



Safety Culture in Context: Macro and Micro Level Factors Affecting its Perception and Implementation: A Qualitative Inquiry

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Abstract— *Safety culture assessment is an essential tool of organizational safety and has become mandatory in the aviation industry. A positive safety culture is a key for sustaining optimal safety performance in organizational safety. Most safety culture assessment tools are based on studies conducted in developed countries. However, safety culture assessment in developing countries, such as Arab countries is rarely examined in the aviation context. Semi-structured interviews with 14 technicians and managers in an aircraft maintenance organization based in an airport in an Arab country were conducted. These interviews discussed several topics related to occupational health and safety and safety management in aviation. The interview questions were designed based on a comprehensive examination of previous research on safety culture. The data obtained from the interview transcripts were categorized, resulting in a data structure that employed participants' quotes as primary codes and ultimately leading to the identification of three overall categories: Management commitment to safety, organizational safety practices, and role of social relationships. This study draws special attention to the influence of micro level internal factors of management commitment and organizational safety practices, and macro level external factors of the role of social relationships on the successful implementation of safety culture. Understanding the elements explored in this study offers a useful tool for distinguishing between various contextual elements and the level at which they operate. This could enable more effective management of these factors to improve the potential implementation of effective safety management.*

Index Terms— Safety Culture, Organizational Safety, Safety Management, Aircraft Maintenance, OSH.

I. INTRODUCTION

The aviation sector is intricate and involves numerous hazards, especially when it comes to safety. The repercussions of a dangerous aircraft operations can be extremely severe. In recent decades, the aviation industry has made substantial efforts to enhance its entire safety system, leading to aviation industry being widely regarded as one of the safest and most reliable modes of transportation. Nevertheless,

it is crucial to continue the efforts to uphold and enhance safety. Despite progress, there are still aspects where safety can be further improved (Cheyne et al., 1999). The notion of safety culture originated in the energy sector after the Chernobyl accident (International Atomic Energy Agency, 1986) and subsequently extended to several other industries such as manufacturing, oil drilling, and health care (Cheyne et al., 1998; Flin et al., 2006; Flin, 2007; K. J. Mearns & Flin, 1999). Following the accident of Continental Express Flight 2574 in Texas in 1991, the aviation sector developed a significant interest in safety culture.

The implementation of the safety culture concept in many industries has prompted multiple efforts to establish a precise definition of the term. In their study, Wiegmann et al., (2004) conducted a comparison of thirteen different definitions of safety culture and identified certain shared characteristics across these definitions. These shared characteristics encompass phrases such as “Safety culture is defined at the group level or higher...Safety culture emphasizes the contribution from everyone...Safety culture is relatively enduring, stable, and resistant to change”. According to their findings, they suggest that safety culture is a long-lasting and consistent perceptions that are defined at the group level. It encompasses the shared values among everyone in organization and stresses the involvement of every individual at every level of an organization.

The objective of this study is to explore the effect of macro and micro level contextual factors that influence aircraft maintenance mechanics and engineers' perceptions of safety culture in an aircraft maintenance organization operates for regional airlines in Middle East and North Africa (MENA) region.

II. PREVIOUS STUDIES

As the scientific argument continues, there is a constant debate over the most effective way to define safety culture. The aviation community has shown great interest in the concept of safety culture, leading to many studies that are focused on investigating the safety culture of different professions and different air

transport organizations. For example, Von Thaden et al. (2003) found five elements of safety culture: Management Commitment, Management Involvement, Employee Empowerment, Reward Systems, and Reporting Systems. They additionally developed an instrument to evaluate the safety culture of pilots employed by a regional airline. Gibbons et al. (2006) evaluated the safety culture in airline repair and maintenance organization of two passenger airlines. They employed factor analysis to establish and verify a safety culture analysis framework with five factors for maintenance operations.

O'Connor et al. (2011) conducted study that assessed 23 studies relating to the safety culture of various aviation personnel, including pilots, cabin crew members, aircraft maintenance mechanics and air traffic controllers in civil and Naval aviation. The study discovered that the majority of safety culture surveys showed construct validity, meaning they were able to measure what they were designed to measure. However, these surveys were unsuccessful in establishing discriminant validity, which refers to their ability to distinguish between organizations or personnel with various levels of safety performance. The authors acknowledged that the absence of discerning validity was a result of the low occurrence of accidents in the contemporary commercial aviation industry, which limits the availability of adequate data for assessing safety performance.

III. METHODS

The study used a qualitative method to investigate aircraft maintenance mechanics' perceptions regarding the airline's safety culture. To this end, we conducted 14 interviews with aircraft maintenance mechanics, engineers and managers working at a regional organization provides outsourced maintenance services to regional airlines in MENA region. The interviews were all conducted face to face and lasted between 25-60 minutes, providing a total of more than 13.5 hours of recorded data. All interviews followed the same protocol (Appendix 1). This protocol developed based on the current safety culture literature. All interviewees were approached by the main author and their demographic details are indicated in Table 1. Participants were knowledgeable about safety culture and it is related practices in aviation maintenance operations. Employing experienced interviewees increases the probability of establishing agreement on important themes with fewer interviews Guest et al., (2006). Hennink & Kaiser, (2022) state in a recent assessment that achieving code saturation often requires interviewing between 9 and 17 participants. All interviews were audio recorded and directly transcribed by the first author. These were double checked and proofread by the second author to correct punctuation or misspelled words (McMullin, 2023).

TABLE 1: PARTICIPANT'S DEMOGRAPHIC DETAILS AND EXPERIENCES.

Participant Number	Sex	Age	Experience (yrs)	Position when interviewed
I1	Male	64	23	Safety manager
I2	Male	59	32	Engineer
I3	Male	61	37	Engineer
I4	Male	59	20	Engineer
I5	Male	60	35	Engineer
I6	Male	61	35	Engineer
I7	Male	56	30	Engineer
I8	Male	58	28	Engineer
I9	Male	60	36	Engineer
I10	Male	55	28	Engineer
I11	Male	61	35	Engineer
I12	Male	53	30	Engineer
I13	Male	31	07	Engineer
I14	Male	62	39	Engineer

IV. DATA ANALYSIS

Prior to coding, the transcripts were thoroughly reviewed multiple times to have a comprehensive understanding of the data at hand. The qualitative data were analyzed thematically according to (Braun & Clarke, 2006). At first, each transcript was analyzed and categorized based on the meaning conveyed by the language used by the participants. This process resulted in the creation of primary codes. The first order codes obtained from each of the 14 interviews were subsequently synthesized. The primary codes derived from the 14 interviews, which focused on the objective of the study, were subsequently merged using axial coding to form second-order themes that were labelled using more general words. The second order themes were subsequently combined into three overarching aggregate dimensions (refer to Table 2).

The main author managed the coding and classification into themes. The second author subsequently verified the matches between the text-code and code-theme as suggested by the main author. Disagreements were cleared up by reviewing the data gathered and the generated codes.

As, to the best of authors' knowledge, this is the first study to investigate the macro and micro-level factors that influence organizational staffs' perceptions of safety culture in aviation domain. The authors did not intend to provide an assessment of the scale or frequency of the findings. Instead, the objective is to provide a qualitative and representative overview of the context to increase awareness of the safety culture in aviation workplace and encourage further investigations, possibly involving quantitative analysis.

V. RESULTS AND DISCUSSION

The results are outlined in Table 3 and classified into three key aggregate dimensions: Management's commitment to safety, organizational safety practices, and the role of social relationships. The findings presented in this section consolidate the responses from various participants, corresponding to their respondent number (Table 1), and are supported with exact quotations.

TABLE 2: CODING STRUCTURE FOR DATA ANALYSIS.

1 st Order Codes	2 nd Order Themes	Aggregate Dimension
Safety expenses A/C safety priority Schedule vs safety Money vs safety Work vs time Lack of training	Performance prioritization	Management commitment to safety
Safety briefings Teach juniors	Lack or organizational training	Organizational safety practices
Lack of safety information	Lack of safety communication	
Lack of safety talks	Teamwork	
Work in groups		
Friendship relations	Hierarchical relationships	Role of social relationships
Community impact		
Relations with managers		
Social network		
Hierarchy		
Social class		

TABLE 3: DATA STRUCTURE: FIRST-ORDER CONCEPTS ARE QUOTES FROM DIFFERENT RESPONDENTS.

1 ST Order concepts	2 nd Order Themes	Aggregate Dimensions
For managers, the flight time is more important than safety (I15). The supervisors put me under pressure (I18) The managers only think of how A/C & passengers dispatch without delay (I11)	Performance priority over safety	Management commitment to safety
Poor safety and engineering training (I17). There is no periodical program about safety training (I13). We ask them to do the job in the ramp or the hangers without safety induction or training (I18).	Lack of organizational training	Organizational safety practices
I never seen safety posters on the notice board (I7). No one talks about safety here (I4). My supervisors talk about safety (I21).	Lack of communications about safety	Role of social relationship
Our work is a teamwork, we work together and we set in the same setting room (I7). Honestly we work as one team (I4). We work as a team like a bee group (I15).	Teamwork	
Pilots want to be right and do not accept criticism and they always take over discussions (I21). It is the culture of I	Hierarchical relationships	

do not do mistakes and I am good engineer (I13). In our airline pilots only are the important and others have no value (I3)		
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A. Management commitment to safety

The main dimension of management commitment to safety reflects the interviewees’ perceptions and opinions regarding safety culture in the context of safety priority, the importance of flight schedules over personnel safety, and the implications of time pressure and turnaround times on safety culture. These main dimensions emerged based on one 2nd order theme, and this theme is coded as performance priority over safety.

A.1. Performance priority over safety.

In this theme, the informants discussed some challenges around the time pressures and the importance of flight time given by supervisors over their safety procedures. Many informants talked about how individuals compromise occupational safety during the turnaround times and the pressures put on them by their supervisors to expedite work. For example, an engineer stressed in an interview that if the A/C was delayed, a pressure would be exercised on the engineers not just from the supervisors, even from the managers. However, most of the participants referred to direct pressures from their immediate supervisors to avoid delays. As illustrated in the following quotations:

“Sometimes I do not have time to work safely, supervisors give me a task, and they tell me if the aircraft did not take off at a certain time, the airline would lose money, so the supervisors put me under pressure.” (I#3).

Many interviewees, especially the seniors, confirmed that managers and some supervisors prioritize commercial performance over occupational safety. They also assumed that performance is an important value from their manager’s point of view. That had decreased the engineers’ satisfaction with their management priorities and encouraged a negative commitment of the employees to OSH, resulting in a negative perception of safety culture. In relation to their claims, some key seniors and other engineers consistently attributed that these commercial pressures were due to the low commitment of the management for their occupational safety and well-being, and it was because of some financial pressures.

An engineer perceived many informal practices that the individuals have adopted as reinforcing performance over OSH. An in-depth interview with a senior avionics engineer gave vital insight into the situation from an insider point of view – explains;

“Participant: The flight time is more important than our Safety. They take it seriously when we do not sign to release the aircraft; otherwise, our safety is not in their interest.” (I#5).

Reviewing existing safety culture literature (see section II), illustrates that there are disagreements and conflicting findings on safety climate elements which have played a significant role in how to conceptualize the safety climate concept (Flin, 2007; Mearns et al.,

2007) and the items loaded for each dimension (Alruqi et al., 2018). This disagreement and conflicting views due to the assumptions among the safety climate researchers is the effect of the different contexts and research settings (Flin, 2007). This conflict implies that because safety culture studies have been conducted in different settings, they will continuously provide different results and suggest that different safety culture factors needs to be explored and that few studies have identified the effect of context.

Fascinatingly, this research shares various dimensions with previous studies on safety climate literature. For example, this research shares similar dimensions, pertaining to senior management's commitment to safety with other studies (ATSB 2004; Cheng, 2018; Cheng, 2019; Evans et al., 2007; Ghahramani & Khalkhali, 2015; Kines et al., 2011; Roberts et al., 2018; Seo et al., 2004; Smith et al., 2019) in aviation and non-aviation settings. Nevertheless, the perception towards senior management's commitment varied between the employees studied in this study context. The results imply that the managers in this research context believed that focusing on operations and production rather than employees' protection was a priority to keep the business running. However, it is worth distinguishing between senior management's commitment to aircraft safety and occupational safety. In this research context, airline managers prioritized aircraft safety over operations, which is consistent with expectations. However, employees' occupational safety was not given priority due to the lack of resources. This is because of the importance given to production and conflicting interests and views between managers holding the power and the workers (Antonsen, 2009).

The employees exhibited a weak perception of the executive management's commitment to occupational safety. The underlying explanation behind this perception was the lack of management support of the engineers' safety and wellbeing in the workplace. This was due to the lack of provision of safety tools and equipment necessary to conduct the maintenance work. Interestingly, compared to the findings from existing studies in the aviation sector, management's commitment to personnel occupational safety in other studies as shown in the literature was determined to be high (Gibbons et al., 2006; Kao et al., 2009). This was due to the organizational value given to employees' safety and the absence of the effect of contextual external factors on workplace safety as in the case of the context of this study.

B. Organisational safety practices.

B.1. Lack of organizational training.

Many participants from different levels contributed to this research. The senior engineers shared their views and stated that their airline management does not provide them with enough training necessary for OSH. For instance, a senior ground engineer who has worked at the MCC department for thirty-five years stated that their organization has gone below the mechanics' expectations of training on OSH in the last six years. He said that with sadness and dissatisfaction – that:

“OSH is a very important and sensitive issue in our work atmosphere. Still, our company does not focus too much on OSH as much as it does on business. For example, company management does not observe the challenges we have in our workplace, such as poor OSH training. I have not got OSH training for many years and what I do is learn by myself and regularly follow the EASA updates and notifications”. (I#6).

Another participant talked about the same issue of the lack of OSH training and personal efforts he made to improve himself to be a competent engineer with sad emotions and stated that:

“We only follow the work task safety information, which is warnings and cautions. I just improve myself and do some online training. There is no periodical program about OSH training.” (I#11).

During the interviews, another outraged participant stated that recruits do not get enough training from the training department, and management sends them to the line to start work without training or induction on OSH:

“The new employees and trainees not trained, they (supervisors) ask them to do the job in the ramp or the hanger without OSH induction or training before joining the work. So there is no safety culture in our workplace; there is none about safety.” (I#4).

B.2 Lack of communication about safety.

The data analysis finds that some of the participants tended to emphasize the weak safety communication about OSH. They also openly shared the negative and positive views and did not hesitate to cite them against their management commitment to organizational safety values. The data analysis shows that the management's commitment to communication about OSH reveals a low level of safety communication up to and down in the organization. In general, the engineering employees, in their discussions, that they share the same view regarding the communication about the safety, and they highlighted how the organization gives low value to communication about OSH. For example, interviewee #7 discussed the poor communication about OSH in the maintenance department from his point of view. However, he attributed that to finance. As he explains:

“We use job cards for every task. And for us as engineers, we do not need that general safety rules. But when it comes to safety information, it is all stated in the maintenance manual. If you mean that the company is giving us some safety bulletins or posters, it is not because the company is cutting expenses up to the maximum. I never saw safety posters on the notice board.” (I#7).

Like participant number 4, participant # 8 stressed safety communication as an important element that will improve safety culture in their workplace. As they demonstrate;

“When I was a student, I trained about safety. But now, no one talks about OSH here.” (I#4).

“All engineers and the majority of them have experience, and they do their work well. We do not talk too much about OSH, but everyone desires to work in a safe and protected atmosphere. I believe that I need to speak to him and other seniors on topics about safety as it's much related to the kind of job we do.” (I#9).

C. Role of social relationships.

C.1 Teamwork

The data analysis from the interviewees' views and perceptions highlighted positive work practices where some engineers believe their work environment was based on teamwork. It was found that many participants believed that maintenance engineering work was based on working in teams, not on an individual effort. Participant #14 stated that he worked and performed the maintenance tasks in cooperation with his colleagues; *"The shift manager asks me to go with a specific group and do certain tasks, like for example group A, they are going to replace a landing gear, go and help them."*

It can be understood from his view that the Libyan maintenance engineers work collectively, which is consistent with findings of other cultural studies. Another participant shared the same view and emphasized the benefits of team working as he stated: *"Our work is teamwork, we work together, and we sit in the same sitting room. We are like one collective family, and when someone could not perform his work tasks, we all go and help him."* (#7).

However, based on the participants' views and beliefs, the hierarchy level between pilots and junior engineers and technicians exists as part of daily work practices. The following element highlights the effect of hierarchal relations on their perception of the wider effect of social aspects.

C.2 Hierarchal relationships

Some employees from the engineering department cited certain informal behaviors that contradict the teamwork culture adopted by the engineers. Some of them alleged the culture of ego inhibits the teamwork spirit from the pilots. Participant 8 claimed that ranking and seniority generated conflict between pilots and some junior engineers; he stated that engineering work was based on teamwork but not with pilots and cabin crews. He pointed out that after many arguments with pilots about the flight times, a disagreement began between him and a senior pilot because of delaying flight times for maintenance checks. Eventually, he decided to respect him and did not argue with him.

"As engineers, we are very polite to each other, but sometimes some pilots, not all of them but some pilots are somehow having an odd attitude, they always want to be right and do not accept criticism and they always take over discussions. I know a pilot, a very senior pilot, always blames me on delays even when I am not responsible for delays."

Consistent with the last interviewee's perception, another senior engineer participant explained that ranking had reduced the coherence between the staff members such as engineers and pilots. During the interview, participant # 3 explained the culture of the company was based on individuals, not on teamwork and work significance and because the airline values pilots' over other staff members, he stated that:

"In our airline, pilots only are important, and others have no value. The culture is based on individuals, not job significance. When he (pilots) says, "I have a headache," ooh, flights delay and may be canceled and

offer him what he wants, but when an engineer does, it is as nothing happened. Can you imagine that?"

Their discussions show that hierarchal relations hinder the teamwork culture and reveal the level of power distance and seniority factor. A junior engineer demonstrated a clear picture of the power distance between him and the pilot and how the pilot was emphasizing his authority. However, he also points out the Arab cultural values, such as respecting elders and seniors.

The cornerstones of organizational safety are organizational commitment to safety, availability of safety training, and sufficient funding to buy appropriate and essential safety equipment. These elements are frequently regarded as important indicators of the organizational safety culture (Gao et al., 2015; Kines et al., 2011). According to the study's findings, Production was given priority over occupational safety. There was little safety training, insufficient funding to buy PPE, and a lack of safety communications. These unsatisfactory responses to important safety climate metrics imply that there needs to be a better safety culture among AME at this airport. This is noteworthy because a strong safety culture is endorsed and promoted by the international aviation industry as proof of safety (ICAO, 2018).

VI. CONCLUSION

This study among AME in a MENA country has demonstrated that, despite sector-wide conventional expectations of a high safety culture within aviation, this is not common. In addition, research participants clarify that the seemingly feeble safety culture can be attributed to the effect of micro-level contextual factors of low management commitment to safety and organizational safety practices, and the macro-level of social relations and its cultural effect. The explored contextual factors revealed by 14 experienced aircraft engineers and mechanics point out, for the first time, the influence of macro and micro level contextual factors on safety culture in aviation sector. This suggests that the significant concepts in aviation safety, such as safety culture that promotes safety management systems may not be easily implemented without considering the effect of internal and external organizational contextual factors. A thorough investigation of these macro and micro level contextual factors through quantitative analysis is recommended to capture the rich nuances of participant's experiences as the findings from our sample cannot be generalized to the broader population.

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APPENDIX

APPENDIX 1: INTERVIEW QUESTIONS PROTOCOL

1. How would you describe safety in your organization?
2. What information about H&S do you receive from your organization?
3. How do you do your day-to-day job?
4. Do you think you work safely? Why?
5. What safety rules and procedures do you have in your company?
6. How does your manager/supervisor treat you/your colleagues?
7. If you see something dangerous/risky/hazardous, can you tell your manager? Why (not)?
8. Do you think that accidents can be avoided? Why?
9. How responsible do you feel your manager/supervisor is for your safety at work?
10. How responsible do you feel about your own / your colleagues' safety?