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Human Factors in Aircraft Maintenance

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Abstract: Aircraft maintenance is the one of the critical aspect in the aviation industry. Human error is cited as a major causal factor in most 80% aviation mishaps, including the 15% - 20% that involve aircraft maintenance error. In this paper, the analysis of human factors in aircraft maintenance (HFIAM) has done to reduce human errors and to improve the current maintenance practices in order to decrease the number of aviation mishaps caused by maintenance-related error. In this paper a Self Descriptive Method- A quantitative descriptive approach adopted to collect and assess the data. A survey administered to a sample population of aircraft maintenance engineers and technicians in regional airlines revealed a steady problem with aviation human errors and the need for a more unified structure to manage human errors in aircraft maintenance. Overall the method adopts a practical, cost-effective and balanced approach to applying Human factors to improve overall organizational effectiveness, culture, personal learning and growth.

Keywords: Aircraft Maintenance, Human Factors in Aircraft Maintenance (HFIAM), Aviation Mishaps, Self-Descriptive Method, Airlines, Survey.

I. INTRODUCTION

Aircraft Maintenance is a complex activity as economical point of view. Human factors or ergonomics is defined as the study of human performance with the people, work, equipments, environment and work organisation [1].Today, more than ever, the aviation industry is facing a constant challenge of addressing human factors in aircraft maintenance. There are several advances to the study of human factors, still several inconsistencies in the human factor training programs for implementation and hence the varied results [7].

Events around the world in the late 1970's 1980's, 1990's and early 2000's involving aviation mishaps alerted the aviation industry to the fact that aircraft were becoming more trustworthy and the human being in this process had the potential to annihilate any of these technological advances[2]. The role played by human performance from past to today can find below [4].

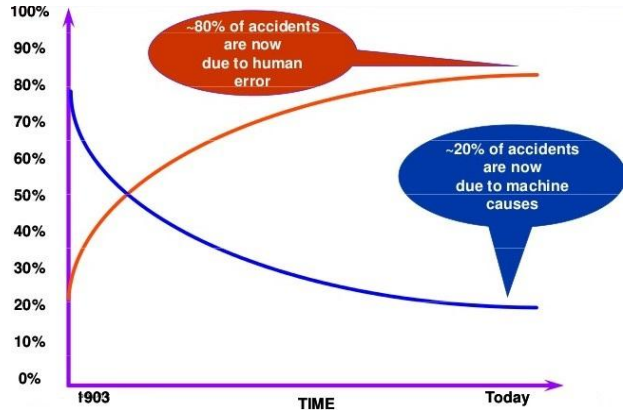

Figure 1: Role of human performance in aviation mishaps

The term human factors in aircraft maintenance (HFIAM) evolved in 1998 during the CAA 12th symposium. Later ICAO incorporated the HFIAM training for the maintenance personnel to prevent human errors occurring [2].

This paper focused on list of "Dirty Dozen" the twelve most common human errors that can cause aviation mishaps developed by Gordon Dupont of Transport Canada [3]. These are

1. Lack of communication
2. Lack of Knowledge
3. Complacency
4. Lack of Teamwork
5. Distraction
6. Fatigue
7. Lack of Resources
8. Pressure
9. Lack of Awareness
10. Lack of Assertiveness
11. Stress
12. Norms

This paper analysed the top human factor problems in the aircraft maintenance and to appraise the holistic solution to address human error problems through a Self Descriptive Method- A quantitative descriptive approach. Survey feedback is the sole source of the data. We will also delve into the current human factor programs adopted by the several organizations and also try to understand why human error will occur, how comprehensive and the solution adopted by the organization to eradicate human errors[5].

Prior research has been carried out to create human free environment.

This paper interprets analogous probable information to wipe out the human error in aircraft maintenance which affects the maintenance activity and also directly influence the cost and aviation safety [6].

II. METHODOLOGY

In this paper method used for this study was the self-report descriptive method is depicted in the figure.

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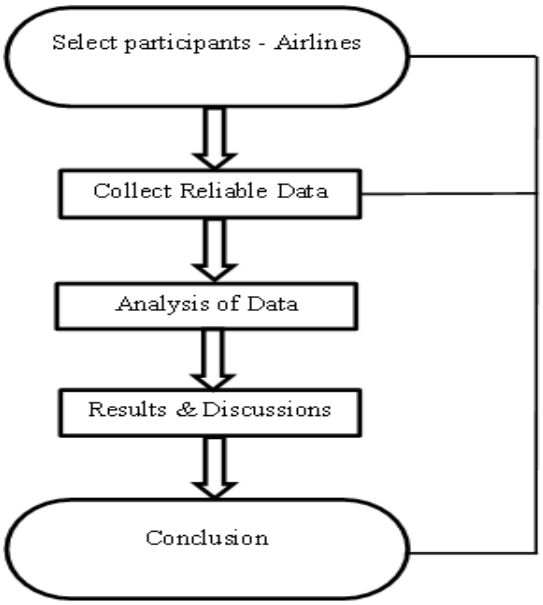

Figure 2: The Process of the study

We will identify the demanded human errors in aircraft maintenance with the reference of survey. The data collected will be classified and analysed to avoid human errors in maintenance.

3.1 Select Participants- Airlines

In this paper collected a wealth of HFIM data and feedbacks from 5 regional organizations to understand the current state of HFIAM and the actions presently implemented. The survey made that will be directly interacted to 3 regional Airlines from Aircraft Maintenance Engineers (AME) and Technicians. The sample population of 100 maintenance personnel is used for this research

3.2 Collect Reliable data

The data collected in this research through a designed survey. The survey comprised to determine the organization, job description, total aircraft maintenance experience in the organization, HFIAM awareness and nine questions designed to find out the employment and effectiveness of HFIAM programs

3.3 Analysis of Data

Upon completion of survey each question was reviewed to evaluate for the relevancy to the purpose to determine the potency of HFIAM programs.

Table 1 - Survey coverage and objectives [2]

Survey Coverage	Objectives
Human Factors Program	To find out if the surveyed classical has a Structured HFIAM program in their organization
	To find out from how many years the HFIAM program has been in existence
	If HFIM program is not existing, then to find out if it is important to have HFIAM program
Human Factors in Aircraft maintenance	To find out if the HFIAM programs in the organization currently implemented have improved Human errors
	To find whether the training and tools currently available is acceptable to manage HFIAM errors in the organization
	To find out if More needs to be done to manage HFIAM errors in maintenance
Most common Possible outcomes of Safety occurrences	To find out what are the most common Possible outcomes of HFIAM safety occurrences
	To find out the most common reason for these Possible outcomes
	To find out the areas needed to be focus to reduce HFIAM errors.

III.RESULTS & DISCUSSIONS

The results of the Human Factors in aircraft maintenance (HFIAM) Survey carried out from January 2016 to February 2016 can be found below.

Table 2 - Survey Demography

Overall					
Participation by MRO's/Airlines					
			Maintenance personnel's-Airlines(A)		
Total (Q) =		**100**	**A-1**	**A-2**	**A-3**
Total participants (TP) =		**89**	35/40	31/35	23/25
Participation Rate = (TP/Q)%		**89%**			
Participation by Airlines (A) = (A-1,2,3/TP)%			87.5 %	88.5%	92%
Participation by Years of Service in Airlines					
			Years of Service (X)		
AMEs	37	41.57%	X<10 yrs.	X<10-20yrs.	X>20 yrs.
Technicians	52	58.42%			
No. of participants by Yrs of Service (Yrs) =			43	27	19
Participation by Yrs. of Service = (Yrs/TP) %			48.3 %	30.3%	21.34%

Of the regional airlines surveyed, 92.13% have a structured Human Factors in Maintenance Program. Of these regional Airlines that have a structured program, 62.92% have had it for more than ten years. Most Airlines agree that the HFIM programs in the organizations have improved human factor in maintenance. The responses on the effectiveness of tools and training to manage human factor in maintenance in that 95.49% thought they were acceptable. However, 96.62% of those surveyed evidently felt that "More needs to be done to manage HFIAM errors". The below bar chart represents the breakdown of HFIAM survey results

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Table 3- Human Factors in Aircraft Maintenance (HFIAM) survey results

Human Factors in Maintenance (HFIAM) Survey (%)	Strongly Agree	Agree	Dis agree	Strongly Disagree
There is a **structured** HFIAM program in your organization?	41.57	50.56	5.61	2.24
	92.13%		**7.85%**	
If yes, from how **many years** it has been in existence?	> 10 years	5-10 years		< 5 years
	62.92	**37.07**		0
If no, it is **important** to have HFIM in the organisation?	100	0	0	0
	100%		**0**	
HFIAM programs implemented in your organization have **improved** the management of human errors	34.83	53.93	6.74	4.49
	88.67%		**11.23%**	
Training and tools currently available in your organization are **sufficient** to manage HFIAM?	26.96	68.53	4.4	0
	95.49%		**4.4%**	
More needs to be done to manage HFIAM errors?	60.67	35.95	3.33	0
	96.62%		**3.33%**	

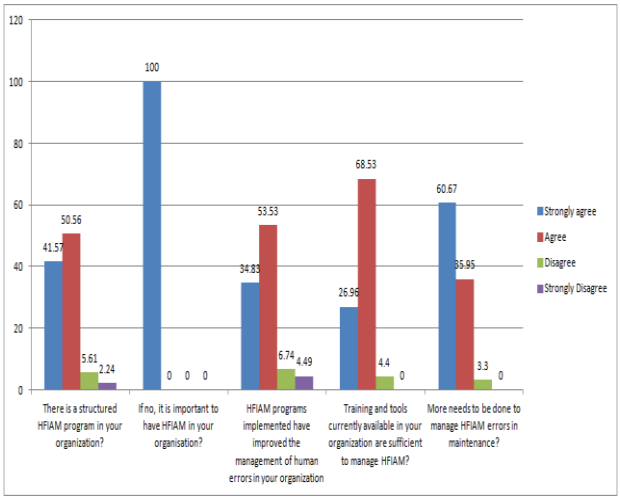

Figure 3: Breakdown of HFIAM survey results

Table 4- Most common Possible Outcomes of safety Occurrences

In your opinion, which of these are the most common outcomes of HFIAM safety occurrences?		
MPO	**Outcomes**	**%**
1	Incorrect assembly or orientation of part	**66.29**
2	System operated unsafely during maintenance	**53.93**
3	Part/aircraft damaged during repair	**33.70**
4	Injury to personnel	**31.46**
5	Tool lost on aircraft/in maintenance facility	**23.59**
6	Material left on aircraft	**16.85**

The highest common possible outcome of HFIM safety occurrences were "Incorrect assembly or orientation of part" and "System operated unsafely during maintenance". More than 50% of those surveyed thought that these were the primary outcomes of safety occurrences in their organization. The below pie chart represents the breakdown possible outcomes of occurrence

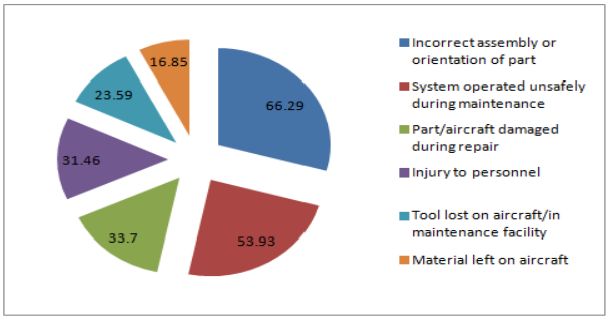

Figure 4: Most common possible outcomes of HFIAM safety occurrences

Table 5- Most common likely reason of Safety Occurrences

The most likely reason for the safety occurrence of these outcomes?		
MPO	**Outcomes**	**%**
1	Pressure	**64.04**
2	Supervision	**52.80**
3	Lack of Training	**50.56**
4	Fatigue	**31.46**
5	Lack of Equipment	**20.22**
6	Environment	**15.73**

In the opinion of those surveyed, 64.04% listed "Pressure" and 52.80% "Supervision" was the dominant reason for the occurrence of safety encroachment. The below pie chart represents the most possible outcomes of safety occurrence

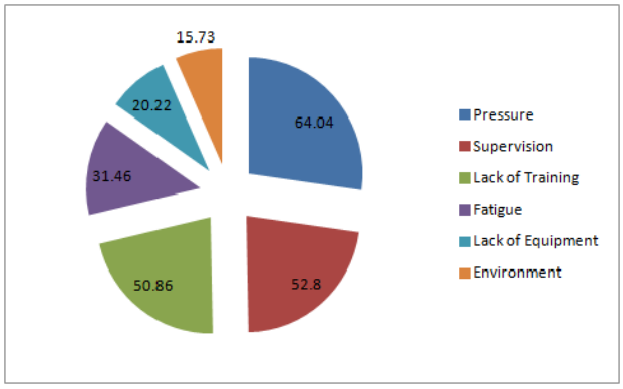

Figure 5: Most common likely reason of HFIAM safety occurrence

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Table 6 - Top HFIAM drivers that need reviewing

The most likely reason for the safety occurrence of these possible outcomes?		
MPO	**Outcomes**	**%**
1	Attitudes of personnel	**85.39**
2	Training effectiveness	**66.29**
3	Leadership	**42.69**
4	Organizational Culture	**24.71**
5	Processes	**16.85**
6	Management of Information	**11.23**

In the opinion of those surveyed, 85.39% listed the "Attitudes of Personnel" and 66.29% listed "Training effectiveness" as the main causes that need to be focused to better manage of human factors in maintenance. The pie chart represents the top HFIAM drivers that need reviewing.

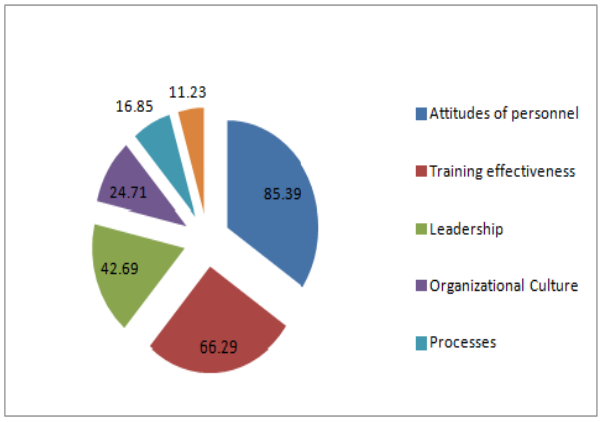

Figure 6: Top HFIAM drivers that need Reviewing

Impact of experience on human factor in aircraft maintenance

There were three categories of those surveyed, namely, those with less than ten years of experience, those between 10-20 years of experience and those with more than 20 years of experience in their corresponding organizations. The results of the survey shows that the experience level had slightly or no effect on the views of current human factor in aircraft maintenance programs, that is, even those with a few years of experience had similar responses to the potency of human factor in maintenance and the types of possible outcomes of safety occurrences.

IV. CONCLUSION

The aviation industry could not operate without the involvement of maintenance personnel, yet human error in maintenance is significant threat to aviation safety. Hence a holistic and integrated approach to manage HFIAM is supported in this paper. In terms of organizational reviews to maintenance errors involves following two ways.

1. Firstly, the contingency of human errors in maintenance can be eradicate by analyzing the error prone conditions in the organizations which involves the consideration of fatigue, human factors training, appropriate tools and equipment, and other actions assisted at the human factors correlated with maintenance error.
2. Secondly the organizations can review the inevitable natural hazards of maintenance error such as attitude of personnel's, organizational culture to diminish consequences of those errors.

The conclusion of this paper is fruitful to aircraft maintenance organizations in rebate of human errors which directly affect the cost and aviation safety.

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