International Journal of Engineering & Technology, 7 (4.13) (2018) 71-73

International Journal of Engineering & Technology

Website: www.sciencepubco.com/index.php/IJET

Research paper



Preventing human error at an approved training organization using Dirty Dozen

Abdul Ghani Abdul Samad*, Muhd Khudri Johari, Sabri Omar

Universiti Kuala Lumpur – Malaysian Institute of Aviation Technology, Dengkil, Selangor, MALAYSIA
**Corresponding author E-mail: abdulghani@unikl.edu.my*

Abstract

Following a recently-submitted review on a few human factor identification models (interpretations of Professor Edwards' SHELL Model, Boeing's Maintenance Error Decision Aid (MEDA), Professor Reason's Swiss Cheese Model, and Dupont's Dirty Dozen), researchers have unanimously agreed on choosing the Dirty Dozen model for this quantitative study before its official implementation in hangars and workshops at Universiti Kuala Lumpur – Malaysian Institute of Aviation Technology (UniKL MIAT). This study measures the levels of awareness and effectiveness of UniKL MIAT's current human factor safety practices. A specifically-tailored, comprehensive, Dirty Dozen checklist is produced and distributed as survey questionnaire to 120 UniKL MIAT's students. Data from all 48 questions related to all 12 domains of Dirty Dozen are analyzed. The results shows that out of all 12 domains, six (*Lack of communication, Lack of teamwork, Norm, Pressure, Lack of attention, Stress*) are marked with "*Agreed*" and the other half (*Complacency, Lack of knowledge, Lack of resources, Distraction, Lack of authority, Exhaustion*) are marked as "*Not Sure*" in terms of awareness and effectiveness of their current human factor's safety practices. These results will be reviewed by the top management of the university to take preventive actions and improvements for future human factor safety implementations. As Dirty Dozen is known to be the simplest technique to measure human error, it is significantly appropriate to be applied as this experiment's variable, especially for students who are still studying and have no industrial working experiences.

Keywords: *Dirty Dozen; human error; human factor identification models; UniKL MIAT.*

1. Introduction

Evolution and modernization have taken aircraft systems to newer and greater heights, which correlates with the notion that identification of technical or system failure can be done with more accessibility and convenience, especially when the technology becomes a great assistance for the people involved. However, being imperfect also means humans can still have a chance to make errors and this includes the ones responsible for aircraft maintenance worldwide [1]. Researchers have found out that in the 1990s, man-made mistakes have been responsible for 20% of flight accidents in the early years and the number has increased to 80% not long after. In fact, the number has kept on increasing by time [2].

The list of most frequent recurring maintenance discrepancies has been circulated by Civil Aviation Authority (CAA) [3]. The list is focused on two separate categories in terms of the most common occurrences: airlines organization related maintenance and that of non-airlines. In short, the first category has six specific outcomes that include incomplete installation, fitting wrong part, loose object in aircraft, inadequate lubrication, cowling, access panel and fairing are not secured, and lock pin on landing gear has not been removed before the aircraft departs. Meanwhile, the second category has three general outcomes: incorrect assembly or orientation, incomplete installation and persons contacting hazard.

Rashid *et. al*. [4] have managed to concurrently analyze the sample population and identify the types of maintenance errors that have ultimately caused the stated safety occurrences. They found out that the most frequent maintenance error, which totals for 23% of the given sample, is the usual combination of *'no or improper inspection'* that led to the defect; not detected error. Another 18% of the population sampled have revealed that maintenance personnel have cut short on the maintenance procedure steps as outlined in the Airworthiness Directive or Service bulletin requirement. In particular order, the other three most frequent errors are incorrect installation (14%), part or material omission (12%) and improper fitting and torque (6%). Therefore, human factors should be included in repair procedures and trainings as well as the certification and qualification of technicians and inspectors. This is one of the many ways to prevent aircraft accidents even before their engines are being initiated.

As the pioneer in offering aircraft maintenance as university programs and courses, Universiti Kuala Lumpur-Malaysian Institute of Aviation Technology (UniKL-MIAT) has been equipped with hangars and workshops to maintain aircraft for both business and learning purposes. UniKL-MIAT currently uses the SHELL model for human factor and safety awareness. SHELL model focuses on the relationships that naturally exist between humans and various components of the system they work with, which in this particular case is the aviation system. This generates the specific structure or platform to enhance the existing relationships within the aviation system. On the other hand, for the Dirty Dozen model, it describes the common error(s) on typical aircraft maintenance tasks. Hence, for each item on the dirty dozen list, there are examples of counter measures that have been designed to reduce the possibility of any human error from causing any problem. It is hoped that these can

Copyright © 2018 Authors. This is an open access article distributed under the Creative Commons Attribution License, which permits unrestricted use, distribution, and reproduction in any medium, provided the original work is properly cited.

improve the students' awareness by recognizing on how the maintenance personnel can possibly contribute to not just aircraft incidents.

2. Dirty Dozen model

Dirty Dozen describes 12 most common possible causes for any maintenance personnel to make errors in their judgments during work. These errors may occur because of one or more causes from these stated 12: lack of communication, lack of teamwork, lack of knowledge, norm, pressure, complacency, distraction, exhaustion, lack of attention, lack of resources, lack of authority and stress [5]. Aircraft maintenance workshop as the workplace can always be a series of complicated systems [6]. It can now be ascertained that aircraft incidents can be caused by both system [7] and also human error [8]. According to Alpo Vuorio *et. al*., preventive actions should focus on the interactions between system components [9]. In any complex system, workers' behaviours could cause an accident but the accident might also be due to the complexity of working environment that leads to unplanned interactions at the system level, which is especially crucial in the aircraft maintenance centres [10] and airports [11], in general. It might even happen at the aviation training schools since these centres involve trainers and instructors; whom are profesionally expected to not be affected by personal problems during teaching [12].

Considering the stated notions above, UniKL-MIAT is trying to find out whether the students are aware or not about the concept of Dirty Dozen as it is quite generic. In order to do that, a survey will be carried out to find out if UniKL MIAT students can relate their previous experiences and knowledge with the current human factor implementation concept. No first year student will be involved in this particular survey as they would not have enough experience and knowledge to respond to the questions provided.

3. Methodology

The researchers have decided to apply the simple random sampling method since it guarantees that every sample chosen is representative of the population. A set of specifically-tailored human factors questionnaire is developed to reflect all 12 Dirty Dozen items. The respondents' demographic factors that are considered in the questionnaire are age, gender, semester and level of academic studies at UniKL-MIAT. They consist of experiences from various levels of academic qualifications and industrial experiences. Further demographic details are tabulated in Table 1. Aside from demographic profiling questions, every Dirty Dozen item has been categorized with four questions each; making it 48 questions in total. The questions reflect the possible risk of misappropriating human factors in the maintenance workshops, awareness of Dirty Dozen among students and also suggestion forms to improve the current practices or problems faced. A few examples of questions from the questionnaire are shown in Table 2.

All 120 respondents have received the questionnaire with a Likert-scale on 1 being the lowest (Strongly Disagree) to 5 as the highest (Strongly Agree). In the quantitative analysis, both *Strongly Disagree* and *Disagree* are labelled as "Disagree" while both *Strongly Agree* and *Agree* will be classified as "Agreed". The number 3-scale, on the other end, signifies *Not Sure*. The 48-item questionnaire is deemed to be reliable after SPSS shows its Cronbach Alpha value is 0.838. Means from respective questions of each Dirty Dozen item will be averaged to get the most valid result as conclusions.

Table 1: Respondents' demographic data

Profile	Value	Frequency (N)	Valid Percentage (%)	Cumulative Percentage (%)
Age	18	6	5.0	5.0
	19	30	25.0	30.0
	20	2	1.7	31.7
	21	14	11.7	43.3
	22	16	13.3	56.7
	23	20	16.7	73.3
	24	22	18.3	91.7
	25	4	3.3	95.0
	26	4	3.3	98.3
	28	2	1.7	100.0
Gender	Male	116	96.7	96.7
	Female	4	3.3	100.0
Semester	3	46	38.3	38.3
	4	74	61.7	100.0
Level	Diploma	40	33.3	33.3
	Degree	40	33.3	66.7
	EASA	40	33.3	100.0

Table 2: Sample questions from questionnaire

No.	Description
1	Is the work instruction very clear?
2	Instruction is given through discussion.
3	Mistake can occur without proper instruction.
4	Never had experienced that the instruction is not clear.
5	Supervisor often assists with tasks.

4. Results and discussions

Table 4 below indicates the means of the respondents' total number of responses towards the questionnaire. Collective responses gathered are either *Not Sure* or *Agreed* in the survey. Since all the respondents answered the questionnaire to the fullest, researchers have taken into consideration that these results are reliable and can be used for UniKL-MIAT top management's reference in upcoming meetings and discussions related to Dirty Dozen implementation.

Table 4: Means obtained from questionnaire

No	Dimension	Mean	Conclusion
1	Lack of Communication	3.95	Agreed
2	Lack of Teamwork	3.95	Agreed
3	Norm	3.98	Agreed
4	Pressure	3.82	Agreed
5	Complacency	2.97	Not Sure
6	Lack of Knowledge	3.17	Not Sure
7	Lack of Attention	3.52	Agreed
8	Lack of Resources	3.04	Not Sure
9	Distraction	2.79	Not Sure
10	Lack of Authority	2.57	Not Sure
11	Exhaustion	3.38	Not Sure
12	Stress	3.72	Agreed

Lack of communication values have clarified the habit of respondents in making assumptions to express their understanding of the given instruction instead of re-affirming their comprehension with supervisors or fellow colleagues within the same department. With that in mind, most agree with the notion that lack of communication can cause great risk and threats in their working environments. In the meantime, *lack of teamwork* is mostly agreed as the nature of aircraft maintenance involves supervisors assisting their supervisees almost all the way from beginning until the job is finished. Hence, working together has been widely accepted as imperative. Moreover, *pressure* correlates well with teamwork because it involves enormous amount of tasks with tight deadlines. Respondents agree that it is perfectly normal for many aircraft technicians to simultaneously do more than two or three tasks with a limited amount of time as aviation companies look at time as money, just like other transportation businesses. Meeting deadlines would also ensure customers' loyalty.

Norm in aircraft maintenance reflects the exercise of referring to the manuals and documenting any update and result every time a work has been done. While some may try to not referring to maintenance manuals whilst repairing aircraft parts, it will only cause personal and professional consequences as it is unethical and can be penalized with huge reprimands, fines or even suspension. On the other hand, *complacency* is definitely an issue in

some countries or aviation companies but the respondents involved are not particularly sure. This might be caused by their current workshop cultures and practices, which have been incorporated with fast-paced and well-disciplined values. Another item that the respondents are quite unsure of is *lack of knowledge*. By definition, aircraft technicians have their own specialization in terms of aircraft parts' maintenance skills. Their previous and also current practices most probably enable them to utilize their own specialization with the tasks given to them from time to time. Therefore, they would not know how to react with the possibility of getting a task card that requires a different skills set.

As for *lack of attention*, this can be mostly agreed upon because the respondents have learned and perhaps, experienced beforehand, that sloppy work, need to be redo tasks, singularizing one task for a long time, or constantly asking for clarifications on instructions will only cause failures and de-motivation. Being students regardless of their age and working experiences, universities must comply with the rules and regulations stated by the government and the specific auditing agencies. This includes sufficient tools, references, expertise and equipment for training and practical exercises. In MIAT, they are fortunate that they never have the problem of *lack of resources*. As stated previously, well-disciplined working culture has been a strong advantage in UniKL-MIAT workshops. Possible *distractions* such as phone calls and texts, idle chit-chats, and sound entertainments are strictly prohibited while working in workshops since their establishment in 1996. This is very crucial in developing strong personalities of self-control and professionalism.

Lack of authority is also in doubt because, unlike any other typical transportation maintenance like cars and motorcycles, which can be done independently or without direct supervision, every work done needs to be observed at all times by their direct supervisors. While some may argue that *exhaustion* will always be a problem, it can be minimized effectively with an optimal delegation of work and also manpower for any task. Working together with a sense of strict discipline will foster satisfaction for a job that has been done well. In addition, respondents being quite unsure could also mean that they rarely or never have the experience of working without any help of assistance from supervisors or colleagues. Hence, they never feel the extreme level of tiredness whilst on the job. The last item, *stress*, would be a problem to many people as it is perfectly normal to feel stressed out at some point while working. For these respondents, not everyone is happy or satisfied all the time, be it for coming to workshop every day or in terms of doing their work in harmony and effectively. Throughout the learning processes, these students are hoped to learn from experiences of the stresses and succeed in finishing their tasks with excellence.

5. Conclusion

Based on the statistics obtained from the survey conducted by the researcher, human errors are concluded as the major cause of accident in hangars and workshop maintenance. It can be said that human error related to Dirty Dozen plays an important role and it is one of the effective ways to reduce the accidents in hangar and workshop maintenance. The human error identification and effectiveness model should be implemented to give the guidelines and awareness on the prevention maintenance technique. It is essential that every student who is working in hangar and workshop understands that no matter how simple the task is, if it is not done properly, the results can be serious. It is very important on high technology and complex system of the aircraft. Preventive measures of human error identification should be implemented for the student in UniKL-MIAT.

References

[1] Pons D & Dey K (2015), Aviation human error modelled as a production process. *The Ergonomics Open Journal* 8, 1-12

[2] Zhang R & Yang J (2006), Association rules based research on man-made mistakes in aviation maintenance: A case study. 6th International Conference on Intelligent Systems Design and Applications

[3] Wang L, Sun R & Yang Z (2009), Analysis and evaluation of human factor in aviation maintenance based on fuzzy and AHP method. IEEE International Conference on Industrial Engineering and Engineering Management

[4] Rashid H, Place C & Braithwaite G (2010), Helicopter maintenance error analysis: Beyond the third order of the HFACS-ME. *International Journal of Industrial Ergonomics* 40(6), 636-647

[5] Dupont G (1997), The dirty dozen errors in maintenance. 11th Symposium on Human Factors in Aviation Maintenance

[6] Salmon PM, Lenne MG, Stanton NA, Jenkins DP & Walker GH (2010), Managing error on the open road: The contribution of human error models and methods. *Safety Science* 48, 1225-1235

[7] Salmon, P., Lenne, M., & Stanto, N. (2010). Managing Error on The Open Road: The Contribution of Human Error Models And Methods. *Safety Science*, 1225 - 1235.

[8] Liang G, Lin J, Hwang S & Wang E (2010), Preventing human errors in aviation maintenance using an online maintenance assistance platform. *International Journal of Industrial Ergonomics* 40(3), 356-367

[9] Vuorio A, Rantonen J & Johnson C (2014), What fatal occupational accident investigators can learn from fatal aircraft accident investigation. *Safety Science* 62, 366-369

[10] Khairuddin MH, Yahya MY & Johari MK (2017), Critical needs for piston engine overhaul centre in Malaysia. *IOP Conference Series: Materials Science and Engineering* 270, 012013

[11] Bardai AM, Er AZ, Johari MK & Mohd Noor AA (2017), A review of Kuala Lumpur International Airport (KLIA) as a competitive South-East Asia hub. *IOP Conference Series: Materials Science and Engineering* 270, 012039

[12] Johari MK & Jamil NZ (2014), Personal problems and english teachers: Are they always bad? *International Journal of Applied Linguistics and English Literature* 3(1), 163-169