SIA Engineering Philippines (SIAEP) Corporation Safety Management System: Mitigating of Hazards and Avoidance of Foreign Object Damage

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Abstract: - The study will allow for a more effective strategy to prevent or eliminate FOD by raising knowledge of dangers and FOD among those working in the aviation industry. Foreign object damage (FOD) has long been an issue in the aviation industry, resulting in several tragic events and fatalities. As a result, the maintenance, repair & overhaul (MRO), including airlines, must implement a proper technique and strategy to minimize FOD incidents further. Due to poor working behavior, a poor working environment, limited technology, and a chaotic housekeeping system, controlling FOD is challenging. The primary purpose of this research is to investigate and explain FOD and FOD prevention methods in greater depth. FOD is a global aviation industry concern, and it is one of the elements that contribute to aircraft failure and unexpected consequences, including fatalities and casualties. Throughout this study, many details on FOD issues and their impact on the aviation industry have been collated and presented.

Key Words— ***Hazards, Foreign object damage, MRO, Airlines, Mitigation.***

I. INTRODUCTION

Foreign object prevention is a hot concern in the aviation business these days. FOD is critical quality control and safety term that refers to loose objects and small debris in work settings that have the potential to cause damage or injury. Although the word "FOD" is most frequently used in the aviation and aerospace industries, it is critical in any company that values quality and safety. For instance, FOD is a severe issue in manufacturing settings, where quality assurance requires that everything is in its appropriate place and that workers are kept safe.

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Foreign Object Debris (FOD) at airports and maintenance facilities refers to any object discovered in a wrong location that can harm equipment or hurt personnel due to its presence. FOD is a broad category of items that includes loose hardware, pavement fragments, catering supplies, construction materials, rocks, sand, luggage fragments, and even wildlife. At terminal gates, cargo aprons, taxiways, runways, and run-up pads, FOD is found.

This Area Requires Special Attention and Examination as Part of This Research.

Maintenance FOD - this term refers to a variety of objects (tools, materials, or small pieces) employed in repair activities (e.g., aviation maintenance, building work, and so on) that can cause damage to aircraft.

1.1 Effects

FOD can cause damage in a variety of ways, the most important being:

- When consumed, FOD can harm aircraft engines;
- When ingested, FOD can cut aircraft tires;

- Sedimentation of airplane mechanisms, rendering them inoperable;
- Injuring individuals due to being accelerated by a jet blast or prop wash.

The consequent harm is projected to be billions of dollars each year for the aircraft sector.

This research discusses the 'best practices for preventing Foreign Object Damage (FOD) in today's aviation industry. This document summarizes the state of industry efforts to track and mitigate the FOD threat. The research team examined current industrial practices concerning FOD. The team identified 'Best Practices' implemented in hangars, on the production line, and in any other location where FOD mitigation is crucial. The analysis demonstrates numerous prospects for industry-wide improvement of FOD initiatives.

II. Literature And Studies

"Safety" is reaching one's destination without getting hurt (Stolzer et al., 2008). The International Civil Aviation Organization (ICAO) provides a definition for "safety" apropos for the safety practitioner: Safety is defined as "the state in which the possibility of harm to persons or of property damage is reduced to, and maintained at or below, an acceptable level through a continuing process of hazard identification and safety risk management" (ICAO, 2013, p. 2-1).

In order to maintain safety, the need to identify the existing and to exist hazards is very vital. Hazards are defined as "a real or potential condition that could lead to an unplanned event or series of events (i.e., mishap) resulting in death, injury, occupational illness, damage to or loss of equipment or property, or damage to the environment", whereas risk is defined as "a combination of the severity of the mishap and the probability that the mishap will occur" (DOD, 2012).

One of the hazards we consider in the aviation industry is the foreign object debris or FOD. FOD includes debris, substances or articles that have the potential to cause damage to any vehicle or system. In other words, FOD can be defined as anything that is around or inside the aircraft and flight line operations that does not belong there. FOD varies in sizes and it has the capability to create hazard to equipment or personnel.

Another definition of FOD is the damage on aircraft, helicopters, launch vehicles, engines or other aviation equipment which takes place when a foreign object smash engine, flight controls, airframe and the other operating systems (R Hussin et al 2016). Based on Federal Aviation Authority (FAA), FOD is principally known as a hazard element that can severely harm the airport, personnel and equipment.

Foreign object debris (FOD) is a significant concern in airport operations. According to McCreary's study in 2010, the aviation industry estimated the worldwide cost of FOD to be between US$2.3 billion to US$4 billion annually. In his study, he found that the direct costs of on-runway FOD were even higher, on the order of US$7 billion a year. More significantly, FOD had been attributed as one of the significant, if not the direct cause of several aviation crashes, the most high-profile of which was the Air France Concorde crash in July 2000 that killed 109 on-board and four on the ground (Alexander Adams 2013).

The effective management of Foreign Object Debris (FOD) at an airport is important primarily in relation to safety, and raises in that context sensitive issues of responsibility and liability. But it also has considerable actual or potential significance in relation to airline and airport economics, runway capacity, the environment and the passenger experience (ICAO 37TH SESSION: Runway Safety).

An SMS must seamlessly integrate safety management processes and institutional arrangements by turning safety into a critical business function – at the same level of importance as finance, marketing, and the mission operations of the organization (Maurino 2017). There are financial benefits to implementing SMS. SMS can be costly, and most organizations consider SMS a cost liability without factoring in its economic benefits (George, 2013).

III. Methods And Procedures

3.1 Research Design

The researchers utilized a quantitative approach to elicit data on how to limit dangers and avoid foreign items at a maintenance repair facility. By and large, quantitative design is based on scientific principles. Thus, the researchers employed deductive reasoning, in which they defined the study's purpose, gathered data to address the problem, and then analyzed the results.

Following that, the researchers drew findings to conclude the investigation.

The researchers employed a Descriptive Method quantitative design. The data was gathered between March and April of 2021. The research effort was designed to eliminate the systematic technique bias that might occur when data are collected from a single source. Responses were explicitly gathered from Singapore Airlines Engineering (Philippines) Corporation employees and other MRO facilities.

The data collection method was electronic, with respondents receiving google forms containing the survey instructions and the necessary information for the researchers. To participate in the research survey, respondents must have an email account. The researchers employed this to assure the survey's secrecy and integrity. Additionally, respondents were informed that their specific comments would remain secret and used solely for research purposes.

3.2 Locale of the Study

Singapore Airlines Engineering (Philippines) Corporation was the location of the research. The poll is conducted electronically because we are amid a pandemic. SIAEP personnel makes up the majority of the respondents.

Respondents were provided access to Google forms, which they can complete at home or any other location conveniently. As a result, the scientists began to look at ways to reduce risks and keep SIAEP free of foreign items.

3.3 Sampling Procedure

Surveying the entire population of a target location helps ensure that the samples are accurate. Singapore Airlines Engineering Philippines has a staff of 500 people in total. The study will use ten percent of the population as its sample size. Various departments of the firm contributed samples. An online portal will be used to collect sample data.

3.4 Respondents of the Study

Employees of Singapore Airlines Engineering Philippines from several departments are the primary respondents in the study. A total of 92 people took part in the research. Due to ethical issues, one of the researchers employed by the company listed is automatically excluded as a respondent.

3.5 Research Instrument

The data was gathered via a questionnaire. The questionnaire is a survey with a Likert scale question. The questions were distributed electronically via Google forms, which respondents may access using their email addresses, and they are divided into three sections. The first section contains the respondents' demographic and personal information.

The second component is respondents' awareness of occupational dangers and Foreign Object Debris/Damages (FOD). The final section included criteria that determined the assessment of the organization's safety management systems.

Point	Adjectival Rating
4.20 – 5.00	Strongly Agree
3.40 – 4.19	Agree
2.60 – 3.39	Neutral
1.80 – 2.59	Disagree
1.00 – 1.79	Strongly Disagree

Table 1. Five-Point Likert Scale

The research instrument was validated by Ms. Meredith I. Rutao, an Aircraft Mechanic/College Instructor/Former Safety Officer, to validate the survey questions employed in the questionnaire, thus helping the researchers guarantee that they ask questions that genuinely assess the problems of concern. See appendices.

3.6 Data Gathering Procedure

The researchers had dedicated a significant amount of time, effort, and cooperation to constructing their questionnaire to serve its intended respondents. The survey was built utilizing appropriate questions adapted from previous studies and individual questions developed by the researchers. The survey was divided into three primary sections. They were then separated into several subparts that addressed how people work together to lessen hazards, avoid FODs, and assess the safety management system on how they view their workplace environment.

The questionnaire used the Likert scale to evaluate whether respondents agreed or disagreed with a statement on the second and third parts of the questionnaire. The questionnaires were distributed electronically via Google forms, which respondents could access using their email addresses. Respondents were given time to answer the researcher's google forms. The

researcher will check the Google forms submission link to collect completed survey questionnaires the following working day.

The data collected from this research instrument were tallied and computed for interpretation based on the frequency of items answered by respondents. In addition to the primary data, the researcher used secondary resources in published articles and literature to support the survey results.

3.7 Data Analysis Technique

The researchers examined the data collected from the respondents to gain valuable and relevant information. The researchers categorized and segregated all of the surveys to be entered into Excel to collect accurate and complete data. The researchers produced a table to make the data easier to understand. The researchers used Jomovi 2.2.2 to acquire accurate and complete data and make the results easier to comprehend and interpret. The researchers calculated the results using descriptive analysis.

IV. RESULTS AND DISCUSSION

The study's overall goal is to investigate methods to mitigate and avoid foreign objects damaging the maintenance workplace. The results were gathered from a survey in SIAEP with 92 respondents. The survey covered an assessment of the safety management system: mitigation of hazards and avoidance of foreign object damage with 42 questions for one person.

Three major conclusions were drawn from this analysis. To begin, individuals who have undergone safety training are aware of the methods that can be used to reduce and prevent hazards and Foreign Object Debris (FOD). Second, employees who have obtained safety training and have more than three years of experience been able to keep a safe working environment in their place of employment. In addition, a lack of training and understanding about the identification of dangers and foreign objects in the workplace leads to dangerous conduct and an unsafe atmosphere. Furthermore, it is possible that it is the product of human error.

On the technical side, the MRO should conduct a FOD risk assessment in order to identify the primary FOD risk that has a high potential of occurring. When assessing risks, it is essential to consider their nature and response as well as their frequency and severity. It is also important to consider the appropriate action that should be taken to reduce the risk. Firms can determine the level of risk and develop mitigation strategies based on the results of this evaluation.

Table.2. Interpretation of Responses in Hazard and FOD'S Assessment

	N	Mean	SD	Interpretation
Is there an effective ongoing hazard and FOD identification program?	92	4.28	0.76	Strongly Agree
Does the hazard and FOD identification program include a confidential reporting system?	92	4.08	0.73	Agree
Are confidential reports properly de-identified?	92	4.17	0.67	Agree
Are hazards and FOD's associated with contracted agencies included in the Hazard Reporting System?	92	4.01	0.75	Agree
Is there a procedure established for acknowledging safety-related reports?	92	4.21	0.62	Strongly Agree
Is there a process whereby the hazards and FOD's are continuously assessed for their risk potential (likelihood and severity)?	92	3.97	0.87	Agree
Are the defenses against the hazards and FOD's identified?	92	4.10	0.70	Agree

Does the process include the identification of the need for further defenses or for hazard and FOD avoidance?	92	3.97	0.78	Agree
Are the results of hazard and FOD reports and safety suggestions made available to the initiator?	92	4.18	0.71	Agree
Are the results of hazard reports and safety suggestions made widely available within the Company?	92	3.71	1.02	Agree
AVERAGE	92	4.07	0.57	Agree

Table.2. provides an explanation of the responses to the Hazard and FOD Assessment. Nine items have a concurring rating, and two items have a strong concurring grade. According to the Likert Scale questionnaire interpretation methods, the average falls within the "agree" interval. This indicates that the majority of respondents believe there is an effective program for avoiding risks and FOBs, a reporting mechanism, and defenses against hazards and FODs.

Table 3
Interpretation of Responses in Assessment of Safety Management System

	N	**Mean**	**SD**	**Interpretation**
Employees are given enough training to do their tasks safely.	92	3.97	0.94	Agree
Managers get personally involved in safety enhancement activities.	92	3.93	0.86	Agree
There are procedures to follow in the event of an emergency in my work area.	92	4.15	0.65	Agree
Managers often discuss safety issues with employees.	92	3.98	0.88	Agree
Employees put all the effort to prevent accidents that may occur.	92	4.16	0.70	Agree
Everyone is given sufficient opportunity to make suggestions regarding safety issues.	92	4.26	0.61	Strongly Agree
Employees often encourage each other to work safely.	92	4.18	0.66	Agree
Managers are aware of the main safety problems in the workplace.	92	3.75	0.86	Agree
All new employees are provided with sufficient safety training before commencing work.	92	4.08	0.80	Agree
Managers often praise employees they see working safely.	92	3.99	0.82	Agree
Everyone is kept informed of any changes, which may affect safety.	92	4.23	0.67	Strongly Agree
Managers do all precautionary actions to prevent accidents.	92	4.16	0.68	Agree
Accident investigations attempt to find the real cause of accidents, rather	92	4.13	0.74	Agree

than just blame the people involved.				
Any defects or hazards that are reported are rectified promptly.	92	3.92	0.94	Agree
The mechanism in the workplace are available in case there's a safety deficiencies.	92	4.03	0.73	Agree
Managers should stop unsafe operations or activities whenever it occurs.	92	3.87	1.13	Agree
After an accident has occurred, an appropriate action is usually taken to reduce the chance of reoccurrence.	92	4.15	0.65	Agree
Safety audits and inspections are made based on the requirements made by the affiliated agencies.	92	3.86	0.67	Agree
Managers considered safety as a very important part of the work activities/duty.	92	4.21	0.60	Strongly Agree
Employees usually report any dangerous work practices they encountered.	92	4.02	0.78	Agree
Suggestions for improving safety were encouraged.	92	4.09	0.67	Agree
Company training provided adequate skills and experience to carry out normal duties safely.	92	4.02	0.84	Agree
Training was received at regular intervals to refresh and update knowledge.	92	4.15	0.68	Agree
Company safety rules and procedures were easy to understand.	92	4.16	0.67	Agree
Management were genuinely interested in safety issues.	92	4.20	0.63	Strongly Agree
Management allocated sufficient resources to safety.	92	3.95	0.80	Agree
How comfortable do you feel reporting safety related issues on a scale of 1 to 5.	92	4.03	1.01	Agree
Safety is always important until we get busy.	92	4.15	0.86	Agree
All employees take pride in doing their jobs in a professional and safe manner.	92	3.92	0.93	Agree
All employees consistently follow all SOPs, even when the boss is not observing.	92	4.08	0.68	Agree
AVERAGE	92	4.06	0.50	Agree

Table 3 summarizes the results of the Assessment of Safety Management System survey. Four items received a strong agreement rating, while 36 received an agreed rating. According to the Likert Scale questionnaire interpretation methods, the overall average falls inside the "agree" interval. This indicates that the majority of respondents believe they have received adequate training to perform their jobs safely, that there are procedures to follow in the event of an emergency

in my work area, that safety concerns are frequently discussed with employees, that everyone is kept informed of any changes that may affect safety, and that safety is always a priority.

V. Findings, Conclusion and Recommendation

5.1 Findings

The level of employee understanding regarding how to mitigate/avoid hazards and FODs in the workplace was discussed.

- Managers have an impact on their employees' compliance with preventive measures designed to avert accidents and incidents caused by dangers and foreign objects in the workplace. Employees adhere to safety guidelines in order to avoid/mitigate hazards and foreign object debris (FODs).
- Preventing risks and FODs is being documented for the purpose of performing audits to ensure that incidents and accidents do not recur. Potential hazards and foreign object debris (FODs) are being identified and evaluated for their potential to pose harm to the organization.
- Employees are encouraged to contribute to the organization's safety improvement efforts and to provide feedback on safety awareness.
- There are current policies, processes, and checklists in place within the company for assessing hazards and FODs. These are provided and explained in the company's safety training for employees.

VI. Conclusion

The researchers conducted a study to determine the most effective techniques for minimizing hazards and foreign object debris (FODs) within the SIAEP. Employees' comprehension of the importance of a safe workplace is also assessed through the survey.

It has been proven that raising safety and FOD knowledge among people involved in the aviation industry is the most effective technique for minimizing or eliminating FOD. The aviation authority, organization, or industry has made adequate efforts to reduce this problem due to the threats of hazards and foreign object debris (FOD). These measures include adopting a FOD prevention program and other preventative measures. It consists of all strategies for eradicating FOD or anything else that is susceptible to FOD as part of the preventive program. In reality, it is one of the most effective means of removing foreign object debris (FOD) in today's aviation environment. It is important to note that the success of this program begins at the highest level of a corporation and becomes more extensive as a result of the participation of subordinates.

Finally, the researchers discovered that everyone in the organization must be constantly aware of the dangers and hazards associated with foreign object debris (FOD) and must make a concentrated effort to eliminate these difficulties. The primary goal of the hazard and FOD prevention program, after all, is to ensure an unsurpassed level of safety throughout the organization. This is done in order to prevent hazards and foreign object debris (FOD) from becoming widespread and resulting in catastrophic failure of the aircraft and everyone on board.

Recommendation:

There are many different kinds of hazards and foreign objects, but they all threaten the safe operation and maintenance of aircraft. A sound Foreign Object Damage (FOD) program, which comprises the following components, should be put in place to handle this potential threat:

- The delineation of hazardous and FOD-risk zones.
- The creation of standards for cleaning and cleanliness
- Handling of hand tools is number three.
- The disclosure of dangers and FODs mitigation methods, as well as the analysis of collected data and feedback on these measures
- Training on hazard and explosives awareness
- Involvement of senior management.

The aircraft manufacturer is putting all of the above-mentioned ideas into action at its manufacturing locations.

The researchers highly recommend that management and subordinates give their full attention to correctly performing jobs and maintaining the aircraft. On the other hand, top-level executives must incorporate strict hazard and FOD avoidance measures into plans, training, and instructions if they are to do this completely.

References

[1]. Xiaoke Yang, Lingyu Yang, Jing Zhang “A WiFi-enabled indoor air quality monitoring and control system” Published in: Control & Automation (ICCA), 2017 13th IEEE International

Conference. School of Automation Science and Electrical Engineering, Beihang University, Beijing, 100191, China.

[2]. Foreign Object Debris (FOD) | SKYbrary Aviation Safety. (2021, May 15). SKYbrary Aviation Safety.

[3]. FOD: Guide to Control & Prevention | Creative Safety Supply. (n.d.). FOD: Guide to Control & Prevention | Creative Safety Supply; www.creativesafetysupply.com. Retrieved April 3, 2022.

[4]. ShieldSquare Captcha. (n.d.). ShieldSquare Captcha; iopscience.iop.org. Retrieved April 3, 2022.

[5]. Articles | Creative Safety Supply. (n.d.). Articles | Creative Safety Supply.

[6]. A study of foreign object damage (FOD) and prevention method at the airport and aircraft maintenance area.

[7]. Aerospace industry | Definition & Facts. (n.d.). Encyclopedia Britannica; www.britannica.com. Retrieved April 3, 2022.

[8]. Aircraft maintenance - Wikipedia. (2012, December 9).

[9]. Definition of FAA | Dictionary.com. (n.d.).

[10]. Foreign Object Debris (FOD) | SKYbrary Aviation Safety. (2021, May 15).

[11]. Hazard and Risk: OSH Answers. (2022, April 3).

[12]. What is the ISO (International Organization for Standardization)? (2021, October 1).

[13]. The definition of an aviation MRO - AirlineBasics.com. (2016, June 14).

[14]. Definition of RISK. (2022, March 24). Risk Definition & Meaning - Merriam-Webster;

[15]. Runway - Wikipedia. (2017, February 1).

[16]. Safety Management System | SKYbrary Aviation Safety. (2021, May 30).

[17]. Stolzer, A., Halford, C., & Goglia, J. (2008). Safety management systems in aviation. Farnham, Surrey, England: Ashgate Publishing Limited.

[18]. ICAO Safety Management Manual, Third Edition – 2013, 21.

[19]. DoD. 2012. Standard practice for System Safety. Arlington, VA, USA: Department of Defense (DoD).

[20]. R. Hussin et al 2016 IOP Conf. Ser.: Mater. Sci. Eng.

[21]. Assessment Of Foreign Object Debris Management Using Group 1 Unmanned Aerial Systems by Lee, Wee Leong.

[22]. "5S for operators: 5 pillars of the visual workplace" Writer: Hiroyuki HIRANO Editions: B&T.

[23]. The jamovi project (2021). jamovi. (Version 2.0).