in aircraft maintenance organizations with a strict hierarchical structure

• Organizing training programs involving the adoption of an approach focusing on leadership, safety management and human factor in aviation with the participation of all stakeholders to promote effective communication

• Increasing the number of practical trainings in addition to theoretical ones

• Providing simulation-aided learning environment opportunities for aircraft maintenance technicians

• Maintaining regular updates for these trainings to ensure compliance to safety standards

• Launching reward and incentive systems facilitating the prevention of safety violations and encouraging employees to report voluntarily and take part in safety processes

• Enhancing the support provided by the administration through practices fostering a positive safety culture

• It is believed that the aforementioned suggestions will improve positive safety culture by affecting stakeholders' point of views towards each other in a positive way. Moreover, implementing these suggestions will ultimately contribute to aviation safety by increasing the efficiency of operational processes in the aviation sector, fostering public trust in aviation and enabling aviation authorities to achieve greater compliance to international standards.

CRediT Author Statement

Ebru Yazgan: Conceptualization, Methodology, Formal Analysis, Investigation, Data Curation, Supervision, Validation, Writing - Review & Editing, Project Administration, Funding Acquisition **Cüneyt Ceyran:** Resources, Investigation, Writing - Original Draft, Visualization. **Vildan Durmaz:** Methodology, Formal Analysis, Investigation, Data Curation, Writing - Original Draft, Visualization.

Nomenclature

C : Criteria

P : Person

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