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REGULAR PAPER

The effects of crew resource management on flight safety culture: corporate crew resource management (CRM 7.0)

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Abstract

The main purpose of crew resource management (CRM) is to ensure safe flights by preventing possible errors with the effective use of non-technical skills. The aim of the current study is to examine the effects of CRM on flight safety culture (FSC) with the help of the structural equation model with 451 airline pilots. As a result of the analysis, it was determined that there was a significant correlation between CRM and FSC and that CRM has a significant positive effect on FSC. It has been demonstrated that if CRM awareness and skills are used effectively, the perception of FSC will also improve. Furthermore, these findings indicate that there is a need to progress to the corporate CRM phase, i.e., CRM 7.0, to ensure that organisation-wide FSC awareness is established through CRM awareness.

Nomenclature

AQP	Advanced Qualification Program
ATPL	Air Transport Pilot License
CAA	Civil Aviation Authority
CASS	continuing analysis and surveillance system
CC	communication and coordination
C-CRM	corporate crew resource management
CFA	confirmatory factor analysis
CMAQ	Cockpit Management Attitude Questionnaire
CPL	Commercial Pilot License
CR	command responsibility
CRM	crew resource management
CRM	company resource management
EE	employee empowerment
EFA	exploratory factor analysis
FAA	Federal Aviation Administration
FMAQ	Flight Management Attitude Questionnaire
FSC	fight safety culture
JAA	Joint Aviation Authorities
KMO	Kaiser-Meyer-Olkin
MI	management involvement
MS	my stress
OC	organisational commitment
PF	pilot flying
PM	pilot monitoring
PNF	pilot not flying

RO	rules and order
RS	reporting system
RW	reward system
SCISMS	Safety Culture Indicator Scale Measurement System
SEM	structural equation modelling
SO	stress of others
TEM	threat and error management
USA	United States of America

1.0 Introduction

The starting point of research on the concept of crew resource management (CRM), which has been used since 1979, can be said to be the Tenerife disaster in 1977 as a European, and the Portland Oregon crash in 1978 as a North American [1]. The development of CRM programs in commercial aviation was studied by Paries and Amalberti [2] and Helmreich et al. [3] in different stages. In the first-generation CRM (1.0), general subjects such as individual attitudes, leadership and communication were emphasised in the psychological field, and there was more of a focus on psychological tests. Although these first CRM programs were generally accepted, some pilots reacted negatively by claiming that their personalities were manipulated. The second generation (2.0) focused on group dynamics and team mentality and was more accepted by the attendees. Basic training was held in the form of seminars covering topics such as teamwork, team building, briefing strategies, situational awareness, situational judgement, and stress management. In the third generation (3.0), new perspectives started to emerge by paying attention to the functions of each crew member within the system. In this phase, CRM was integrated with technical and cognitive skills, attitudes and behaviours were emphasised for the recognition and evaluation of issues related to the human factor. Ongoing training for flight crews began to be given to cabin crew, dispatchers, and aircraft maintenance crews, and thus the application area was expanded. The fourth generation (4.0), started with the Advanced Qualification Program (AQP) initiated by the FAA in 1990. CRM training and applications appropriate to its needs were improved by conducting training-needs analysis. At the same time, standards have been established and certified by linking the training and its contents to certain rules and practices [3]. Furthermore, Paries and Amalberti planted the seed for the term company resource management by stating that CRM extends beyond individual safety and that it includes organisational safety [4].

The fifth generation (5.0) began with the recognition that human error is inevitable and ubiquitous. With the error management approach, reporting systems have begun to be developed for collecting and measuring data about errors to find their causes in the system. A three-stage error management model (error management troika) has been developed for the purpose of avoiding errors, detecting them before they cause a problem at the initial stage, and reducing the effects of undetectable and occurring errors [3, 5]. The sixth generation (6.0), alternatively known as threat and error management (TEM), focuses on error, but the perspective is broadened to also focus on managing safety threats by flight crews not only within the cockpit, but also threats arising from the working environment. Thus, CRM skills have expanded from error management to threat management [6, 7]. Threat and error management, which is well accepted by pilots, managers, and regulators, has also started to be accepted in other parts of aviation organisations that affect flight activities. During this period the effective use of automation was emphasised, which made a significant contribution in reducing the workload and started to take an important place in aircraft incidents and accidents [8].

As it can be seen, CRM, which first started with pilots and then flight attendants, has become widespread in units that have a direct impact on the flight activities. Subsequently, it has been observed that flight safety is not the responsibility of a particular person or unit, but of all departments and employees of an organisation as a whole, and CRM is an important tool in fulfilling this responsibility [9]. CRM has begun to be seen as the entirety of activities conducted to develop and strengthen the understanding of organisational safety, which reduces the risk of financial damage and losses in the company.

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With the seventh generation (7.0), whose seeds are newly sprouting today, the domain and application of CRM has been further expanded and developed beyond original recognition. It can be said that the first step toward establishing the seventh generation was taken at Southwest Airlines with the idea of the management to include all personnel of the organisation to CRM training programs; thus, management resource management was born [7, 10]. It is possible to define the programs where other departments separate from flight crew get involved in the same training as "management resource management" or "company resource management" [7, 11, 12] and holistically as corporate crew resource management (C-CRM).

Flight safety is the totality of efforts to prevent errors that may cause aircraft accidents, and which may arise because of the faulty practices of both people and the organisation. Flight safety culture is the visible face of values and behaviours shared by all employees beginning with pilots of an aviation organisation. This study has been carried out with the idea that CRM has an impact on the creation of a flight safety culture, which is an indicator of how prepared the employees of an organisation are against hazards and risks. It is considered that CRM practices will have important contributions in establishing a positive flight safety culture where organisations can achieve competitive advantage, benefit more from the competencies of their employees, and create a synergistic effect among employees. At the point reached today, with the seventh-generation CRM stage, it is thought that the importance of CRM should be focused on the establishment of a positive safety culture in an organisation [13].

2.0 Theoretical background

2.1. Crew resource management

CRM is an error prevention system developed in the field of aviation in the late 1970s to increase the managerial skills and efficiency of flight crews and to reduce human-induced errors. It is a tool that includes a variety of knowledge, skills, attitudes, and behaviours such as situational awareness, communication, decision-making, and cooperation for the effective use of resources, enabling collective and critical thinking, collective decision-making, and joint action [14–17]. CRM has been made mandatory in all airlines to increase flight safety with the regulations of the Federal Aviation Administration [18] in the USA and the Joint Aviation Authorities [19] in Europe and is an operational management system that practices effective communication, problem solving, coordination, and cooperation skills for the management and utilisation of all available people, equipment, information, procedures, and human performance at maximum efficiency. With the use of CRM, the basic point of which is to create a learning culture which will prohibit the negative effects of personal mistakes, it is aimed to provide pilots with the cognitive, coordination, and cooperation skills required for safe flights and efficient management of resources [20–25].

The main study on the evaluation of CRM is the Cockpit Management Attitude Questionnaire (CMAQ), which consists of three dimensions; command responsibility, recognition of stressor effects, and communication and coordination [26–28]. Subsequently, the Flight Management Attitude Questionnaire (FMAQ) was created by integrating the cultural dimensions of Hofstede [29] into the CMAQ questionnaire [7]. The FMAQ survey assesses CRM in five dimensions; command responsibility, my stress, stress of others, rules and order, and communication [30, 31]. In this study, these five dimensions of the FMAQ questionnaire were used as CRM dimensions.

Command responsibility relates to the attitudes and behaviours exhibited by the captain pilot towards the safe performance of a flight mission [32]. This responsibility is given to the captain pilot within the framework of aviation laws and is a non-transferable responsibility [33]. The captain themself always bears full responsibility of the aircraft, whether they directly have the controls of the aircraft or give the controls to the first officer. The attitudes and behaviours shown while fulfilling this responsibility directly affect both flight performance and flight safety [34]. From the day of the first flight until the establishment of the CRM concept, there was a strict hierarchical structure in the cockpit of the aircraft, where captains declared their rule. With new assignments which have been created over time, such as

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pilot flying (PF), pilot not flying (PNF) or with its new definition, pilot monitoring (PM), the hierarchy in the cockpit has decreased and the captain pilot has begun to transfer the aircraft's controls to the co-pilot when they deem appropriate. Although the responsibility cannot be delegated, within the scope of new regulations it has been underlined that the co-pilots are also responsible for the safety of the flight mission with an active participation with these new task shares, created to make the task more effective and safe [7]. Command responsibility begins with the information and assignments required for the mission in pre-flight briefings and continues until the de-briefing at the end of the flight. In this process, the command style, leadership structure, and CRM attitudes and behaviours of the captain become an important determinant in the efficient and safe performance of the flight duty [35, 36].

Stress, which is one of the most important factors affecting pilots' performance, is a factor that can create major problems when not recognised and not controlled. Psychological stress including elements such as emotional factors and mental workload; physical stress including elements such as fatigue and irregular diet, and physiological stress including elements such as temperature, noise, and humidity are all stress factors that negatively affect pilots' ability to use their potential skills [37]. Unlike common sources of stress, in the pilot profession there are psychosocial stresses such as work stress, illness, family ties, flight duty times, rest periods, and environmental stresses such as altitude, speed, temperature, aircraft design, and weather conditions [38]. This dimension, which is related to the perception, definition and management of these stressful factors using CRM skills, determines the level of awareness of pilots regarding stress and fatigue [34].

The dimension of awareness of the stress of others is related to the ability of crew members to be aware of each other's stress and fatigue and to compensate for their diminished capacity in case of an emergency. It is not possible for pilots to perform a flight mission alone. It is important to be aware of the stresses of all crew members affecting the task so that the task can be carried out safely. For this reason, the entire flight crew should be aware of the stress and fatigue levels of both themselves and other crew members [32]. The effectiveness of a crew is related to the ability to combine the personal skills of its members and to achieve the assigned tasks with a crew understanding in line with the goals determined by the organisation. For this reason, each crew member should know the characteristics of the assigned task and the competencies and weaknesses of their crewmates, fulfil their responsibilities, monitor the activities of their crewmates, resolve conflicts, and share responsibilities [39, 40]. Crew members need to be compatible with each other in order to adapt to changing situations and conditions. For this, each crew member must be aware of the roles and responsibilities of the others as well as their stress [41]. In order to increase stress awareness within the crew, it is necessary to create an environment that encourages crew members to act appropriately and responsibly; all crew members must respect and trust each other, be sensitive to each other and the needs of the crew, and crew members must be willing to cooperate with each other and work together in all activities [42].

Hofstede [43] explained the dimension of avoiding uncertainty as how employees feel themselves to be when under threat in unfamiliar situations. This feeling, which creates tension in the individual, creates the need to know what will happen ahead of time or to have written and unwritten rules to deal with uncertainty [44]. Defined by Hofstede [43] as "uncertainty avoidance", this dimension was named by Helmreich [5] and Merritt [31] as *rules and order* within the scope of CRM dimensions [45]. Studies show that more than 70% of aircraft accidents and incidents in the civil aviation sector are caused by errors made on the part of the flight crew. These errors mostly occur in the form of application errors such as not conducting briefings and checklists, and communication errors such as incorrect transmission of information and misinterpretation within the crew [46, 47]. The rules set for the safe and effective execution of a flight mission are mostly developed as a result of the experiences gained from previous accidents and incidents. In this context, the responsibility of the captain is to ensure that flight activities are carried out safely by complying with the rules and instructions [48, 49].

Communication is a form of action and interaction that ensures coordination and is also a production and exchange. It is the process of using words and other symbols to achieve various goals. Thanks to communication, information can flow from one place to another to create different behaviours and results. Thus, people have the opportunity to share common values through communication. Communication

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and coordination in aviation relates to how successful crew members are in working together, communicating, and coordinating work. It is an important responsibility of the captain to ensure that communication and coordination take place effectively so that the crew understands their roles and responsibilities and what is expected of them [32, 50–52]. The captain is the person who communicates with everyone about the flight mission and coordinates the crew members to make decisions about managing resources effectively and efficiently. While providing communication and coordination, the captain can switch between authoritarian and democratic leadership styles in the face of changing situations [53, 54].

2.2. Flight safety culture

Organisational culture, which is the reflection of the basic values, beliefs and assumptions shared by the employees, consists of sub-cultures such as safety culture, technical culture, business culture, work group culture, and shift culture [55, 56]. Turner [57] expresses safety culture norms, beliefs, roles, attitudes and practices related to reducing the possibility of encountering hazards [57–60]. According to another definition, safety culture is about the attitudes, behaviours, common values, ways of working, and willingness to learn from mistakes of an organisation's management and its employees [61]. Safety culture, which is essentially expressed as the safety attitudes of the employees of the organisation, and more broadly described as a whole of commonly accepted attitudes, values, beliefs, and symbols [62], is the behavioural style acknowledged as the common value of learning, information, reporting, being flexible, adaptable, and fair to ensure and improve operational safety [63, 64]. It is the collection of beliefs, norms, attitudes, roles, and social and technical practices within the organisation that reduce the possibility of individuals being exposed to situations that are considered hazardous [65, 66]. Safety culture is not limited to managers and control systems, it is the expression of the values shared by all employees of the organisation and the visible side of the employees' behaviour at work. It requires the participation of everyone in an organisation, taking lessons from mistakes, incidents, and accidents, and being open to development [67].

Just like organisational culture, safety culture includes different subcultures according to the environment and the activities of the organisation. FSC, which is a subculture of safety culture, consists of shared feelings, norms, interactions, expectations, assumptions, beliefs, attitudes, and values for safe flight activities. FSC is a way of recognising hazards and effectively managing acceptable risks and resources so that flight missions can be carried out safely by creating an environment free of errors [63, 68].

FSC refers to the measure of how well each individual and group in an aviation company is prepared for hazards and risks, especially in the activities of pilots. This state of preparedness can be summarised as a set of permanent values and attitudes that consist of maintaining and developing safety attitudes and behaviours, the ability to adapt to the situation, the willingness to communicate when a situation related to safety is encountered, and the constant evaluation of safety-related behaviour. Beliefs about the importance of safety form the core of FSC. These beliefs are related to what people in all positions think about the priority of safety, including those working together, managers, and leaders, and are indicated by accepted norms and behaviours [65].

Airline companies with a positive FSC have a communication built on mutual trust, common perceptions on the importance of safety, and beliefs in the effectiveness of preventive measures. The established standards, rules and practices are seen as part of achieving the safety target by all employees who affect flight activity. At the same time, there is a commitment and leadership approach to safety culture at all levels, from the most junior employees to top level management [59, 63, 69, 70].

Wiegmann et al. [71] established the following five dimensions related to safety culture by examining studies conducted on safety culture and safety climate between 1974-2001: organisational commitment, management involvement, reward systems, employee empowerment, and reporting systems. Later, using these dimensions, the Commercial Aviation Safety Survey (CASS) was developed to evaluate safety culture in the commercial civil aviation industry [67, 71]. Subsequently, the CASS questionnaire was

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rearranged by the University of Illinois researchers, and the Safety Culture Indicator Scale Measurement System (SCISMS) questionnaire was developed consisting of the dimensions of organisational commitment, operational interactions, formal safety indicators, and informal safety indicators [72–74]. The present study uses the safety culture dimensions demonstrated in the CASS questionnaire, as determined by Wiegmann et al. [67, 71].

Organisational commitment is the commitment of top management to adopt the concept of safety as a fundamental value, the determination they demonstrate in implementing safety policies, and their commitment to fulfilling the necessary responsibilities in safety application. Commitment is an expression of the engagement of top management in safety rules and practices [73, 75, 76]. In organisations that are committed to safety values, even in times of economic strain, safety is not compromised by senior management and safety practices are encouraged. Similarly, the regular evaluation of the organisation's business processes and making the necessary safety-related corrections also reflect the organisation's commitment and determination towards safety [77]. Creating a positive safety culture in an organisation is possible with the will, guidance, and organisational determination of senior management. The prevalent understanding of safety in an organisation is indicative of the effective safety approach and enforcement ability of top management [78].

Management involvement is about how personally top and middle management are involved in safety-related processes within the organisation. Managers' encouragement of and active participation in training and their active follow-up of operations are seen as an indicator of the effort required to create effective communication both from the bottom up, and from the top down [77]. In order to establish a positive safety culture in an organisation, the top management's stance on safety must be strong and determined, open to opposing views, willing to accept criticism, and create an environment that encourages feedback. In return, employees are responsible for having an understanding of safety, to know the consequences of unsafe actions, and to be aware of the importance of effective communication and reporting safety data [79].

The reward system is an evaluation system that rewards safe behaviour and punishes unsafe behaviour. Reward methods such as appreciation, praise, paid leave, and monetary incentives are practices that encourage and support safe behaviours of the organisation. Likewise, deterrence and punishment practices aimed at prevention of taking unnecessary risks and unsafe behaviour are also part of the rewarding system. In establishing a positive safety culture, the organisation should have a fair reward and evaluation system that encourages correct behaviour and discourages unsafe behaviour [71, 78]. The values that make up the organisational culture are created by the attitudes and behaviours of upper management, the guidance of middle management, and evaluation systems such as the reward system [80]. It is not enough that the reward system merely exists in the organisation. All these criteria need to be fully explained to the employees and the practices documented formally in a clear and understandable manner, and these must be understood by the employees [77].

Employee empowerment is related to employees taking responsibility in the face of safety problems and their willingness to provide input in decisions regarding safety with their expert knowledge as the actual undertaker of a job [77, 78, 81]. Employee empowerment is a motivational process that sees the employee as a specialist in their job, gives the employee authority and the power to use it, and strengthens the belief of the individual about their own effectiveness [82–84]. The level of employee involvement is related to how much the employees are empowered by management, and how much they are made aware of and empowered against safety problems. As employee involvement increases, the decision-making process in the organisation becomes decentralised, thus managers give employees more autonomy and discretion [85, 86].

The reporting system allows the weak and ineffective parts of the system to be seen earlier on so measures can be taken to prevent the occurrence of accidents. To learn from the mistakes and errors made and to take measures to avoid such events again, there is a need for events and occurrences to be reported by the employees, and for the organisation to analyse these reports and turn them into practice. In this context, reporting is not only the responsibility of the employees, but the organisation should also be willing to receive information and create the environment and technical infrastructure for the

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reporting system [75, 87]. A good reporting system allows employees to report safety-related problems and encourages reporting. At the same time, it provides feedback to all employees to increase their awareness [77].

Studies revealed that culture has important effects on CRM, and that CRM trainings should be focused on culture [30, 88–92]. Moreover, CRM is an important tool and an ongoing process in establishing a flight safety culture in an aviation-related organisation. With CRM, pilots' attitudes and behaviours towards safety becoming a common value, have helped organisations gain a new perspective in understanding that CRM may be essential in the creation of safety culture. Research shows that the new awareness, attitudes, behaviours, and values created by CRM have positive effects on the formation of the safety culture of the organisation [93–95]. Based on our research, a study has not yet been performed on CRM affecting FSC, thus, the possible effects of CRM on culture presents itself as a new research topic. Therefore, the current study is aimed at addressing this issue.

3.0 Methodology

3.1. The purpose and importance of the research

Many studies have been conducted on CRM and the importance of the concept in reducing errors caused by the human factor has been emphasised. However, it has been observed that the studies on the importance of CRM in establishing a FSC, which is an important element in preventing aircraft accidents, are insufficient. This study is expected to contribute to the importance of CRM in determining the effect of FSC and in reducing organisational errors, for which there is not yet sufficient research available in the literature.

3.2. Research model and hypothesis

The model of the research is as seen in Fig. 1. According to the model, the main hypothesis of the study is that CRM has a positive effect on FSC. The sub-hypotheses are based on the notion that each of the sub-dimensions of CRM has a positive effect on each of the sub-dimensions of FSC. The hypotheses created within the framework of the research model are as follows;

H_1: Crew resource management will have a positive effect on flight safety culture.
H_{1a}: Command responsibility will have a positive effect on flight safety culture sub-dimensions.
H_{1b}: My stress will have a positive effect on flight safety culture sub-dimensions.
H_{1c}: Stress of others will have a positive effect on flight safety culture sub-dimensions.
H_{1d}: Rules and order will have a positive effect on flight safety culture sub-dimensions.
H_{1e}: Communication and coordination will have a positive effect on flight safety culture sub-dimensions.

3.3. Procedures, sampling and limitations

The population of the current study consisted of pilots who are members of the Foundation of Turkey Airline Pilots. The Foundation of Turkey Airline Pilots, which has 3,880 members, is a social assistance and solidarity institution established by pilots holding an Air Transport Pilot license (ATPL) or Commercial Pilot license (CPL). The current study, which has an empirical research design, a field survey model and a survey technique, a data collection method in which the opinions of the subjects are taken in written form, were used to obtain the data. Four hundren and fifty-one pilots participated in the survey, which was sent to the Foundation of Turkey Airline Pilots members with an informative email.

An apriori power analysis was conducted to determine the ability of the pilots who agreed to participate in the survey to produce robust results. In studies by Cohen [96], it was stated that the statistical

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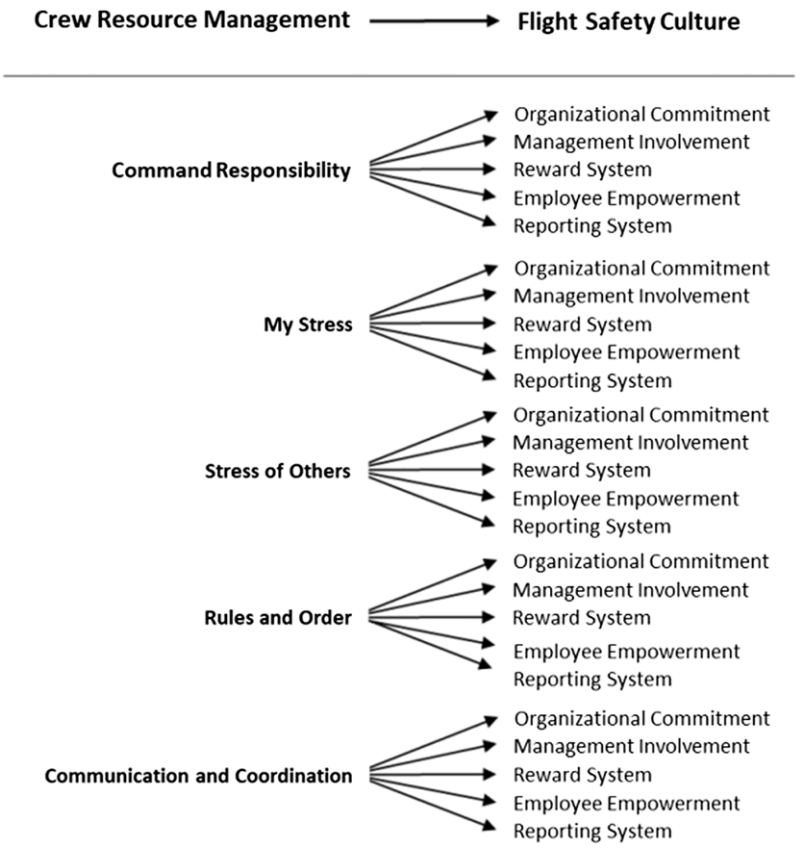

Figure 1. *Research model.*

power of 1-β=0.80 is sufficient [96]. In this study, as a result of the power analysis performed by taking the effect level of 1-β = 0.90 and statistical significance α=0.05, it was determined that the study would be valid if at least 191 samples were used for both relationship analysis and testing group differences. Therefore, in this study, it was revealed that the analyses to be made for the 451 pilots who participated in the survey would be reliable.

Ninety-seven percent (435) of the participants are male, 85% (382) are married, 77% (349) have children, 72% (325) have a bachelor's degree, and 69% (309) are between the ages of 35 and 49. Fifty-four percent (244) of the sample have twenty years or more aviation experience, 36% (163) have more than 10,000 hours of flight experience, 78% (353) have less than ten years seniority in the company they work for. Forty-six percent (208) of the sample group fly Airbus-type aircraft, and 46% (208) Boeing type aircraft, 61% (275) of them work as captain pilots, 81% (366) as line pilots, and 16% (71) of them have managerial experience. Sixty-three percent (282) of the participants started flying in the military, 37% (169) in civilian institutions, 91% (414) of them work in passenger transport companies, and 64% (291) have flown the same aircraft type for less than five years.

It is assumed that the pilots who answered the survey questions reflected their true feelings and thoughts, answered the survey willingly, answered the survey correctly and completely, and understood what was being asked in a real sense. Due to the collection of the data discussed in the study from a single source, common method bias and misconceptions that may occur were ignored. In addition, since the survey was conducted between certain dates, the information of those who responded in that period is included here.

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3.4. Statistical analysis

The questionnaire used in the study was prepared by making use of the scales whose validity and reliability were approved in previous studies as a result of a wide literature review. CRM was measured with a total of 34 statements: nine for command responsibility, 6 for my stress, 5 for stress of others, 5 for rules and order, and 9 for communication and coordination. While creating the scale, the FMAQ questionnaire (Cronbach's α= .79) which had positive results in terms of reliability and validity was used [26, 28, 30, 97]. FSC was measured with a total of 46 statements: 10 for organizational commitment, 10 for management involvement, 6 for reward system, 10 for employee empowerment, and 10 for reporting system. While creating the scale, the CASS questionnaire (Subscales' Cronbach's α= .94, .90, .71, .81, .86), which had positive results in terms of reliability and validity was used [71]. In the evaluation of the statements related to the questionnaire, a 5-point Likert-type scale was used with 1 = "Strongly Disagree", 2 = "Disagree Slightly", 3 = "Neutral", 4 = "Agree Slightly", 5 = "Agree Strongly".

4.0 Findings and results

Cronbach Alpha, split, parallel and strict tests were applied as reliability tests for the data obtained from the survey study. A Cronbach Alpha value above 70% indicates that the survey was successful. The results of the reliability analysis of the survey conducted in this study were determined as Cronbach-Alpha = 0.916, Parallel = 0.917, Split = 0.912-0.919, and Strict = 0.906.

4.1. Exploratory factor analysis (EFA)

In order to reveal the factor structure, the varimax rotation method and principal component analysis method was applied as the factor retention method. Then, all the factors of the proposed model were subjected to factor analysis with their eigenvalues higher than 1, and five factors were obtained for the sub-dimensions of crew resource management, as seen in Table 1, and five factors for the sub-dimensions of FSC, as seen in Table 2.

The sample adequacy of the Kaiser-Meyer-Olkin (KMO) CRM scale was obtained as 0.928, above the significant level value of 0.70. The result of the Bartlett test of sphericity, which was conducted to measure the consistency of the variables to be analysed, was statistically significant ($\chi 2$= 7428.55 and p= 0.000) for the scale of perceived organisational support. According to the results of the anti-image correlation matrix, the cross-correlation coefficients of the statements were between 0.59-0.89 for the perceived organisational support scale, above the critical level of 0.5. There are no questions below 0.20 in the extraction column for the scale, therefore the question was not removed.

The sample adequacy of the Kaiser-Meyer-Olkin (KMO) FSC scale was obtained as 0.931, above the significant level value of 0.70. The result of the Bartlett test of sphericity, which was conducted to measure the consistency of the variables under analysis, was statistically significant ($\chi 2$= 6812.48 and p= 0.000) for the scale of perceived organisational support. According to the results of the anti-image correlation matrix, the cross-correlation coefficients of the statements were between 0.61-0.90 for the perceived organisational support scale, above the critical level of 0.5. There are no questions below 0.20 in the extraction column for the scale, therefore the question was not removed.

4.2. Confirmatory factor analysis (CFA)

With the exploratory factor analysis, the factors that make up the CRM and FSC – the latent variables – were revealed. However, as a result of the compatibility of these factors and their relations with each other, EFA is insufficient in determining the general explanation levels. For this reason, CFA was applied to analyse the validity of the factor structure obtained and the validity and reliability of the dimensions in the structure, as seen in Table 3. Within the scope of CFA, first of all 10 factors obtained as a result of EFA were defined as latent variables, the expressions forming the factors were defined

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Table 1. *Exploratory factor analysis (EFA) of crew resource management*

Crew resource management items		Factor loadings				
		Command Responsibility	My stress	Stress of others	Rules & Order	Communication and Coordination
CR1	The captain should take physical control and fly the aircraft in emergency and non-standard situations	0.686				
CR2	Crew members should not question the actions of the captain except when they threaten the safety of the flight	0.614				
CR3	Except for total incapacitation of the captain, the first officer should never assume command of the aircraft	0.596				
CR4	Successful flight deck management is primarily a function of the captain's flying proficiency	0.674				
CR6	Captains who encourage suggestions from crew members are weak leaders	0.649				
MS10	I am less effective when stressed or fatigued		0.672			
MS11	Personal problems can adversely affect my performance		0.692			
MS12	I am more likely to make judgment errors in an emergency		0.621			
SO16	I let other crew members know when my workload is becoming (or about to become) excessive			0.592		
SO18	Crew members should monitor each other for signs of stress or fatigue			0.684		
SO20	Effective crew coordination requires crew members to consider the personal work styles of other crew members			0.796		
RO22	The airline's rules should not be broken – even when the employee thinks it is in the airline's best interests				0.732	
RO24	An essential captain duty is training first officers				0.609	
RO25	A true professional does not make mistakes				0.782	
CC26	It is better to agree with other crew members than to voice a different opinion					0.456
CC27	If I perceive a problem with the flight, I will speak up, regardless of who might be affected					0.652

Table 1. *Continued.*

Crew resource management items		Factor loadings				
		Command Responsibility	My stress	Stress of others	Rules & Order	Communication and Coordination
CC28	A debriefing and critique of procedures and decisions after each flight is an important part of developing and maintaining effective crew coordination					0.596
CC29	The pre-flight briefing is important for safety and for effective crew management					0.661
CC30	The pilot flying the aircraft should verbalise plans for procedures or manoeuvres and should be sure that the information is understood and acknowledged by the other crew members					0.609

CR: command responsibility; MS: my stress; SO: stress of others; RO: rules and order; CC: communication and coordination.

Table 2. *Exploratory factor analysis (EFA) of flight safety culture*

Flight safety culture items		Factor loadings				
		Organisational Commitment	Management Involvement	Reward System	Employee Empowerment	Reporting System
OC1	Management doesn't show much concern for safety until there is an accident or incident*	0.554				
OC3	Following safety procedures is consistently expected	0.692				
OC4	Safety works until we are busy*	0.526				
OC5	Management tries to get around safety requirements whenever they get a chance*	0.661				
OC8	My airline does all it can to prevent accidents or incidents	0.702				
OC10	When it comes down to it, people in this airline would rather take a chance with safety than cancel a flight*	0.684				
MI11	Management involvement in safety issues has a high priority at my airline		0.693			
MI 15	Management is receptive to learning about safety concerns		0.613			
MI 17	Management stops unsafe operations or activities		0.796			
MI 18	Management does not hesitate to approach pilots to discuss safety issues		0.642			
MI 20	There are good communication here about safety		0.501			
RW22	Airline management negatively evaluates pilots who behave recklessly			0.766		
RW 25	Our reward system promotes high performance even if it means acting unsafely*			0.593		
RW 26	Action is consistently taken against pilots who violate safety procedures or rules			0.791		
EE27	Pilots are seldom asked for input when airline procedures are developed or changed*				0.306	
EE 31	Pilots look at the airline's safety record as their own and take pride in it				0.774	

Table 2. *Continued.*

Flight safety culture items		Factor loadings				
		Organisational Commitment	Management Involvement	Reward System	Employee Empowerment	Reporting System
EE 34	Pilots try to get around safety requirements whenever they get a chance*				0.596	
EE 35	It is important for me to fly safely if I am to keep the respect of other pilots in my airline				0.607	
EE 36	Pilots often encourage one another to work safely				0.633	
RS37	I am familiar with the system for formally reporting safety issues in my airline					0.651
RS39	Pilots hesitate to report minor injuries and incidents*					0.508
RS42	Pilots who raise safety concerns are seen astroublemakers*					0.453
RS43	Pilots can report safety discrepancies without the fear of negative repercussions					0.667
RS45	There is no point in reporting a near miss*					0.602

*Item indicates a negative safety culture and is reverse coded for all analyses.
OC: organisational commitment; MI: management involvement; RW: reward system; EE: employee empowerment; RS: reporting system.

Table 3. *Confirmatory factor analysis goodness-of-fit indices*

Measurement model index	Fit criteria		Survey measurement model value	Survey measurement model value fit criteria
	Good	Acceptable		
X^2 /sd	≤ 3	≤ 4-5	3.56	Acceptable
NFI	≥ 0.95	0.94-0.90	0.949	Acceptable
TLI (NNFI)	≥ 0.95	0.94-0.90	0.973	Good
IFI	≥ 0.95	0.94-0.90	0.985	Good
CFI	≥ 0.97	≥ 0.95	0.966	Acceptable
RMSEA	≤ 0.05	0.06-0.08	0.039	Good
GFI	≥ 0.90	0.89-0.85	0.941	Good
AGFI	≥ 0.90	0.89-0.85	0.913	Good
RMR	≤ 0.05	0.06-0.08	0.038	Good

Table 4. *Correlation analysis results*

	Factors	1	2	3	4	5	6	7	8	9	10	11	12
1	Command responsibility	1											
2	My stress	,46**	1										
3	Stress of others	,55*	,56*	1									
4	Rules and order	,53**	,46**	,39**	1								
5	Communication and coordination	,38*	,44**	,38**	,31**	1							
6	Organisational commitment	,58**	,60**	,82**	,65**	,69**	1						
7	Management involvement	,44*	,65**	,59**	,82**	,47**	,64**	1					
8	Reward system	,72*	,55**	,62**	,71**	,54**	,45**	,44**	1				
9	Employee empowerment	,52**	,41**	,38**	,50**	,71**	,51**	,54**	,45**	1			
10	Reporting system	,40**	,58**	,59**	,69**	,54**	,55**	,62**	,45**	,54**	1		
11	Crew resource management	,70*	,72**	,65**	,69**	,68**	,79**	,64**	,58**	,50**	,57**	1	
12	Flight safety culture	,65*	,62**	,48**	,54**	,64**	,74**	,76**	,85**	,69**	,63**	,75**	1

**p<0.05 **p<0.01.

as indicator variables, and a measurement model was created with the AMOS 19.0 program in order to define the model. This measurement model in which the observed variables are gathered under 10 independent factors is the first level CFA model for the proposed model.

The modification index was examined to see if the model needed any improvement, and it was seen that there was no need for any adjustments.

4.3. Correlation analysis

In the correlation analysis applied at this stage of the current study, the relationship between CRM and FSC, and the relationships between CRM and FSC dimensions were discussed.

As seen in Table 4, according to the data obtained from the correlation analysis it has been determined that there was a significant (p<0.05) and positive correlation (0.75) between CRM and FSC. Likewise, it is seen that there was a significant and positive relationship between the dimensions of CRM and the dimensions of FSC. When the relationship between the command responsibility dimension of CRM and the FSC dimensions is examined, it is seen that the strongest positive correlation

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Table 5. *Structural equation modelling goodness-of-fit indices*

Measurement model index	Fit criteria		Survey measurement model value	Survey measurement model value fit criteria
	Good	Acceptable		
X^2 /sd	≤ 3	$\leq$ 4-5	3.09	Acceptable
NFI	≥ 0.95	0.94-0.90	0.985	Good
TLI (NNFI)	≥ 0.95	0.94-0.90	0.968	Good
IFI	≥ 0.95	0.94-0.90	0.952	Acceptable
CFI	≥ 0.97	≥ 0.95	0.968	Acceptable
RMSEA	≤ 0.05	0.06-0.08	0.035	Good
GFI	≥ 0.90	0.89-0.85	0.922	Good
AGFI	≥ 0.90	0.89-0.85	0.929	Good
RMR	≤ 0.05	0.06-0.08	0.038	Good

(0.72) was with the reward system and the weakest positive correlation (0.40) was seen in the reporting system dimension. While the my stress dimension had the highest positive correlation (0.65) with management involvement, it had the weakest positive correlation (0.41) with the employee empowerment dimension. Likewise, the stress of others dimension had a weak positive correlation (0.38) with the employee empowerment dimension, but had the strongest positive correlation (0.89) with the organisational commitment dimension. In the dimension of rules and order, the highest positive correlation (0.82) was with the management involvement dimension and the weakest positive correlation (0.50) was with the employee empowerment dimension. It is seen that the communication and coordination dimension had the highest positive correlation (0.71) with employee empowerment, and the weakest positive correlation (0.47) with management involvement.

4.4. Structural equation modelling

Before testing the main hypothesis of the research, the fit indices of the model were examined in order to reveal the compatibility of the research model with the data set at hand. When the results of the structural equation modelling (SEM) estimations fit index presented in Table 5 are examined, it is seen that the values generally have good fit and are at an acceptable level.

It is seen that there is a significant relationship between CRM and FSC, and CRM has a positive effect on FSC. For every one unit change in the score of CRM, on average, FSC score increases by 0.739 units. There are significant, positive effects of the dimensions on FSC. For every unit change in the CR score, the FSC score increases by 0.637 units. For every unit change in the MS score, the FSC score increases by 0.591 units. For every unit change in the SO score, the FSC score increases by 0.708 units. For every unit change in the RO score, the FSC score increases by 0.662 units. For every unit change in the CC score, the FSC score increases by 0.659 units. It has been determined that the SO dimension has the highest effect among CRM dimensions, while the MS dimension has the lowest effect.

It has been determined that all the sub-dimensions of CRM have a significant and positive effect on the sub-dimensions of FSC. It is seen that among the CRM dimensions; every one unit change in the CR score increases the RW score the most, by 0.692 units and RS the least, by 0.379 units. Every one unit change in the MS factor's score increases the MI score the most, by 0.626 units, while it increases the EE score the least, by 0.357 units. Every unit change in the SO factor's score increases the OC factor's score the most, by 0.819 units and the RS factor's score the least, by 0.425 units. Every one unit change in the RO factor's score increases the RS factor's score the most, by 0.863 units and the EE factor's score the least, by 0.481 units. Every one unit change in the CC factor's score increases the EE factor's score the most, by 0.702 units and the MI factor's score the least, by 0.458 units.

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Table 6. *Structural equation modelling results for main hypothesis*

Hypothesis	Structural relationship	Direction	Non-std. estimate	Std. err.	*t*-value	Std. estimate	p	Conclusion
H_1	CRM→FSC	+	0.732	0.024	36.62	0.739	0.000**	Supported
	CR → FSC	+	0.629	0.087	7.229	0.637	0.004**	Supported
	MS → FSC	+	0.562	0.056	10.03	0.591	0.001**	Supported
	SO → FSC	+	0.691	0.192	3.598	0.708	0.000**	Supported
	RO → FSC	+	0.637	0.126	5.055	0.662	0.015*	Supported
	CC → FSC	+	0.642	0.104	6.173	0.659	0.000**	Supported

**p<0.05 **p<0.01.
CRM: crew resource management; FSC: flight safety culture; CR: command responsibility; MS: my stress; SO: stress of others; RO: rules and order; CC: communication and coordination.

5.0 Discussion

In the current study, the effect of CRM on FSC was investigated for 451 pilots. In addition, it has been determined whether the sub-dimensions of CRM – command responsibility, my stress, stress of others, rules and order, communication, and coordination – have an impact on the sub-dimensions of FSC, which include organisational commitment, management involvement, reward systems, employee empowerment, and reporting systems.

In Table 6, according to the results of the SEM analysis, it was determined that every unit change in the CRM score had, on average, positively increased the FSC score by 0.739 units. This finding shows that as CRM awareness increases, attitudes, and behaviours towards flight safety become a common value and positively affect FSC.

Looking at the studies in the literature, the findings of Ford [45], O'Connor et al. [98], and Taggart and Butler [99], which reveal the positive effect of CRM on pilots' attitudes and behaviours, confirm the impact of CRM on FSC. Likewise, Homan et al. [100], Flin et al. [101], Yule et al. [102], Kyte [103], Metscher et al. [104], and Ford et al. [105] found that CRM is effective in reducing errors and increasing safety performance results, which reflect the contribution of CRM to the formation of FSC.

It is seen that awareness of stress of others is the dimension of CRM that has the most positive effect on FSC, on average, increasing its score by 0.708 units for every one unit change. This finding indicates that as CRM awareness increases, the attitudes, and behaviours affecting flight safety become a shared value which positively affects FSC. Every one unit change in the rules and order dimension score positively increasing the FSC score, on average, by 0.662 units, can be interpreted as a result of the pilots' awareness through CRM that the rules should never be violated and written procedures should be followed at all stages of the flight, even if doing otherwise is thought to be best for the company. It is possible to say that every one unit change in the communication and coordination dimension score, on average, positively increasing the FSC score by 0.659 units, is the result of the pilots' awareness of their communication and coordination skills and their practices becoming a common value. The positive effect of the command responsibility dimension, which, on average increased the FSC score by 0.637 units for every one unit change in its score, can be considered a sign that the sense of responsibility of the pilots has become widespread in the company and has become a common value. The awareness of personal stress (my stress), which was seen to, on average, positively increase the FSC score by 0.591 units for every one unit change in its score, can be seen as an indicator that the awareness of pilots that personal problems, fatigue, and stressful situations are factors that increase human error has become an organisational value.

In Table 7, it is seen that every one unit change in the command responsibility dimension score, on average, has the highest positive effect on the reward systems dimension score by 0.692 units, followed by organisational commitment by 0.572 units, then employee empowerment with 0.537 units, management involvement by 0.453 units, and with the lowest increase being on the reporting system dimension score by 0.379 units. A reward system refers to how the results of decisions made are evaluated within an

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Table 7. *Structural equation modelling results for sub-hypotheses*

Hypothesis	Structural relationship	Direction	Non-std. beta coefficient	Std. Err.	*t*-value	Std. beta coefficient	p	Conclusion
H_{1a}	CR→OC	+	0.514	0.133	3.850	0.572	0.009**	Supported
	CR→MI	+	0.439	0.114	3.847	0.453	0.016*	Supported
	CR→RW	+	0.707	0.117	6.045	0.692	0.027*	Supported
	CR→EE	+	0.491	0.081	6.137	0.537	0.000**	Supported
	CR→RS	+	0.365	0.072	5.214	0.379	0.003**	Supported
H_{1b}	MS→OC	+	0.697	0.087	8.712	0.618	0.016*	Supported
	MS→MI	+	0.618	0.103	6.001	0.626	0.002**	Supported
	MS→RW	+	0.560	0.083	7.002	0.583	0.000**	Supported
	MS→EE	+	0.339	0.012	28.25	0.357	0.000**	Supported
	MS→RS	+	0.556	0.026	27.81	0.561	0.000**	Supported
H_{1c}	SO→OC	+	0.799	0.015	79.92	0.819	0.026*	Supported
	SO→MI	+	0.638	0.163	3.914	0.728	0.001**	Supported
	SO→RW	+	0.664	0.127	5.228	0.669	0.000**	Supported
	SO→EE	+	0.472	0.106	4.452	0.582	0.000**	Supported
	SO→RS	+	0.391	0.097	4.030	0.425	0.000**	Supported
H_{1d}	RO→OC	+	0.581	0.135	4.303	0.606	0.029*	Supported
	RO→MI	+	0.784	0.081	9.679	0.783	0.031*	Supported
	RO→RW	+	0.653	0.077	8.480	0.652	0.000**	Supported
	RO→EE	+	0.493	0.011	44.81	0.481	0.000**	Supported
	RO→RS	+	0.832	0.126	6.603	0.863	0.000**	Supported
H_{1e}	CC→OC	+	0.702	0.164	4.280	0.674	0.015*	Supported
	CC→MI	+	0.442	0.094	4.911	0.458	0.021*	Supported
	CC→RW	+	0.538	0.081	6.725	0.529	0.000**	Supported
	CC→EE	+	0.691	0.107	6.457	0.702	0.026*	Supported
	CC→RS	+	0.553	0.035	17.28	0.528	0.008**	Supported

$N = 451$. $^{**}p<0.05$ $^{**}p<0.01$.
CR: command responsibility; MS: my stress; SO: stress of others; RO: rules and order; CC: communication and coordination; OC: organisational commitment; MI: management involvement; RW: reward system; EE: employee empowerment; RS: reporting system.

organisation. In this context, it is possible to say that the decisions and practices of pilots to ensure flight safety have a positive effect on the reward system of an organisation and contribute to the formation of values for the establishment of a clear balance between reward and punishment. The findings also show that pilots' awareness of safety issues and their practice of taking responsibility affect the dimensions of employee empowerment, management involvement, and organisational commitment, as well as FSC. The tendency of pilots to always obey the rules explains the effect of command responsibility on the spread of the adoption of safety consciousness by employees throughout the whole organisation. In addition, the fact that the dimension of command responsibility has the least effect on reporting systems indicates that an organisation's safety management system does not sufficiently encourage reporting, and that reporting is not expected.

Research conducted by Demirbilek [106], Akalp and Aytaç [107], Ocaktan [108], and Altınel [109] found that there is a positive correlation between management commitment and safety priority practices, Cox and Cox [110], Cox et al. [111], and Akalp and Yamankaradeniz [112] have shown that managerial attitudes and behaviours have an effect on safety culture, in parallel with the results of research by Ali et al. [113] that good management practices are effective in reducing accidents and incidents. All this can be said when taking into consideration the fact that pilots are the responsible party in control of a flight task.

Every one unit change in the personal stress (my stress) awareness dimension, on average, positively increased the management involvement dimension score by 0.626 units, the organisational commitment

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dimension score, on average, by 0.618 units, the reward systems dimension score, on average, by 0.583 units, and the reporting systems dimension score, on average, by 0.561 units, and it was seen to have, on average, positively increased the employee empowerment dimension score the least, by 0.357 units. These results are consistent with the findings of O'Connor [114], Fernández-Muñiz et al. [115], and Yang et al. [116], which show that managers' situational awareness and behaviours have a positive effect on ensuring the continuity of safety, safety performance, and safety culture.

The fact that pilots inform management by making the necessary notifications about any situations and outcomes that occur as a result of their awareness of the observation, recognition and management of stressors can be considered as an indicator of the effect of personal stress (my stress) awareness on reporting systems, employee empowerment, and reward systems.

At the same time, it is possible to say that this finding, which can be seen as an indication that the decisions made by pilots in the face of changing situations as a result of effective task analysis and appropriate situation judgement are embraced by management within the scope of fair culture, explains the effect of personal stress (my stress) awareness on organisational commitment. However, the low impact on employee empowerment can be considered an indication that unless there is an accident or event in the organisation, the opinions of the employees are not consulted, everything is thought to be fine as long as there is no problem, and that there are no voluntary studies to identify safety-related problems.

The findings of this study show that every one unit change in the dimension of awareness of the stress of others' score, on average, has the most positive effect on the organisational commitment dimension's score, by 0.819 units, then management involvement by 0.728 units, followed by reward systems by 0.669 units, and behind that employee empowerment at 0.582 units. On average, the least increase in score is the reporting systems dimension by 0.425 units. These findings are in parallel with the results of Leedom and Simon [117], Ikomi et al. [118], and Salas et al. [119], which showed that pilots who received CRM training showed significant improvements in their attitudes and behaviours towards crew coordination, exhibited more safe behaviours in situations requiring excessive workload, and displayed better performance.

The pilots' positive awareness of both their own and other crew members' stress and fatigue explains the effect of the stress of others dimension on organisational commitment and management involvement, as well as on employee empowerment. This situation also shows the impact that awareness of the stress of others dimension has on reward systems in terms of its contribution to the choice of correct attitudes and behaviours, and to the formation of a culture of obtaining information about flight safety in the organisation. However, although pilots are aware of the stress of others, they may sometimes refrain from reporting negativities that occur due to the organisation's safety management system not working well enough.

This instance, which could be viewed as a reason why the reporting system is less affected, may also indicate that the level of the organisation's safety culture is at the bureaucratic level or between the pathological and bureaucratic levels, where a solution is produced if any event occurs in the organisation, reporting is not expected and if a report is received, it is not questioned.

The fact that the effects of the organisational commitment and management involvement dimensions are higher than the others can be interpreted as an indication that pilots are ultimately responsible for the safety of flight operations as delegated by management, they are encouraged to stop the flight if necessary, and those safe behaviours are supported by management. However, due to the low impact on reporting systems, it can be concluded that management prefers to use the gaps in safety requirements for profitability by pushing the limits until a problem arises, and that they abstain from reporting unless there is a problem with their pilots.

The dimension most affected by rules and order regarding how much the pilots avoid uncertainty is the reporting systems dimension, where every one unit change in the RO score, on average, positively increased the RS score by 0.863 units. Next comes management involvement, an increase of 0.783 units, reward systems saw an increase of 0.652 units, and then the organisational commitment score increased by 0.606 units. The least affected dimension is employee empowerment, an increase of 0.481 units in its

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score. Failures and experiences that occur are mostly reported by pilots. This reporting habit explains the effect of the rules and order dimension on organisational commitment, management involvement, and reward systems. However, it is possible to say that the reports are submitted by the pilots to protect themselves in the context of just culture in case of insufficient or erroneous procedures being carried out, or due to the organisation's understanding of proactive and productive safety. The fact that the dimension of rules and order is least affected by the participation of the employees may indicate that the reports are not due to the productive structure of the organisation, but on the contrary, to pilots reporting to protect themselves within the scope of a just culture.

The present research findings are in line with the findings of Byrnes and Black [120], Uryan [121], and Kayten [122] that CRM has a positive effect on attitudes and behaviours towards reporting, increases safety awareness, and has a positive effect on safety culture. However, it is seen that the results do not overlap with the study by Gill and Shergill [123], which shows that employees do not care about safety culture and do not believe much in the safety management system of their organisations. In addition, Demirbilek and Çakır [124] indicate that the factors affecting the use of personal protective equipment the most are, respectively, the accessibility of protective equipment, the need for safety and having a work accident. In this context, it is possible to say that the reason why the rules and order dimension affects the reporting system the most is the awareness of the pilots as well as the easy accessibility and usability of the organisation's reporting system.

The dimension most affected by the communication and coordination dimension is employee empowerment, where it saw, on average, a 0.702 increase in units for every one unit change in the CC score. Next comes the dimension of organisational commitment, an increase in its score by 0.674 units. While it increased the reward systems and reporting systems dimensions' score, on average, by 0.529 and 0.528 units, respectively, the lowest increase was seen in the management involvement dimension's score, by 0.458 units. Findings appear to be consistent with the results of studies by Helmreich and Merritt [30], Sumwalt and Lemos [125], Wu et al. [126], Alsowayigh [127], and Başdemir [128], showing the positive effect that managers' safety briefings and safety experts' safety coordination and regulation have on safety culture.

The understanding of pilots to perform their flight duties with effective communication, coordination, and crew cooperation explains the effect on employee empowerment. On the other hand, the fact that the communication and coordination dimension is least affected by management involvement may indicate that the transformation of the communication and coordination awareness of pilots into action is not sufficiently supported by management and perhaps even unfavoured. It is possible to say that the awareness of pilots to be in communication and coordination with everyone who affects the mission in order to ensure flight safety constitutes a contribution to organisational commitment. At the same time, since this contributes to management's action to comply with safety commitments, it also serves as an explanation of the effect of communication and coordination on reward and reporting systems.

6.0 Conclusion

This study aims to determine how CRM affects FSC and to create a new perspective for the establishment of CRM understanding throughout an organisation, based on the results obtained. The findings demonstrate that CRM has a significant positive impact on the development of FSC. Likewise, the positive effect of the sub-dimensions of CRM on the sub-dimensions of FSC shows the importance of CRM awareness in a corporate structure.

The current study points out that the responsibility of ensuring flight safety should not be placed solely on pilots, and that everyone from the most senior manager to the subordinate staff in flight organisations is jointly responsible for ensuring flight safety and sustainability. Within this scope it is possible to say that there is a need and necessity for all employees to be introduced to CRM in order to create a FSC in flight organisations.

This study also reveals the importance of realising that personal stress and problems are factors that increase human error in carrying out and completing tasks safely. It points out the importance of being

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aware of the stress of other employees in foreseeing potential problems that may arise and preventing possible errors when making mission analyses, situation assessments, and assignments. It is emphasised that the roles and notions of pilots' command responsibility are widespread among all company employees and become a common value in increasing and maintaining safety and performance. It furthermore emphasises the necessity of effective communication and cooperation becoming a common value in order to perform tasks together safely, and highlights a necessity for awareness that rules should be adhered to written or otherwise, even if it seems that a violation would be in the company's interest at the time.

In the current studies context, this is a pioneering study on the way to the development of an understanding for the corporate crew resource management (C-CRM) (CRM 7.0) concept, for the use of CRM throughout whole organisations, starting with the pilots flying the aircraft in the cockpit and encompassing all the individuals involved in the activities conducted to carry out a flight mission.

This study was conducted on pilots only. Future studies need to be carried out to include all crew members and employees who affect the flight activity.

7.0 Impact on industry

Accumulating all training on a common platform where all employees participate will contribute to everyone's understanding of each other and the work they do. Currently, joint CRM training sessions are held with pilots and cabin crew. However, it is considered that everyone working in a flight organisation needs to receive training on CRM both individually and jointly with all units. Spreading the CRM philosophy to cover all departments of an airline company and making it a part of the organisational culture is a step that will make significant contributions to ensuring flight safety.

This research revealed a need to collect additional data at behavioural and organisational levels in future research in order to determine the contribution of CRM to performance and productivity increase and cost reduction in an organisation. In addition, CRM should be seen as a change management approach in order to eliminate the results of active and passive errors that occur in the system without causing an accident or incident and to manage existing resources more effectively. In this context, it is considered that there is a need to create a CRM department within the management and organisational structure of companies.

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