Analyzing the Impacts of Poor Maintenance Practices on Aircraft Operations

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**Abstract**

The purpose of this project is to examine the main causes of poor maintenance practices on aircraft operations and how human factors associated with aircraft operations. Human factors are considered as one of the biggest threat to the Aviation industry, and the researchers will find out how the numerous technological advancements made within aircraft industry to ensure proper maintenance procedures are being performed and facilitated on current aircraft operations. The poor maintenance practices which are being utilized these days are imposing many problems. Researchers will introduce that what change is required in the technology to improve the poor maintenance practices. Currently, poor maintenance practices are considered one of the leading cause of aircraft accidents. Poor maintenance impacts the aviation industry as a whole. Researchers have the current data on the impacts of poor maintenance practices on aircraft operations and how it is affecting human factors in aviation accidents. There are many variables which have the potential to impact aircraft operations through poor maintenance practices, and this research paper intends on discussing quite a few of them.

**Introduction**

Since the beginning of the 20th century, it has been observed that most of the incidents and accidents have been caused due to poor maintenance. Poor maintenance has caused many fatalities and injuries during the 20th century. There were about many incidents which were discussed in the report by the national transportation safety board due to poor maintenance of the aircraft operations. The main aspect of poor maintenance was considered as human errors which are responsible for all the incidents happened due to poor maintenance. The errors of humans have been responsible for over half of the entire aviation accidents because they don't perform proper maintenance of the aircraft (Griffin & Young & Stanton, 2015).

There were also many incidents which were because of the system failures which is not considered as a human error, but there has been a massive amount of incidents caused by the maintenance errors in the aviation industry. The aviation industry requires to use quality systems for the maintenance of the aircraft. Researchers have been observing to establish the cost-effective methods which help in aircraft operations to provide effective ways of maintenance to the technicians.

This paper will present the influence of maintenance errors on the aircraft operations. The maintenance policy will be announced in this paper to monitor aircraft operations. Maintenance policy is not only the requirement to reduce incidents, in this paper safety and management policies are also discussed which will help the aviation industry to avoid any causality in the future. The maintenance policy will also discuss the safety of the technicians that they should not be punished for any accident or incident and management should be responsible for any accident or incident.

**Background**

Over the past years, the strategies for the maintenance of aircraft have been changed due to the history of the aviation accidents which are mostly caused because of poor maintenance of aircraft. The current strategies for the maintenance are helping a lot in decreasing the number of accidents, but technology has brought a lot of changes to the current system of aircraft operations which was increasing the rate of aviation accidents. New technologies in the aviation industry have been increasing rapidly, and it is the requirement of the technologies that technicians must be professional, dedicated and most importantly flexible while performing their aviation tasks.

Aviation accidents are increasing because of the poor maintenance of aircraft. The reasons which were responsible for the incidents were maintenance errors, human errors, engine failures or technical failure. However, the new technology is helping a lot in improving aircraft components and decrease the rate of the accidents. Maintenance errors are one of the major concern for the incidents, but management is also responsible for the incidents because management has to ensure that issues of technicians are being resolved.

The training programs which are managed by organizations are not providing proper knowledge to the technicians. There are no proper measures for the safety of the aircraft set by organizations. The leading cause of aviation errors is poor maintenance which is due to lack of communication, no teamwork, stressful environment, and pressure of deadlines. The higher authority of aviation is responsible for ensuring the safety of the aircraft and providing a strategy which will help in future to avoid any casualty.

**Literature Review**

The researched resources contain information about the impacts of poor maintenance on aviation operations and causes of aviation incidents due to such failures. Aviation safety is a very important factor to avoid any incident, and it depends on reducing errors in all the aspects of the system. Human error is one of the primary concern for aviation safety which is responsible for many incidents. More attention should be paid towards the inspection and reducing human errors in the aircraft to avoid any severe incident (Latorella & Prabhu, 2000).

Aviation inspection and maintenance tasks are being performed by multiple organizations. The inspection and individual tasks are being performed in a very complex environment where the problems which individuals face are difficult rotating conditions, time pressures, and scattered feedbacks. These problems are the leading causes of human errors in the maintenance of aircraft operations and cause many severe accidents in which many people lost their lives (Latorella & Prabhu, 2000).

The research found out that 20% of all in-flight engine shutdowns are due to poor maintenance practices on aircraft operations. Usually, the maintenance errors occur due to loose objects left in the airplane, inconsistent electrical wiring, wrong installation of the components, Fuel or oil caps and fuel panels are not correctly adjusted, fitting of inaccurate parts, low-quality lubricants, and fairings, access panels and cowlings not fixed properly. All these errors mentioned above are because of humans (SKYbrary, n. d.).

An analysis was made on the maintenance error by United Kingdom Maintenance organizations which found that four categories are involved in the 78% of errors. The categories which involve in these errors were Installation errors (39%), not giving proper attention (16%), and lousy inspection standards (12%) and approved data not followed (11%). Another study found out that installation errors on engines were Borescopes plug not repaired, Engine attachment bolts are inaccurately adjusted, Fire bottle squibs not adjusted, fuel pipes are not reliable, magnetic chip detectors are not fixed, Fuel control units are not fixed and Anti Ice valves locked out (SKYbrary, n. d.).

Maintenance is a very important factor in aviation safety. Poor maintenance on aircraft operations is one of the main reasons for aviation accidents and incidents because a tiny percentage of maintenance and installation tasks are not performed accurately. Some of the examples for the poor maintenance includes were missing parts, the omission of unnecessary checks and installation of parts incorrectly. The mistakes of poor maintenance are very difficult to determine and have the potential to remain quiescent which affects the safety of aircraft operations badly for a very long period of time. While finding out the reasons for poor maintenance, it was also acknowledged that an individual is also responsible for their actions. It must be determined that in most of the cases the maintenance errors are due to bad technicians. It is essential to carefully detect each error and find the reason why an error occurs because it will help aircraft organizations to sort out problems and able to fix the bugs (Hobbs, 2008).

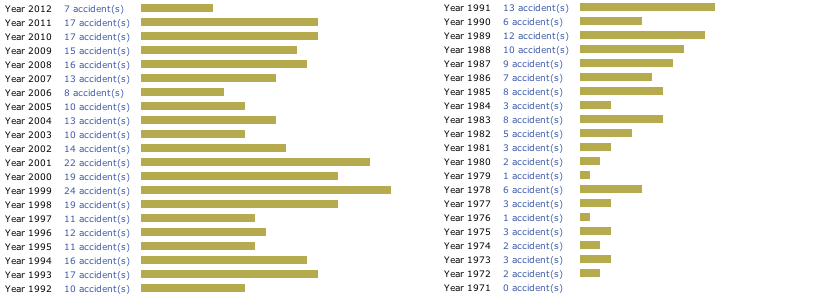
Maintenance errors require an effective countermeasure which includes a systematic approach not only towards low-level issues of work environment and technicians but also to organizational factors which include task scheduling, training, and procedures. Organizations need to take countermeasures which include reduction of the probability of error by improving their equipment’s, training, conditions and most importantly their work environment. It is very difficult for every organization to eliminate all the maintenance errors. However, organizations are required to make their systems more resilient to those poor maintenance errors which are difficult to prevent (Hobbs, 2008).

Human by their nature can make mistakes; therefore a human error will not a big surprise for the cause of the incident. The research found out that 70% to 80% accidents in the civil and military aviation is due to the human error. They also found out that incidents which occurred due to mechanical errors have been decreased from the last 40 years as compared to human errors which are decreasing slowly. Researchers claim that in order to reduce the incidents or accidents, more emphasis needs to be placed on reducing human errors (Wiegmann & Shappell, 2001).

Human errors are considered as one of the main factors which contribute to aircraft accidents. They are main reasons for maintenance problems of aircraft and force a huge financial budget issue on airlines which are main causes of delays and cancellation in flights. Poor maintenance in aviation, maintenance errors or maintenance carelessness are commonly considered as the top three factors of poor maintenance. The research found out that almost 12% of the accidents are because of the poor maintenance of aircraft operations. Failure of aircraft equipment is part of an incident, and one-third of these failures are due to poor maintenance. It was also found out that 50% of engine delays are due to maintenance errors (O’Brien, 2012).

In the United States, poor maintenance has contributed to 42% of fatal airline accidents from 1994 to 2004 excluding the 9/11 terrorist attack. Poor maintenance on aircraft operations is due to failure of the organization processes, decisions, and culture. Aircraft operations are also badly influenced by human factors that present as weaknesses in organizational processes leading to factors which are absence of motivation, time pressures, insufficient skills, Fatigue and stress (O’Brien, 2012).

One of the famous aircraft maintenance failures was of Japan Airlines flight 123 on 12 August 1985. On this day aircraft suffered a maintenance failure 12 minutes into the flight and crashed into two mountains of Mount Takamagahara, Japan after 32 minutes. The aircraft was already involved in an incident which was back in June 1978 at OSAKA international airport. Aircraft was involved in a tail strike in that incident which damaged the aircraft's rear pressure bulkhead. Technicians tried to fix the issue but it was not properly fixed by them, and in the end, it causes the lives of many people due to poor maintenance (O’Brien, 2012). The figure below shows the number of aircraft accidents by years (O’Brien, 2012).

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The works and activities on aircraft maintenance can produce such errors which are very difficult to found on the aircraft. The errors which are not visible during aircraft flying are difficult to find and are known as hidden errors. Such errors which are hidden may not cause a bigger problem, but when they combine with another unfavorable event they pose a huge threat to aircraft safety. These type of errors occur due to poor maintenance on aircraft operations. There are many methods and tools which are helping in aircraft maintenance and helping the aircraft technicians to identify the errors in aircraft.

Aircraft maintenance involves the replacement of the components which are not working. It is not easy to perform maintenance of the aircraft as it is a very complex task. A considerable effort is required for the maintenance of the aircraft to make it effective. Planning is also a very important factor in the maintenance of aircraft. It has been noticed out in the literature that about 60% of all repair work during maintenance of aircraft is not planned and not inspected properly. Maintenance which is not planned is not effective and create bad impacts on the aircraft operations. Reliability is very important in the aircraft industry where the safety of the aircraft is a top priority. A proper maintenance strategy is only the option in the maintenance of the aircraft.

**Maintenance Perspective**

The complexity of maintenance related problems of accident investigations continue to increase because airline operators are moving towards second and third tier outsourcing for their activities of maintenance. Airlines are not taking maintenance as a serious issue they are spending less time in maintenance of their planes, mechanics are also not checking the planes, and the safety of one of the essential transport system of the world is at stake (O’Brien, 2012). However in 2012, there was a significant drop in the fatal accidents, but still, emergency landings due to engine or landing gear maintenance failure are still huge concerns. The airline industry is responsible for fixing these problems, and they need to focus more on the maintenance of the aircraft, otherwise, in future, they can only expect more disasters (O’Brien, 2012).

Maintenance errors do not only create a threat to flight safety but can also force notable financial costs by delays, cancellations, diversions and other problems in the schedule. For example, it was found that cancellation of flight can cause around $140,000 to Boeing 747-400 which is a large aircraft and delay at the gate can cost them around $17000 per hour. From this example, it can be concluded that poor maintenance has a huge impact on aircraft operations and even a small error can involve a significant cost to organizations. Small reductions can have a huge impact on the savings of the company which organizations understand at some point when they are facing financial problems (Hobbs, 2008).

Maintenance technicians work in an environment that is more risky and dangerous as compared to the other jobs in the labor force. They spend more time getting prepared for a task than actually performing that task. Maintenance technicians can require physical strength, but most importantly they require skills and more attention. One of the key activities is to deal with the documentation and maintenance technicians usually spend nearly as much time wielding a pan as they do holding a screwdriver. Mechanical technicians work requires good coordination as well as good communication. However verbal communication will be very difficult for them due to noise levels. Maintenance technicians also have to face a lot of stress in their working environment. Sometimes the impact of errors can be seen immediately and sometimes there is no impact of errors. There is an emotional burden on maintenance technicians whose work has been involved in accidents, and they considered that they had taken their own lives because of their maintenance error.

There are many accidents which are caused due to poor maintenance. One of the accidents in which maintenance was cited as a cause for an accident by the National Transportation Safety Board was in June 1995. In this incident, the right engine exploded as the jet started to accelerate for takeoff. NTSB detected the problem which was a crack in engine fan blade which should have detected four years earlier. NTSB blamed the overseas maintenance facility for this accident. There are many other accidents like these which happened due to poor aircraft operations and also caused many fatalities (FAA, n. d.).

**Management Perspective**

There is an increasing emphasis on the errors in the management because it is the most important part of the organization safety management system. Proper management for the airline is required to avoid any future incidents or accidents. One of the major concerns that organizations are facing is how they can address the problems which they are facing in maintenance to the management. Maintenance work is less visible to the management team these days despite having large scale knowledge of maintenance issues. Management only focuses on the work of the pilots and air traffic controllers because the pilot works under the security of the recorders by which they mention they work to the management. Similarly, the air traffic controllers are also monitored very carefully, and their errors are visible to both the pilot and the management. However as compared to pilot and air traffic controllers, engineers and technicians who perform maintenance operations were not given attention unless they choose to disclose the problem. It will take years to find out the maintenance error by management team because of not giving proper attention (Hobbs, 2008).

Training of human is also part of the management. First, the goals of the training and the requirements of the specific department training should be identified then the training program must be established to reduce the impacts of human errors. Proper training requires research and but it doesn’t need any assessment because skill levels of individuals were already identified in the industry. The effectiveness of the training will be enhanced by mapping the training content with each topic according to organizational workforce requirements (Operator’s manual human factors in aviation maintenance, n.d.).

Collecting information on daily operations is necessary for the safety of the aircraft operations. It helps in finding the causes for the failures and helps in recovering the loss. (Langer, 2016). Ineffective management can lead to additional errors in the aviation industry. There were 36 unobserved desired states which were not properly managing their aircraft operations. Threats and errors provide valuable information to the organization and help in examining the strategies. In the current aircraft maintenance safety is measured negatively which is based on the number of incidents or accidents. The research found out that maintenance errors are usually because of the organizational problems, so it's better to address these problems than to punish individuals and will help in increasing the safety of the organization. Managers play an important role in the development of the organization, and they can target specific threats which help maintainers recognize the problems and reduce the errors associated with the aircraft operations (Dekker, 2006).

Aircraft maintenance planning and scheduling is also a very complex problem which the aviation industry is facing. There are many components which are involved in the different stages of planning and execution. The current practices problem areas and issues in aircraft maintenance are becoming a huge concern for the organizations. Researchers found in this paper weakness of individuals in management. They conclude key improvements which are required in the planning and scheduling area. Benefits which these improvements will provide in planning include reduction of inventory in spare-parts, less turnaround time and reduction of cost (Samaranayake, 2006).

Every organization requires management which is effective. Similarly, the aviation industry also requires proper management of aircraft maintenance. Most of the processes are not automated and performed by humans in the maintenance of aircraft. An organization needs to manage their staff, technicians, mechanics, and engineers to make their work more effective. For the proper management of the maintenance tasks, work will work in different shifts because aircraft organization requires their technicians 24/7 to ensure the quickest and quality service for the aircraft maintenance.

Managing the availability of the products, components, necessary parts, and raw material is all the duty of management for the maintenance of the aircraft. Many companies these days keep stock of the required items, but for some companies, it is difficult to keep stock because of the financial problems. Another issue which technicians face in maintenance is not the availability of the parts. Management has to provide the parts and ensure that there are no maintenance errors. Managing of tools and equipment's is also not the responsibility of the technicians, management is responsible for the tools and equipment of the company.

**Safety Perspective**

Safety is becoming a huge concern for airlines. It is the responsibility of the organizations to ensure the safety of the passengers and avoid any serious incident. Organizations should increase aviation maintenance and inspection safety. A system was proposed in the paper which enables an online maintenance assistant platform for technicians to perform maintenance tasks (Liang et al., 2010). The platforms have helped in removing human errors and improve satisfaction with the job. However many computer training programs were introduced in the maintenance industry to avoid incidents. The platform-like online MAP helps a lot to engineers in providing them assistance for maintenance and preventing human errors in the aviation maintenance industry.

The safety of aircraft operations not only depend on human errors, but they also depend on the technical systems, parts, tools, and equipment of the aircraft. However, accidents and incident reports continue to express that maintenance technician sometimes made errors, and the management was unable to sort out these errors and fail to monitor their work effectively. These factors can have very tragic consequences on the organization. Even though everything goes right organization still requires taking safety precautions and performing maintenance on a daily basis. The systems should ensure that every task is accomplished to the highest standard (FAA, n.d.).

Quality systems are necessary for every organization these days in order to improve the processes, products, and services which organizations deliver. The quality system must work independently and perform a daily inspection of the system in order to make sure that all the maintenance is performed correctly. The characteristic of a quality system is to fulfill all the requirements of the airline industry through meeting their requirements and supporting them in all of their aircraft operations. The quality of a quality system must be assured to get the desired outcome (FAA, n.d.).

Despite rapid changes in technology, people are still a concern for aviation safety. Many organizations are investing in the new systems to improve the level of security. From the history of aviation incidents, organizations figured it out that they can't rely on human factors and they need tools and equipment's which can help them in maintenance of aircraft. Many organizations have already moved towards a new system and have implemented new systems which ensure the safety of passengers. Organizations are hiring specialists who can figure out the problems of human errors during the maintenance of the aircraft and built a system for them which eliminate human errors. Implementing new technology will help the organization to reduce the rate of accidents and ensure the safety of the passengers in the aircraft. These tasks may require a lot of effort, but they are essential for every organization these days.

Safety of the aircraft entirely depends on the work of technicians and mechanics. They have to ensure the reliability of their work. Improvements which have been seen from the past years are due to the productive work of technicians. Human factors are considered as the primary cause for the incidents in the aviation industry. Eliminating the human factors from the aircraft is difficult. The purpose of making a safety strategy is to reduce human errors during the maintenance of aircraft which will help in decreasing the number of accidents. Technology can't replace humans completely because systems can fail at any point due to any technical faults while a human can only produce mistakes, but if they are given proper instructions during the maintenance of aircraft, they will not produce any error and ensure the safety of the passengers.

**Results**

The result of developed technologies for maintenance practices of aircraft operations have brought safety, effectiveness and have also given financial gain to the aviation industry. Many aviation accidents were investigated and able to find that leading causes of the accidents were due to poor maintenance of aircraft operations. The aviation authorities are working on finding the errors which are causing maintenance errors and develop the new quality systems for maintenance of the aircraft considering the factors which are causing maintenance errors. The quality systems which have been developed are based on knowledge of human factors.

The research found out that about 80% of the total aviation accidents were caused due to poor maintenance of the aircraft and human errors while 20% was because of the system errors (Dunham, 2016). There were a lot of incidents which were caused by the mistake of the pilot in the cockpit. Poor technician knowledge is one of the significant factors of poor maintenance. During maintenance of the tasks, many technicians get confused with the failure of the system which don't have any proper instructions or data for the technicians to solve the problem.

Research also found out that management also is having a hugely important role in the maintenance of the aircraft. Managers don't pay attention to the maintenance tasks, and technicians were unable to express the issues to the management is one of the major issues which was seen in the aircraft operations by researchers (Operator’s manual human factors in aviation maintenance, n.d.). Researchers also found out that the quality of the systems is very important for the maintenance tasks as they play a key role in the processes of an organization. It is very important for the organization to ensure the quality of the systems and analyze them on a daily basis. Moreover, it was found from the analysis that management level did have many proper solutions for the poor maintenance of aircraft operations.

**Conclusion**

Most of the aviation accidents were due to poor maintenance of the aircraft and year by year amount of incidents have been increasing due to maintenance errors. The aviation authority is only focusing on inventing new technologies for pilots, crew members, and people but they are not focusing on poor maintenance practices which are a major cause of the incidents. New technology is the requirement of the aviation industry, but the most important concern for organizations should be resolve maintenance issues.

Many organizations from the aviation industry are using strategies that are helping them in reducing errors. Organizations have introduced training programs for the technicians and mechanics to guide them on maintenance issues. Another major concern for the aviation industry is human error which is responsible for many incidents just like poor maintenance. Organizations are using strategies that have been helping them in understanding the human factors. These strategies are basically about understanding the causes of human errors and finding alterations which can help in the reduction of errors.

New technologies are the requirement of the aviation industry so they must be designed while considering the factors which are causing issues for the aviation industry. They are also responsible for providing the information of each component which will guide technicians during the maintenance of the tasks. Organizations should also modify their current design and tools to reduce human errors. This paper provided information about how organizations can modify their current tools. Similar strategies should be accepted by the higher authorities because these are having a massive impact on the maintenance of the aircraft. Using the strategy and analysis from this paper, organizations can reduce errors in the technical maintenance of the aircraft.

**Recommendations**

There are many aspects which need to be considered to improve maintenance practices including human errors. Researchers found out the following recommendations for improving the maintenance practices and reducing the impact of poor maintenance on aircraft operations.

* Proper Management is essential for the maintenance of the tasks, organizations should emphasize more on the management
* Teamwork is a key factor for every organization, and the aviation industry should focus on teamwork because it will help in solving the issues and problems more efficiently.
* Organizations should develop training programs for the technicians and emphasize more on the communication skills during the training sessions.
* An organization should create an environment which is effective for reducing human errors by considering various factors. Humans usually lost concentration in work and don't have enough stamina to perform maintenance tasks.
* Quality systems should be implemented in an organization to analyze maintenance errors.
* When designing a strategy, organizations should consider the factors which are responsible for incidents such as human error, system error, mechanical error, and electrical errors.
* Organizations should be able to implement the strict policies for the employees in the working environment and not allow them to use any equipment without permission of management.
* It is very important for the organizations to reduce the psychological stress and pressure of employees in the working area.

The following aspects should also be considered in future to improve maintenance (O’Brien, 2012):

* Organizations should focus on retraining for aircraft technicians
* Organizations should develop a more satisfactory mechanism for reporting, investigation of reports and providing legal rights to the people who notify them.
* Organizations should more emphasize on human factors training for aircraft operations and their management.

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