

# A Study of Aircraft Damage Accidents and Safety Culture in the Ground Services in an Airlines Company

Ahmad Hamad Aljehani<sup>1\*</sup>, Mohamed A. Zytoon<sup>2</sup>

<sup>1</sup>Engineer, Department of Industrial Engineering, King Abdulaziz University, Jeddah, Saudi Arabia, Corresponding Author E-mail: [a7md7md@hotmail.com](mailto:a7md7md@hotmail.com)\*

<sup>2</sup>Associate Professor, Department of Industrial Engineering, King Abdulaziz University, Jeddah, Saudi Arabia, E-mail: [mzytoon@kau.edu.sa](mailto:mzytoon@kau.edu.sa)

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**Abstract:** The performance of the airline industry is highly affected by ground services operations. For instance, a failure in one ground operation activity could result in the poor on-time performance of the airline's companies. The objective of the current study is to analyze the causes of ground operations accidents that resulted in aircraft damages in an airlines company in Saudi Arabia. Furthermore, the safety culture of the ground operators was assessed. The number of accidents during the period 2016-2019 was found high. The main causes were unsafe operator act and unsafe supervision. Also, the safety culture questionnaire revealed that other causes had a role in developing unsafe acts, such as organizational aspects. The study recommends improving many organizational aspects such as properly designed procedures, roles and responsibilities, training, communication and reporting system, equipment maintenance schedule, field inspections, strict and supportive supervision, as well as fair workload and compensation. Improving these aspects should reflect on the safety culture and behaviour of operators and immediate supervisors. The result is reduced aircraft damage accidents and on-time performance improvement.

**Keywords:** Aircraft Damage, Accidents, Safety Culture, Ground Services.

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## I. INTRODUCTION

The aviation field is considered the safest mean of transportation and this explains why the demand for this field is high. Therefore, there are international standards and regulations must be met by the airlines to maintain a high level of safety. Improving air safety has always been the top priority for the airline industry and having an acceptable air safety record is important to an airline's success (Liou, Yen & Tzeng, 2008).

Safety compliance is the priority in the aviation industry which is evident in the strict intentional and local aviation organizations regulations and standards that are mandatory for the airlines to comply with. In compliance with these regulations and standards will lead to many issues for the airline in regard of safety aspects. Several indicators can measure the level of safety in the airline's companies. The number of aircraft damages is an indicator of the level of safety in the aviation industry. The occurrence rates of accidents in ground handling operations were found higher than other operations (Roelen & Blom, 2013). Of course, if the number of aircraft damages is increasing from year to year, this means that something is going wrong. For this, in case of there is increasing in the number of aircraft damages the airline should study and evaluate the situation and make the right decision on the proper corrective actions to mitigate and minimize the risk to an acceptable level; and, consequently, to maintain the level of safety within this acceptable level.

The studied airlines' company (denoted by X Airlines Company) has two problems regarding the ground services activities. The first problem is that the number of known (or recorded) aircraft damages is gradually increasing from 2016 to present. The second problem is that, for one reason or another, there are unknown aircraft damages that are not reported to the concerned department. They are unexpectedly discovered before departure or after arriving to the next destination. In both cases, the outcomes are delays or time loss, due to the time consumed to fix the damages, and additional cost.

Most of the aircraft damages happen by a human (Shappell & Wiegmann, 1996; Shappell et al., 2007) while handling the arrival or the departure of the aircraft, especially the following activities: (a) using Ground Support Equipment (GSE) to serve the aircraft, the damage may happen in the GSE area, (b) doing pushback for the aircraft, and (c) loading and offloading Unit Load Device (ULD) or cargo.

Preparations for any departure and arrival flight passes through several activities from deferent departments to get the safe and on-time flight, however, all deferent teams/departments need to work as one team simultaneously to achieve the target. The cooperation between civil aviation (airport authority), customs, immigrations, flight operations (captain & crew), maintenance (technical), and ground operations (ground services) is highly required for any flight. The current research focuses on the activities of ground operations department. Ground operations department has several activities that need to be done simultaneously or back to back (sequential) to prepare the flight for departure or arrival whereas each activity has lots of processes and all of these processes and activities have to be done according to the international airlines' standards. Incompliance to the standards may cause an accident and delay for the aircraft. The objectives of this study are to analyze the aircraft damages due to ground operations activities in X airlines company, as well as to assess the safety culture of the ground operations in a Saudi major airport.

## II. METHODOLOGY

The data of aircraft damage were collected for the years 2016-2019 from the company database. This period was selected because the number of aircraft damage increased from 2016 to 2019. The majority of analyzed accidents were related to loading and offloading in the cargo compartment of the aircraft.

The data were analyzed in terms of root causes where because classification was based on the IATA root cause classification, including organizational influences, unsafe supervision, unsafe act and preconditions of the unsafe act.

The study of the safety culture among ground handling operators and their supervisors/managers was implemented using a tailored safety culture questionnaire encompassing all aspects of safety culture that are deemed to be important in measuring the safety performance of the operators and managers. Furthermore, the safety management system of the ground handling operations was studied to uncover its strengths and weaknesses and to decide the areas of improvement.

## III. RESULT AND DISCUSSION

### A. Aircraft damage accidents

Table (1) presents the aircraft damage data during the period of the study (i.e., 2016-2019). There is an increasing trend over the three years 2016-2018. Although a decrease was observed in 2019, it is still higher than the first two years 2016 and 2017. Despite being a problem worldwide (Roelen & Blom, 2013), the number of accidents in this study was found higher than in other locations. The increased number of aircraft damage during ground operation is an indicator that an improvement is required in this regard, otherwise, more safety issues will certainly arise. Increased number of ground

aircraft damage is considered a high-risk factor for the passenger, employee and the company. Regarding the company, it will cause lost reputation, cost of delay, cost of maintenance/repairing, and cost of other probable consequences such as related flight accidents.

Table (1): Aircraft damage data during 2016-2019

<i>Item</i>	<i>Numbers (and %)</i>				
	<i>2016</i>	<i>2017</i>	<i>2018</i>	<i>2019</i>	<i>Totals</i>
<i>Total number of aircraft damage accidents</i>	45	49	92	69	255
<i>Reported aircraft damage accidents</i>	39 (86.7%)	30 (61.2%)	60 (65.2%)	49 (71%)	178 (69.8%)
<i>Unreported aircraft damage accidents</i>	6 (13.3%)	19 (38.8%)	32 (34.8%)	20 (29%)	77 (30.2%)
<i>Domestic stations damage accidents</i>	33 (73.3%)	39 (79.6%)	76 (82.6%)	56 (81.2%)	204 (80.0%)
<i>International stations damage accidents</i>	12 (26.7%)	10 (20.4%)	16 (17.4%)	13 (18.8%)	51 (20.0%)

Table (1) shows that significant portions (average: 30.2%, range: 13.3-38.8%) of the damage accidents were not reported. This leads us to ask an important question of why the employee did not report all the ground aircraft damage. Is it something related to company procedures, supervision, communication or training? Most of the ground activities damage from 2016 to 2019 occurred in the cargo compartments which explain to us something is going wrong with loading and offloading activities and this is the weakest point in the ground operations activities. Loading and offloading include different items, for example, cargo shipments, passenger luggage, medical equipment and aircraft equipment.

The analysis of occurrence destination shows that most of the ground aircraft damage (average: 80%, range: 73.3-82.6%) took place inside kingdom (domestic stations) as presented in Table (1). In comparison to the international destination, the high percentage of aircraft damage accidents in the domestic destinations reveals that there are weaknesses that need to be discovered and solved.

As a first trial to find the root causes of such damage accidents, Table (2) shows that the main causes for aircraft damage are unsafe acts (average: 44.7%, range: 30.4-55.1%) and unsafe supervision (average: 44.7%, range: 38.8-51.1%). Small portions were attributed to organizational aspects (8.6%) and preconditions to unsafe acts (2%). Unsafe acts included mainly neglecting rules and procedures, and incorrect operations handling. On the other hand, unsafe supervision included mainly assigning the tasks to unqualified operators. These human factors causal factors can act as early warning signs of growing risks (Yan, 2014).

In a second trial, the root causes were discussed with the safety department personnel to explain their occurrence. Based on views of the safety personnel, the reasons of continuous occurrence of these types of damages were:

- The operator is not aware of the existing rules and procedures.
- The operator is not aware of the rules and procedures updates.

- Improper training of operators.
- Supervisors sometimes enforce the operators to violate the rules to obtain on-time departure.
- Sometimes safety is not a priority for some operational staff.

For these, it was necessary to assess the safety culture of the operators by using a questionnaire design specifically for this purpose. The results are discussed in the following section.

### B. *The safety culture of the ground operators*

This questionnaire is dividing into five items, the first part is the work environment, the second is training, the third is communication, the fourth is reporting and the last is equipment. This questionnaire has been distributed to 31 staff who are working in the ramp to serve aircraft. Among those who responded to the questionnaire, about 94% were full-time workers and 84% were working more than 8 hours per day. The ramp area is a very sensitive area that needs full concentration and readiness. However, working more than 8 hours in such a critical area is a risk factor due to physical fatigue and exposure to high thermal conditions in domestic airports. This situation may develop conditions that create an accident leading to aircraft damage.

Table (2): Root cause classification of aircraft damage accidents

<i>Classification of root causes</i>	<i>Numbers (and %)</i>				
	<i>2016</i>	<i>2017</i>	<i>2018</i>	<i>2019</i>	<i>Totals</i>
<i>Unsafe acts</i>	23 (51.1%)	25 (51.0%)	28 (30.4%)	38 (55.1%)	114 (44.7%)
<i>Unsafe supervision</i>	18 (40.0%)	19 (38.8%)	47 (51.1%)	30 (43.5%)	114 (44.7%)
<i>Organizational influences</i>	4 (8.9%)	4 (8.2%)	14 (15.2%)	0 (0.0%)	22 (8.6%)
<i>Preconditions for unsafe acts</i>	0 (0.0%)	1 (2.0%)	3 (3.3%)	1 (1.4%)	5 (2.0%)
<i>Total</i>	45	49	92	69	255

#### *Work Environment:*

The work environment is the important factor for the success of any organization. The questionnaire results showed that, generally, 39% of the staff were not satisfied with the work environment. In details, the job responsibilities and procedures were not clear to 45% of the respondent operators, 61% of them were not satisfied with the salaries, and 45% of them were not satisfied with human resources rules and procedures. As a result of these, 22.6% of the operators reported that they were not following rules and procedures all the time. This result uncovers a risk factor in ground operation which is an unsafe act from operators which is evident in the records of aircraft damage accidents. However, the reasons behind unsafe acts should be understood. It seems from the responses of the participants that some organizational aspects need to be improved to enhance the safety culture of the operators. Examples of this are setting realistic and practicable rules, easy procedures and fair compensation.

#### *Training:*

Training is required for all jobs, especially for the aviation industry to make sure that the operator implements the tasks safely and efficiently. In general, 39% of ground operators were not satisfied with the training policy. Also, 32% of them thought that the training they joined was not necessarily

matching the needs of their tasks. Besides, 35.5% of them reported that safety issues were not adequately covered in the training courses they joined. Furthermore, 52% of the operators believe that the chance to improve and develop their skills through training is limited. Despite the importance of training in the aviation industry, ground operators were found having inadequate access to training in other studies (Ek & Akselsson, 2007).

#### *Communication:*

The communication is an essential way to communicate between the top management and the staff, and between different levels. Through excellent communication, the information will go smoothly to the concerned people and departments. Also, the managers/supervisors will be familiar with staff requirements. If there is a problem in the communication this will lead to failure in the operations. The results of the questionnaire showed that 65% of the staff had a feeling that the communication with the management is unsatisfactory to them, which could result in a feeling that lessening to them and paying attention to their thoughts are far less than needed. Besides, the communication between the teams when they are doing the job was poor according to 48.5% of the staff. Regarding the updated information and procedures to perform the tasks, 39% of staff said they cannot get the updated information easily. The studied airline company has ongoing safety awareness campaign. However, unfortunately, 45% of the staff did not attend. Furthermore, solving the obstacles by the company is slow or sometimes poor according to 61% of the staff.

#### *Reporting:*

In case of there is an unusual situation or hazard, the formal way to inform the company should be through reporting. However, 29% of the staff are not aware of how to report such issues, and 42% of them believed that the reporting system is ineffective. In case the report is submitted, 48% and 42% of the staff described the response of the management and other parties, respectively, as slow. In case there is a safety issue, 52% of the operators do not report it. This is a very poor safety behaviour that was found the immediate cause of the increasing trend in the unreported aircraft damage. Although reporting is one of the ground operators' concerns in other studies (Ek & Akselsson, 2007), the problem is more observable in the current study both from the questionnaire results and the accident data. Again, the blame for the problem of safety issues reporting should not be attributed to operators' behaviour only. Other factors that led to this situation should not be overlooked, such as the absence of clear procedures for reporting and feedback.

#### *Equipment:*

The equipment is essential tools used to serve the aircraft. Unavailability of the equipment means there are no operations. Using improper or inefficient equipment could lead to accidents that cause injuries or aircraft damage. Based on the questionnaire result, 48% of the operator said that they use equipment in bad conditions, while 52% believed that there was no regular check. Besides, 68% of them said that they were using expired-license equipment or equipment without a license. Finally, 26% of the staff were not following the procedures when using the equipment while serving the aircraft. Based on these, the equipment could be one of the main causes of ground aircraft damages.

## **IV. CONCLUSION**

This paper presents a study on aircraft damage accidents due to ground operations in an airline company. The number of accidents during the period 2016-2019 was found high. Based on accident reports, unsafe operator act and unsafe supervision were determined as immediate causes of accidents. However, the safety culture questionnaire uncovered indirect or basic causes that might have played a role in developing unsafe acts. Most of these basic causes were organizational despite being reported in the accident causes as the minor cause (8.6% of accidents). Therefore, the study recommends

improving many organizational aspects such as properly designed procedures, roles and responsibilities, training, communication and reporting system, equipment maintenance schedule, field inspections, strict and supportive supervision, as well as fair workload and compensation. Improving these aspects should reflect on the safety culture and behavior of operators and immediate supervisors. The result is reduced aircraft damage accidents and on-time performance improvement.

**Conflict of interest:** The authors declare that they have no conflict of interest.

**Ethical statement:** The authors declare that they have followed ethical responsibilities

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