The Possible Factors Related in Failure to Follow Aircraft Maintenance Procedures

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Abstract: ***The purpose of the project is to study the possible factor related in failure to follow aircraft maintenance procedure. The project will be in quantitative and the instrument used is a survey that will be evaluated for the possible factor on why people failed to follow procedures. The survey will be given to one sample that is line aircraft maintenance technicians in Galaxy Aerospace. The Curry Rule of Thumb table is used to get the percentage of sampling by following the size population of company. The data collected from the survey will be sorted in Microsoft Excel and calculated the Cronbach's Alpha for reliability of the questionnaire using SPSS.***

Keywords: Aircraft maintenance procedure, quantitative, aircraft maintenance technicians, SPSS

I. INTRODUCTION

Overview

The research is to analyze the possible factors related in failure to follow aircraft maintenance procedures. Nowadays, as the commercial aviation industry recognizes that human error rather than mechanical failure is the root cause of the aviation incidents and accidents, it makes the word "human factors" is growing increasingly popular. In addition, human error will exist when humans were involved in any activity. The aircraft maintenances error does not necessarily exist in maintenance only, it may also be a design error, and nevertheless, it is an error that is of concern to the maintenance personnel. Also, the incident and accident can cause because of every human has its own capabilities, strengths, weaknesses or limitation when working.

Next, each aircraft has the proper and standard maintenance documentation that consists of different manuals. Moreover, the documentation that the aircraft maintenance technicians (AMTs) must use to perform the maintenance task is established from the different manuals. The different parts of information warning and caution messages, information for the preparation of the task, information required for the successful performance of the task, the procedure to perform the task, and information about actions to be performed at the end when the task is finished was contained in it. Lastly, in the aviation industry, it is important to do some checks and inspection to maintain the aircraft in the best condition before take-off to fly.

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The aircraft scheduled and unscheduled maintenance, line and hangar maintenance, routine and non-routine checks are the types of maintenance for aircraft. After a certain amount of time or usage, all commercial aircraft should be periodically inspected.

Statement of Problem

Nowadays, the improvement of the technology in aviation industry was rapidly increasing. It helps the people who work in aviation industry use less effort to perform the maintenance check or task. But the machines cannot do the work same as a human because it need to be monitored and maintained by a specialist. That is the reason why the aviation industry still needs to hire AMTs for completing the task or inspection on the aircraft.

Objectives

The main purpose of this study is to find the possible factors related in failure to follow aircraft maintenance procedures among AMTs. Then, the best solution to overcome this problem will be carried out. The specific objectives of this study has been found out. First is to evaluate the possible factors related in failure to follow procedure on aircraft maintenance personnel. Second is to recommend safety measure that can minimize failure to follow maintenance procedure on aircraft maintenance personnel.

Scope and Limitation

Although currently there is less accident or incident related to this study, but the small error will become a more serious matter someday. So, the finding of this study is important to aircraft maintenance technicians by minimizing the mistake and the reputation of the airline company will be less affected when the error caused by AMTs is reduced. Also, it may lower the number of incident or accident related to maintenance due to the failure to follow maintenance procedures and it can also increase the safety awareness or safety precaution in individual or management. The scope for this study, which was initiated by aircraft maintenance technicians, on the issue of the possible factors related in failure to follow aircraft maintenance procedures. It involved the participation of the AMTs from Galaxy Aerospace Company branch in Universiti Kuala Lumpur Malaysian Institute of Aviation technology (UniKL MIAT) in Subang, Malaysia. The respondents, who were working in line maintenance in the company, were randomly selected by the researcher.

The data collected via questionnaires were distributed this year to the company that have been chosen after the questionnaire were completely constructed. There are some of the limitations of the study. First, it hard to approach the aircraft maintenance technicians to do a survey for this study because there is no line maintenance operated in UniKL MIAT. I need to find a company with an operated line maintenance such as Kuala Lumpur International Airport (KLIA), or Aircraft Maintenance Organisation (AMO) like Galaxy Aerospace, AAT Company, and SAE Company. Secondly, there is fewer of the latest journal on the incident or accident related to the study.

II. LITERATURE REVIEW

As mentioned in previous chapter in statement of problem. The problem may seem simple, but the errors made by employees or AMTs can put the entire aviation company at risk. It was calculated that approximately seventy percent of all accidents were attributable to man's performance [1]. Thus, twelve percent of major aviation accidents have been attributed to maintenance and inspection deficiencies [2].

What causes the accident related?

The causes of the accidents in the case study happened had been concluded. In three of the case studies above, it has the similarities or common causes. The following causes to be considered in these finding with respect to the causes of the accident are:

- Boredom
- Complacency
- Violation of procedure or Procedure Abuse
- Short-cut
- Routineness
- Lack of assumption
- Lack of awareness

The AMTs failed to follow established procedure is not uncommon in incidents and accidents of aircraft. Among in these causes of accidents above, the possible factors that lead AMTs failed to follow procedure are boredom, complacency, the violation of procedure, short-cut, and routineness were the possible factors the AMTs failed to follow procedure. This possible factor seem may not give harm on individual or maintenance personnel but with this kind of behavior, it will make the AMTs to perform the unsafe act.

Fuel Tank Component

In the recent FAA-H-8083-31A notice [3], it was stated "a review of accident related data indicates that approximately 75 – 80 % of all aviation accidents are the result of human error. From that, about 12 percent are maintenance related". The problem is one of the human errors arises from the fact that sometimes AMTs fail to follow the established procedures and/or do not read the maintenance documents even if they were required to do so, thereby increasing the risk of committing a clear breach in the procedure mentioned by Zafiharimalala et. al. [4]

The aircraft comes with a manual that defines its envelopes and performance capabilities. The procedure has also created by people and can be documented and understood. But when it comes to people, we face elements of the system that do not contain operating manuals or performance specifications, and sometimes performs in ways not anticipated by the system designers. Some of these failures can be easily explained, errors are wrong, for example, while others are difficult to predict [5].

Every human has the limit while working due to many obstructions and difficulty there were facing through such as time pressure, stress, weather condition etc. Because of that, AMTs tend to make a mistake whether small or big and intentional or unintentional.

Lastly, the Figure 1-1 provided the illustration of the Mandatory Occurrence Reporting (MOR) maintenance error types for the period 2005 – 2011 in CAP 1367 by CAA [6] about 534 events was reported on not following approved data and was represented around 28 percent. Also, the failure to use approved data was the causal factor in the case of incorrect installation events.

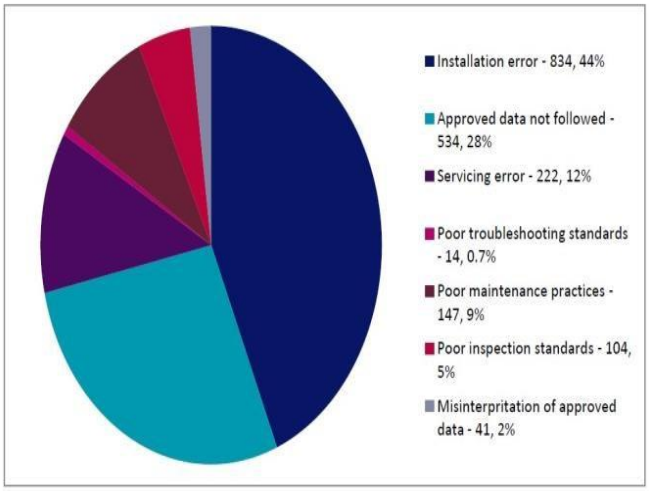

Fig. 1 MOR Maintenance Error Types 2005 – 2011[6]

All the human error may be from the human factors. The preventive method or act should be taken either individual or management to make sure we can reduce the number of incidents or accidents. Using a Swiss cheese model to investigate the factor or causes of the accident happened and not to find the one who cause the accidents. So, it important for the future references and to increase the safety awareness regarding the AMTs failed to follow maintenance procedure.

III. METHODOLOGY

In this study, a questionnaire will be distributed to get respondent feedback and information about the human factor and human error issues in the Aircraft Maintenance Organization. Data of this research were collected by referring to questionnaires that had been distributed among the aircraft maintenance personnel. A set of questionnaires containing a few questions that had been divided into two sections which are, section A and section B.

Section A consists of personal details of aircraft maintenance personnel, which are include the gender, age, education level, level in the organization and working experiences.

For Section B are focusing on the factors of maintenance personnel failure to follow procedure. This section will be divided into four parts which are:

Part A – Boredom
Part B – Complacency
Part C – Norms
Part D – Violation of procedures

The project is about finding the possible factors related in failure to follow aircraft maintenance procedure. The selection of the sampling will from the aircraft maintenance personnel of Galaxy Aerospace. From the population of the company to be survey, the curry rule of thumb is used to get the percentage of data sampling.

The data collected through the sample will be tested using reliability test and will be sort by variables. Results were presented through frequency counts and other descriptive statistics. Form the results, chart can be used to present the data as well as can identify the highest and the lowest number of choices from the respondents.

IV. ANALYSIS

The questionnaires are mainly answered with ratings. Those ratings are the point of the objectives, to gain more understanding about this survey towards the students who will go into the aviation industry.

Reliability Analysis

In this study, the survey was conducted at the Galaxy Aerospace in UniKL MIAT Subang. The researcher decides to apply simple random sampling method because it guarantees that every sample chosen is representative of the population. The pilot test survey was conducted from the population of Galaxy Aerospace. A set of questionnaires was distributed to achieve the objective of the research. The use of SPSS sampling in Table 1 show 0.928 percentages of the 42 questionnaires distributed which indicated the reliability of the questions.

Table. 1 Reliability Statistics

Reliability Statistics	
Cronbach's Alpha	N of Items
0.928	25

Section A - Respondent Demographic Profile

There are 42 participants in this survey, which are from different level of experiences.The respondents' demographic factors considered in the questionnaire are age, gender, having an AMEL, the category of AMEL and working experiences. The distribution of respondents as shows in Table 2, according to the demographic factors

Table. 2 Basic Information

Demographic Profile		Frequency (N)	Valid Percentage (%)	Cumulative Percentage (%)
Age	21 – 30	34	81.0	81.0
	31 – 40	8	19.0	100.0
Gender	Male	36	85.7	85.7
	Female	6	14.3	100.0
Having AMEL	Yes	16	38.1	38.1
	No	26	61.9	100.0
License Category	B1	10	23.8	23.8
	B2	10	23.8	47.6
	Others	22	52.4	100.0
Working Experiences	1 – 5 Years	24	57.1	57.1
	More than 20 years	8	19.0	76.2
	others	10	23.8	100.0

The majority of respondent as shown in table above who answers this questionnaire are from the group age of 21 – 30, these respondents are workers from Galaxy Aerospace branch in UniKL MIAT Subang. The percentage represented by age 21 – 30 = 81% and 31 – 40 = 19%. The percentage is 100% of 42 workers. The target of my research is on Aircraft Maintenance Organization (AMO) which the workers of Galaxy Aerospace represented.

Part A: Boredom

Table. 3 Mean Part A

	Q1	Q2	Q3	Q4	Q5
Mean	2.8095	2.4762	3.0000	2.0000	2.9524

Based on the Table 3 above, it can be concluded that Question 4 have got less mean among the other questions. The question is "When I work on high focus, I will feel bored easily". It concludes that when some of the maintenances are working on high focus task especially the risky job may challenge them so the tendency of them being bored while perform the task is low and the interest of them to follow procedure also increases. It is because the level of their arousal increases and reach to optimal arousal as well as optimal performance.

Part B: Complacency

Table. 4 Mean Part B

	Q6	Q7	Q8	Q9	Q10
Mean	2.4286	2.7619	2.7619	2.8095	2.7143

From the Table 4 above, the author can see that Question 6 has the less mean between the other questions. The question sounds "I become complacent when I have many experiences". It is good to have many experiences but become complacent may affect the behavior of someone and sometimes error or mistake or unsafe act can happen. It concludes that having many experiences can make someone become complacent. that is mean, the maintenances are became overreliance and overconfidence.

Part C: Norms

Table. 5 Mean Part C

	Q11	Q12	Q13	Q14	Q15
Mean	3.3333	2.7619	2.7619	2.5714	2.9524

In Table 5 show that the Question 14 has the least mean between norms questions. The question is "Doing a "short-cut" is normal in my daily work culture". The "short-cut" habit always happened not only in aviation company but taking a shortcut on approved maintenance procedure is the one of example of unsafe Norms. It can be concluded that, maybe among their colleagues they did not care when one of them did not follow the approved maintenance procedure while performing the task. There are many reasons why people always choose to skip or "short-cut" the procedure. Boredom and being complacent also can be the reason of someone do it.

Part D: Violations

Table. 6 Mean Part D

	Q16	Q17	Q18	Q19	Q20
Mean	2.9048	1.9524	2.5714	2.4286	2.7143

Based on the Table 6 above, the author can see that the least mean among the questions in Violations is Question 17. The statement is "I prefer to refer the "black book" or their own references rather than the approved maintenance procedures". It concludes that the respondents are still preferred to refer the approved maintenance procedures even though they have their own references. As the author can see, the maintenances personnel were received adequate continuing training and enough knowledge about violation of the procedures is one of the unsafe acts.

V. CONCLUSION

Based on the survey that had been distributed, it answered the objective that stated in Chapter 1. The objective is to evaluate the possible factors related in failure to follow maintenance procedures. This objective has been perceived by result taken by the survey. The questionnaires show that the what are possible factors of some maintenances failed to follow the approved maintenance procedures. As the author got in the survey that have be done, all the four possible factors, boredom, complacency, norms and violation are the factors why the maintenance failed to follow maintenance procedures.

Part A

In Part A which is boredom. From the survey, it can be concluded that mostly the respondents are neutral and agreed with the all statements given. As a human being, become boredom may happen at any time and anywhere especially if we do not feel challenged by what we do and are not motivated to meet that challenge. In addition, the line maintenances always perform the task and face the same problem almost every day such as inspection and it can make them become lack of interest on the same task. Reading or following the procedure sometimes harder as we need to stay focus. Working on high focus task especially the risky job may challenge the AMTs, so the tendency of someone being bored is low. The incident or slight mistake during inspection may happened because of someone being bored. Yerkes–Dodson law stated that, boredom can develop if the AMTs done the task many times or being stress. As result of that, they will take the easy path and become less interest for the task.

Part B

Next in Part B, the complacency, it is good to have many experiences but become complacent may affect the behavior of someone and sometimes error or mistake can happen. From the result, we can see that having many experiences can make someone become complacent. Also, the confident level increases if someone had done the task before, it can be concluded, they were confident enough to not seek any procedure. But sometimes complacent people will have the 'absent minded' mistake. The respondents agreed that the complacency may develop the automation skill in someone and the procedure is no longer needed because of that existence. Besides that, become complacent make them always complete the task with their own decision.

Part C

In Part C, norms, the work culture of the company plays an important role in extracting the best out of the employees. The result in chapter four show that, the respondents are really satisfied with the work culture of their company. When it comes to culture, some of the respondents agreed as not seeking the procedure become their habits but some of them are disagreed with that. In addition, maybe among their colleagues do not care when one of them not follow the procedure, because many of respondents agreed that they feel it is no wrong for not seeking the procedure. The "short-cut" habit always happened not only in aviation, but from the survey many respondents are neutral whether to agree or disagree with the statement, maybe sometimes they did a shortcut on the approved procedure but not make it as a habit.

Every person likes to work with their own skill if they want to solve the problem, it is very easy and more comfortable to complete the task quickly.

Part D

Lastly, the author found in Part D, violations, that many respondents have their own references such as "black book" or notebook. In author opinion, they maybe have their own references as they record on what they need to do or as reminder and maybe noted the important things. Also, the respondents are still preferred to refer the approved maintenance procedure rather than their own reference. Skipping the procedure can happen when someone being bored and being bored happened because of various of external factor such as, repetitive task, fatigue or stress. In addition, the respondents may have many experiences on the task given, so they prefer not to seek the procedure. There are many reasons why people always choose to skip or "short-cut" the procedure. Boredom, being complacent and norms also can be the reason of someone violate the procedure.

Safety Recommendations

Based on the results of the survey regarding the possible factors related in failure to follow approved maintenance procedure, the author found the suitable safety recommendation on reducing human factors errors in their organizations.

Training

Firstly, the organization should ensure that all maintenance personnel receive adequate continuing training every two years in order to ensure that the staff has up-to-date knowledge of related technology, organizational procedures, human factors issues. The organization should also set up a sustainability training program to validate the staff.

Organizational Measures

Secondly, recognizing all factors that may affect attitudes and labor behavior, organizations can establish practical management strategies to reduce violations. Organizational measures should mainly be directed towards improved management and supervision methods, work design, procedure design, equipment design, and training. However, management strategy needs to start with honest and clear management responsibility. Actual or perceived pressure from supervision or management of cutting angle has been found to promote violations of the procedure.

Management's Recognitions

Thirdly, management must be sensitive to employee's poor recognition of safety and operational risk. The management must constantly monitor the situation not meeting the expected standards and take measure to rectify the situation or discipline officials in exceptional circumstances. Organizations should make clear policies regarding the expected behavior of the employee. The reasons for discipline must be clearly stated and discipline should be given once a violation is identified. Supervisory authorities must be consistent and do not allow procedures violations under certain conditions.

SOPs

Lastly, a well-designed and written procedure can help reduce the likelihood for errors. To accomplish this, there should be an effective job design, task analysis, and the use of reminders in the written procedures to help reduce the likelihood of omission of procedural steps. Then, an effective training program must be implemented to assure that all employees have a minimum level of knowledge and are aware of the implications of violating any procedure.

In this safety measure recommendation, based on the data from the survey had been done, the author has come out the safety measure that reliable to accomplish or done by the organization and the individual. From that, the second objective is to recommend safety measure that can minimize failure to follow maintenance procedure on aircraft maintenance personnel has been answered. Moreover, the human error cannot be eliminated but we can try to reduce it. By reducing the human error, all the unsafe act that may happen can be minimized as well as the number of incident and accident related with this kind of possible human factor.

VI. CONCLUSION

This study was able to achieve all objectives of the research the findings show a positive relationship between the human factor issues and human error. The study has been able to show the main human factor issues which are boredom, complacency, norms and violations that effect on Approved Maintenance Organization. The conclusions, this study provides an overview on the human factor issues in perspective of Approved Maintenance Organization. Human error cannot be eliminated but we can try to reduce it. The Approved Maintenance Organization must have a solution to reduce human error to avoid unwanted thing like delay, high cost maintenance and so on. Hopefully, the findings of this study can serve as guidelines for the other researcher for their studies. The survey is to provide practitioners with a general overview of the prominent human error perspectives typically espoused in the aviation human factors literature. Examples of frameworks that characterized each approach were provided, as well as a critique of the relative strengths and weakness of each perspective. A brief discussion of some objective criteria for evaluating error frameworks was also presented. The hope is that this critical overview of human error perspectives and evaluation criteria will help make practitioners better analyzer of error-analysis systems and will allow for more informative discussion to occur between practitioners and human factors professionals when developing error management program.

In addition, surveys can always be modified and adapted to improvise various SOPs and protocols within many organizations and departments in aviation. These departments include research units that have been doing many research on other technological and social science progress, e.g. increasing personnel's sensitivity towards safety [7-16], innovating airplane avionics [17-24] and mechanical parts [25-27], staffs' personal development [28-29], and line productions' advancement [30-36].

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