A

PROJECT REPORT

ON

"OPERATION AND MAINTENANCE OF AN AIRCRAFT"

SUBMITTED TO-

Mrs. Namrata Mishra

SUBMITTED BY-

Akash Sharma

Enrollment No.

18021020218

BACHELOR OF BUSINESS ADMINISTRATION

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GALGOTIAS UNIVERSITY

(Established under Galgotias University Uttar Pradesh Act No. 14 of 2011)

SCHOOL OF BUSINESS

GALGOTIAS UNIVERSITY

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AKASH SHARMA

BBA(Aviation Management)

SEMESTER-5

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Under the guidence of

Mrs. Namrata Mishra

Assistant Professor(S.O.B)

GALGOTIAS UNIVERSITY

Greater Noida

Certificate of Approval

The following Research Project Report titled "OPERATION AND MAINTENANCE OF AN AIRCRAFT" is hereby approved as a certified study in management carried out and presented in a manner satisfactory to warrant its acceptance as a prerequisite for the award of Bachelor of Business Administration for which it has been submitted. It is understood that by this approval the undersigned do not necessarily endorse or approve any statement made, opinion expressed or conclusion drawn therein but approve the Research Project Report only for the purpose it is submitted to the Research Project Report Examination Committee for evaluation of Research Project Report

	Name	Signature
1.	Faculty Mentor - Mrs. Namrata Mishra	_____

Certificate from Project Guide

This is to certify that Mr.Akash Sharma, a student of the Bachelor of Business Administration has worked under my guidance and supervision. This Research Project Report has the requisite standard and to the best of my knowledge no part of it has been reproduced from any other research project, monograph, report or book.

Faculty Mentor : Mrs. Namrata Mishra

Signature:

Designation: Assistant Professor
School of Business
Galgotias University

Date

DECLARATION

I hereby declare that this synopsis submission is my own work and that to the best of my knowledge and belief it contain neither and material previously published or written by another person nor any material which has been accepted for the award of any other degree or diploma of the university other institutes of higher learning except where due acknowledgment has been made in text.

Akash Sharma

Signature of Candidate

Date-19-03-2021

Name- Akash Sharma

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I convey my gratitude to the Director of our college for his guidance and support all these years. I want to thank all my teachers who have been a constant inspiration for me. This project report could have taken this shape without their kind and spontaneous help.

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INTRODUCTION

Aircraft maintenance is one of the critical operational tasks to sustain continued airworthiness. It also contributes a significant proportion of the total life-cycle cost. Based on introducing the fundamental concepts and theories of reliability and maintainability, some maintenance control and management methods are presented in this book. For overcoming the MSG-3 shortage in practice, this book is going to determine flexible and cost-effective maintenance schedule for aircraft structures particular in composite airframes. By applying an intelligent rating system, the back-propagation network (BPN) method, and FTA technique, a new approach was created with a powerful learning ability and a flexible data fusion capability, to assist in determining inspection intervals for new aircraft structures, especially in composite structure. Also, this book discusses the influence of Structure Health Monitoring (SHM) on scheduled maintenance. An integrated logic diagram was established incorporating SHM into the current MSG-3 structural analysis, based on which four maintenance scenarios with gradual increasing maturity levels of SHM were analyzed. The inspection intervals and the repair thresholds are adjusted according to different combinations of SHM tasks and scheduled maintenance. This book provides a practical means for aircraft manufacturers and operators to consider the feasibility of SHM by examining labor work reduction, structural reliability variation as well as maintenance cost savings. Finally, A380 Reliability and Maintainability program, as an example, is explained in this book.

Review of Literature

Aircraft maintenance is that part of the process of aircraft technical activity which is conducted on aircraft whilst it remains in the line maintenance or base maintenance environment. Aircraft maintenance is intended to keep the aircraft in a state which will or has enabled a certificate of release to service to be issued. A hangar environment may be available but is often not necessary. The reasons for carrying out maintenance are neatly summarised by [Lam 2002]:

1. Aircraft safety – airworthiness at its heart
2. Keep aircraft in service – Availability, which is of key importance to an operator i.e. the aircraft can meet its schedule.
3. Maximise value of asset (airframe, engines and components) – of prime importance to the owner or lessor.

Maintenance will consist of a mixture of preventive and corrective work, including precautionary work to ensure that there have been no undetected chance failures. There will be inspection to monitor the progress of wear out processes, in addition to:

- Scheduled or preventive work to anticipate and prevent failures.
- Unscheduled work – Repair maintenance and On-condition maintenance

In general terms, for preventive work to be worthwhile, two conditions should be met:

1. The item must be restored to its original reliability after maintenance action, and
2. The cost of maintenance action must be less than the failure it is intended to prevent

Aircraft Maintenance

Meaning-

Aircraft maintenance can be defined in a number of ways and the following may help understand the different aspect-

- "Those actions required for restoring or maintaining an item in a serviceable condition including servicing, repair, modification, overhaul, inspection and determination of condition". [World Airlines Technical Operations Glossary]
- "Maintenance is the action necessary to sustain or restore the integrity and performance of the airplane" [Hessburg, 2001]

The key aspects of aircraft maintenance are as follows:

- The regulations
- Maintenance production system
- Internal functions
- Other external bodies

Types of Aircraft Maintenance

Light Maintenance-This would typically include Pre-flight checks, daily checks (before first flight) fluids, failure rectification as well as minor, scheduled maintenance tasks as follows-

- **Type A**: A very basic routine check is to be done after 65 hours of flight. In this maintenance check, it includes landing gears, engine, and control surfaces. It is a light maintenance takes up to 10 hours usually.
- **Type B**: A little more typical and second major check is to be done after every 300 to 500 hours of flight. It also associates visual inspections, horizontal stabilizer, and ailerons. Even after such hours Lubrication is also required which include in type B check. The whole maintenance usually takes 10 hours to a day.
- **Type C**: Type C check takes place in a hanger or in aircraft yard where it can be inspected fully. It includes routine and non-routine inspection, structural inspection of an airframe. There are some outside access panels which also needs to check and takes up to 3 days to a week. A few airlines break the C check into four quarter – C checks called balance checks so aircraft spend shorter time but have to visit balance check station frequently.
- **Type D**:Type D check is also known as "Heavy Maintenance Check". This maintenance check also takes place on a hanger in order to inspect fully aircraft internally and externally. During this check, it includes flap removal, hydraulic and pneumatic systems, electronic types of equipment etc. In addition, interior fittings and external checks and paint removal are

also considered in major checks. Type D inspection usually consumes month to a couple of months which happen after every 3 to 4 years.

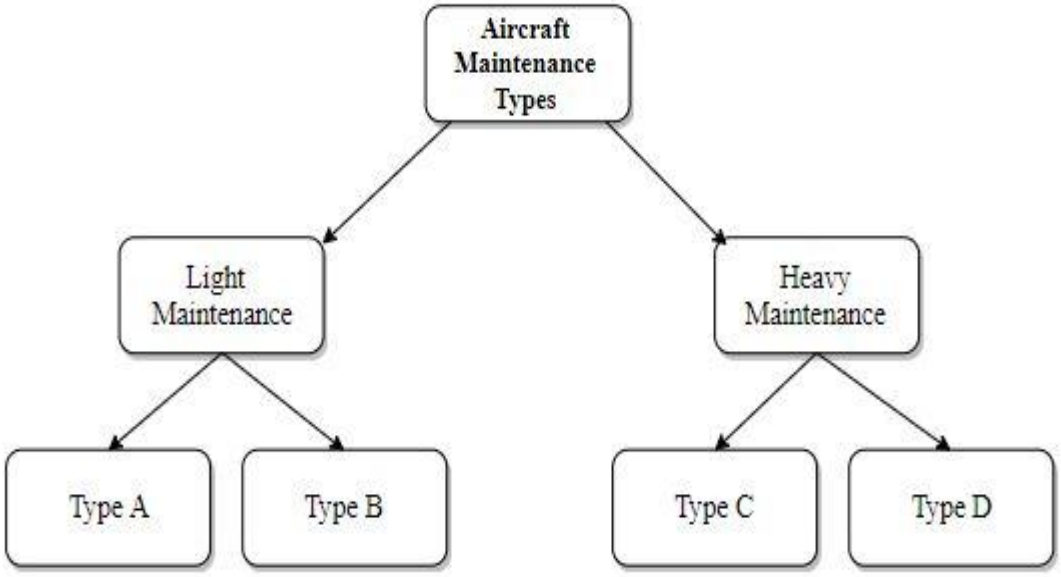

Fig. 1 Types of Aircraft Maintenance

Maintenance Check

Meaning-

The aviation industry is highly regulated, meaning that airlines and other commercial airline companies must practice continuous inspection programs established by aviation authorities. In the United States, aircraft maintenance programs are overseen by the Federal Aviation Administration (FAA). The FAA requires each airline/operator to establish a Continuous Airworthiness Maintenance Program (CAMP). The CAMP outlines routine and detailed inspections or “checks” of aircraft they have in their fleet. Checks are important to continually perform as they keep aircraft safe and airworthy. Having such a rigorous maintenance program ensures that passengers will get to their destinations safely on an aircraft that has been fully vetted for any issues prior to leaving the airport gate!

Maintenance Interval

The intervals of maintenance are parameters set within the Approved Maintenance Schedule (AMS), which is in turn based on the Maintenance Planning Document (MPD). These will be set according to different criteria, mostly depending on how well damage can be detected and failure predicted [CAA, 2017]:

- Hard Time
- On-Condition
- Condition Monitoring

Units of Maintenance Interval

- Flight Hours(FH)
- Flight Cycle(FC)
- Calendar Time(Cal)
- Operating Hours

Aircraft Maintenance Problem

Generally, commercial aircraft maintenance consists of number of potential problem areas, such as hanger scheduling; heavy maintenance planning and scheduling; line maintenance, component maintenance and engine maintenance. Scheduling a number of aircraft for maintenance at various levels is a huge task for the airline industry because much of this maintenance involves planning, control, and execution of large number of components such as materials (spare parts), operations (both assembly and disassembly), resources and suppliers.

As a result, those maintaining aircraft are confronted with a large number of secondary problems, including:

- Large maintenance project networks involving a large number of activities,
- A large number of components and different maintenance levels,
- Integration of materials planning, operations and resources scheduling, and project planning,
- A large number of configurations for a generic aircraft structure,
- A huge amount of data and information in number of systems, and
- Large percentage of unplanned maintenance activities.

These problem areas, noted above, can be categorised into following main areas of planning, control and execution shown in fig2

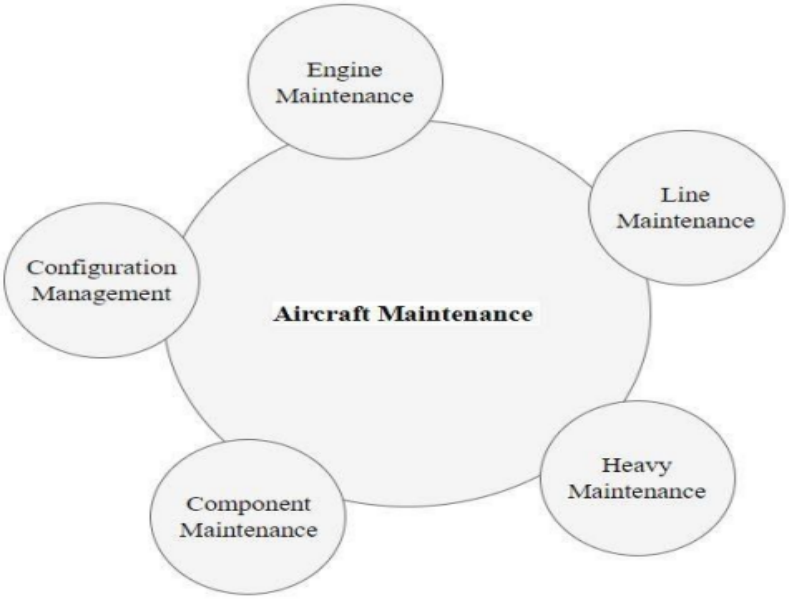

Fig. 2 Aircraft Maintenance Categories

• Base and Heavy maintenance -Base maintenance may be referred to as heavy (or depth) maintenance, and consists of tasks that are generally more in-depth and long-lasting than those above, but are performed less frequently. An MRO (maintenance, repair and overhaul) company will have to have large facilities and specialised equipment and staff to undertake base maintenance,
and many operators contract-out this function.

• Line maintenance -Line Maintenance generally refers to minor, unscheduled or scheduled maintenance carried out on aircraft that includes: ... Preparing and readying an aircraft for flight during a period of service. Maintenance activities being performed to ensure that the aircraft is airworthy and fit for flight.

• Engine maintenance -Both maintenance and complete engine overhauls are performed normally at specified intervals. This interval is usually governed by the number of hours the powerplant has been in operation. The actual overhaul period for a specific engine is generally determined by the manufacturer's recommendations. Each engine manufacturer sets a total time in service when the engine should be removed from service and overhauled. Depending upon how the engine is used in service, the overhaul time can be mandatory. The overhaul time is listed in hours and is referred to as time before overhaul (TBO).

• Component maintenance- This covers maintenance on components when removed from aircraft e.g. engines, APU, seats. Sometimes this is carried out within the same organisation as the Base Maintenance, but sometimes special companies carry out this work separately.

Maintenance Planning and Management

Planning the maintenance of an aircraft involves monitoring aircraft or equipment conditions to determine when work is due in the short, medium, and long term.
Efficiencies are achieved by scheduling work to make maximum use of resources when maintenance is required.

- Planning Maintenance Location
- Maintenance Cost
- Configuring task card and Master task card
- Managing Maintenance work

Aircraft Maintenance Planning and Scheduling

It is really difficult to maintain such large fleet aircraft in order to achieve conflicting goals relating to maintenance and operation costs, targeted service level, especially with safety. Impingement of capital equipment downtime, regulatory compliance and value of spare parts inventory needed further accentuate maintenance cost. However, in a previous time, there have been worth efforts directed towards developing approaches that help minimize the downtime by more effective planning and control of maintenance operations. In addition, there have been predicting the usage of spare parts usage and other resources required by using forecasting method. In the meantime, technology came in market and after that many software systems used in aircraft planning and scheduling like:

- Material Requirement Planning (MRP)
- Project Management
- Shop Floor Control

To determine the top-down process of planning and organization, most of the companies used the classical approach with an area of specialization. According to some studies, usually, an engineer goes for long-term planning by ordering in ample amount and make maintenance schedule for aircraft. Afterward, planning department certifies order and dispatch to the workplace. After conquering the ocean of organization, some of them are trying to move to a very process-based organization which affect the actual traditional department and make the complete process cross-functionally. Aircraft maintenance planning and scheduling is an actual support system in order to achieve 100% performance of an aircraft.

Current Problems in Aircraft maintenance planning and scheduling

Current practices and issue regions, regular in numerous carriers were confirmed by a current report (Interior provide details regarding the examination of an aircraft in the area, as a component of a formerly finished research venture), on more extensive regions of spontaneous support, save parts stock and segment upkeep are:

- The cost of extra parts in stock speaks to a noteworthy speculation for many airlines. Notwithstanding, by decreasing extra parts stock by the present accessible techniques without incorporated arranging, critical deficiencies are bound to arise.

- Where shortages happen in spare parts that have been sold off, the cost of re-buying these parts is probably higher than the offering value that an airline got and re-purchasing can likewise cause delays, with inconvenience in maintenance.

- There appears to be insufficiently detailed data about unserviceable spare parts in stock that require servicing and strategy for booking these extra parts to meet the planning requirements of individual aircraft because of lay-up.

Limitation in planning and scheduling process

There are multiple ways to solve planning and scheduling techniques at different level provide by industry. However, some deficiencies take place in planning and scheduling techniques which are described in below:

- There is no concurrent planning of materials and operation with the finite capacity of resources.

- There is no particular pattern of operation within a heavy maintenance project activity.

- Every early process of scheduling of all maintenance orders pointing towards the start of network activity.

- There is no finite loading of resources hence it tends to manual leveling of overload resources.

Improvements in Planning And Scheduling Process

When aircraft go through heavy maintenance with proper planning, control and execute the various techniques, it actually excludes the maintenance of large aircraft components such as landing gear, flaps removal etc. Nowadays, materials are planned based on MRP and resources are planned using Project Management Techniques such as CPM and PERT. To work on improvement of planning and scheduling process, it is necessary to work on such part as improving turnaround time, overtime cost and minimizes idle time of under-utilized work centers.

- Better work on spare parts requirements at the same time of planning of material and other main components.
- Need to make sure every time while planning on purchasing new spare parts including forwarding planning to make it efficient.
- Even there is the configuration of aircraft needs improvement using joint data structure.
- By balancing the further planning which should base on reassemble and disassemble network.
- After completion of every type of check, it should configure the new generation of aircraft.

Aircraft Maintenance Optimization

We characterized maintenance advancement models as those numerical models whose aim is to discover the ideal balance between the expenses and advantage of maintenance. Maintenance benefits comprise of savings on costs which would be acquired something else. This definition does exclude all tasks look into models connected in maintenance. We also avoid spare parts models as these major focus on inventory control.

In general, optimization model cover four points of view described in below:

- A definition of a high-tech system, its task and it's important
- A modeling of the disintegration of the system in time and possible outcome for the system.
- A detail of the available intelligence about the system and performance open to management.
- A decent function and an upsurge technique which helps in finding the best balance.

The maintenance of components, mostly engine of an aircraft, is vital and difficult. An engine is complicated, tend to wear and failure, safety critical and lavish. Consequently, the optimization of the policy for maintenance and maintenance scheduling of engines, which interpose the balance cost/safety, is a huge problem. Most of the airline companies fly with various aircraft families, represent by specific engine version for every single aircraft. The supervision and overhaul of the engines are generally completed at the airline special facility for engine maintenance.

In a nutshell, including many parts and overhaul routings, a job shop environment can be implemented in a part of engine maintenance facility.

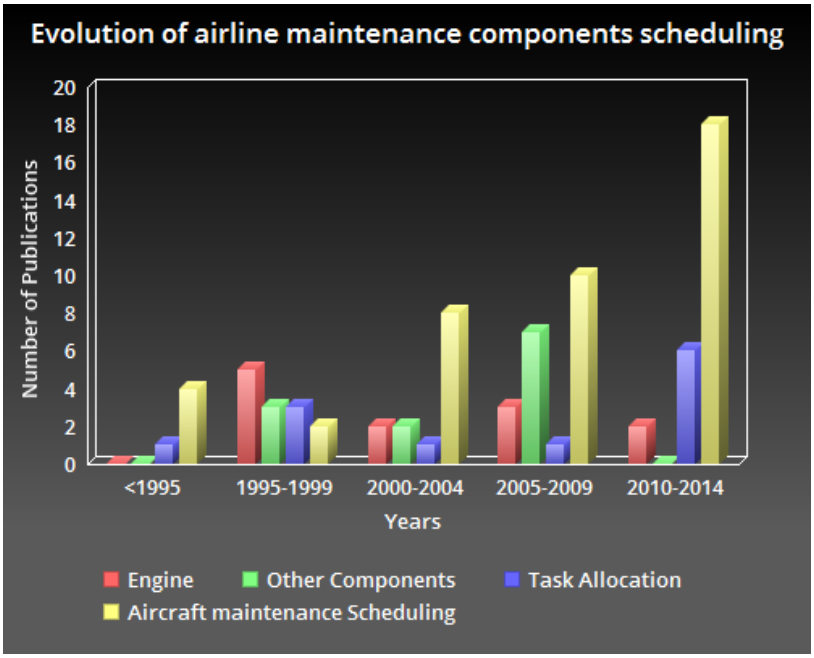

Fig. 3 Progression of airline maintenance components scheduling by the every half decade

- Fig.3 represent that whereas the number of documents that focus on engines or other components is shrinking, the task allocation and the aircraft maintenance scheduling problem are receiving more consideration recently.
- A productive maintenance system is of key importance for an airline to meet its objectives. Minimizing costs is a very obvious aspect. However, also 'minimal flight cancellations', 'minimal delays', 'minimal repair turn time' and 'efficient utilization of maintenance resources' can be essential.

The actual goal of the aircraft maintenance is to determine the concrete maintenance time and site with the constraint of the original flight plan. Aircraft maintenance plan model is to drive every single aircraft's specific time and site during maintenance certain period to diminish the cost of the airline. There are some optimization assumption below:

- Flight plan are known, actual flight plan expected to perform.
- 10% of aircraft maintenance time can advance.
- Allowance of any type of aircraft on any airport.
- Does not count the old aircraft's special constraints.
- Do not consider the festival periods, station closing times.

Significance of Human Element in Aircraft Maintenance

Definition of human factor

—Canadian Department of Defense Our focus is on human factors as it relates to improper actions. Note, however, that human factors exist in both proper and improper actions.

The human factor is a key point in order to run aircraft maintenance business meticulously. However, there are always chances to happen accidents or incidents. In aircraft maintenance industry, every single person knows his responsibilities especially when they put themselves inside of aircraft.

There has been majority workload inside cockpit surrounded by electronic equipment such as navigation system, radar system etc. feel by a human being In aviation, human factor has attracted towards most important aspect

in order to maintain aircraft's performance. Nonetheless, in a previous time, operation and maintenance of an aircraft have been underestimated. In addition, air traffic control has been managed by human element for so long precisely. Human is not perfect as a factor and creates such errors in system unintentionally. Back in the seventies, there was a term known as Cockpit Resource Management (CRM) used to reduce the pilot error. Later on, it changed to Crew Resource Management just to concentrate on cockpit group dynamics. After a couple of decades, it was noticed that majority aircraft incidents happened by human errors. By the time, Maintenance Resource Management was included into Human Factor In Maintenance (HFIM) in order to prevent human errors. Here is presentation of Human error against Machine error happened by the time in fig. 4.

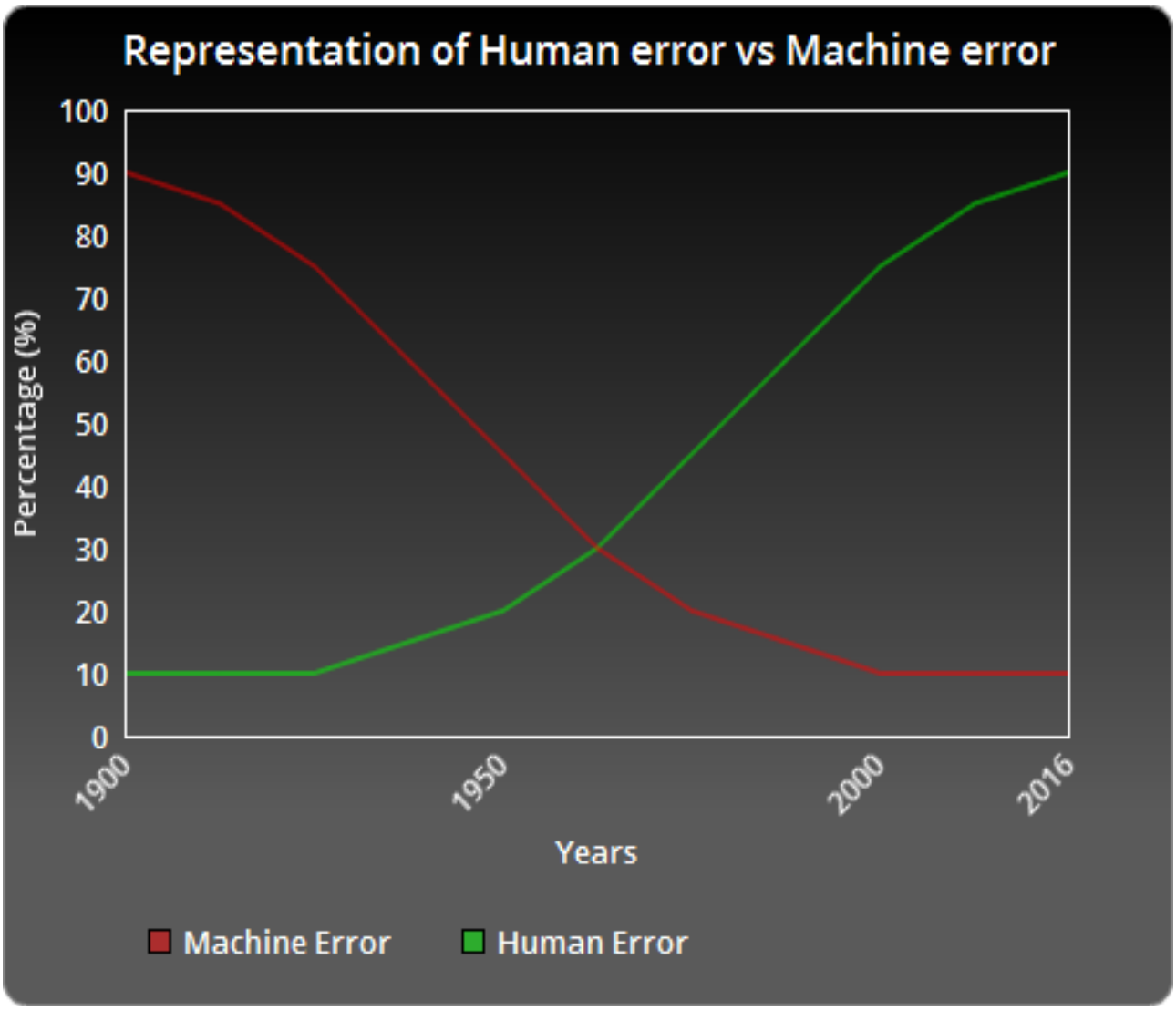

Fig. 4 Presentation of Human error vs Machine error caused by Years

Human Error In Aircraft Maintenance

Today, in the aviation industry, biggest issue from safety angle is errors. Human is part of a system, therefore errors are stick to the two aspects of a human at work which are performance speed and human well-being. Performance is measured by speed and reliability which is a prime aspect of employees. On the other hand, human well-being is related to human health and safety of workforce which is also an important concern. During aircraft maintenance, it creates a certain type of active and hidden errors. Active errors are errors that occur rapidly at a time and damage aircraft or suffer to people inside aircraft. Hidden errors are the type of invisible error. It does not affect the aircraft during flight but it does react actively when something happens to an airplane.

During 1990 human factor training program was started by Mr. Gordon DuPont. An employee of Transport Canada, Gordon DuPont, characterized the causes of unintentional errors into twelve different phases called “Dirty Dozen” Dirty Dozen was actually based on the occurrence of errors during the process of aircraft maintenance. According to Gordon, Dirty Dozen is:

1. Lack of communication
2. Lack of assertiveness
3. Lack of teamwork
4. Lack of knowledge
5. Lack of resources
6. Complacency
7. Distractions
8. Fatigue
9. Pressure
10. Stress
11. Lack of awareness
12. Norms

Pilot error or Human error term is actually an indication of 75% incidents of the time, yet a recent study in the United States shows that 18% of accidents occur due to maintenance factor.

Advancing Maintenance By Reducing Human Error

The study of human error is not fundamentally new. In fact, psychological research from the 50's studied human error in decision-making and overhauling. Furthermore, installation error is defined as mechanic or maintenance system actions or inactions that resulted in reliability, safety, or documentation that was discovered in the final stages of a heavy check or within the first 21 days of operation. While the works cited above refer to complex tasks, like overhauling, it is the everyday tasks, such as component installation. The study is focusing on everyday tasks because many airline studies show that exclusion is repeatedly diagnosed as the most common error in aviation maintenance. Since 1988, numerous speakers at the annual FAA Conference on Aviation Maintenance and Inspection have elaborated on the problem of installation error. Most importantly the FAA Safer Skies resource has the goal to reduce accidents and incidents caused by human error. Therefore, the lengthy rationale for this study need not be repeated here. Clearly, there are instructions to reduce such errors during installation.

The Aloha B-737 involved in this accident had been inspected as required by two Aloha Airlines inspectors. One inspector had 22 years of experience and the other, the chief inspector, had 33 years of experience. Unfortunately, neither found any cracks in their inspection. These findings attention onto maintenance and aviation maintenance technicians (AMTs) as potential accident causal aspects and proportional to the development of Maintenance Resource Management (MRM) and human factors training.

There are several concepts that could help after considering MRM theory and described below in detail:

1. **Understanding the maintenance operation as a system**

A perceptive of the systemic nature of the maintenance operation is important to understand how one's individual actions affect the whole management.

2. **Identifying and understanding basics human factors issues**

General human factors concepts have been taught in the course of MRM training. These concepts typically cover human perception and awareness, workplace and task design, group nature (norms), and ergonomics.

3. **Recognizing contributing causes to human errors**

An elemental reader to human error is also a key component to MRM training. By understanding the communication between organizational, workgroup and individual factors that may head to errors and accidents, trainees can learn to prevent or manage them passionately in the future. Many other models of human error exist, such as DuPont's Dirty Dozen, and can also be adapted for use in MRM.

4. **Communication Skills**

Communication is the heart of both CRM and MRM, but specific aspects of communication are different in each work environment. Mechanics, crew leads, supervisors, and inspectors all must have the knowledge and skills to communicate effectively. A lack of proper communication can have any or all of the following undesired consequences:

- The quality of work and performance may be reduced.

- Time and money may be lost as errors occur because important information is not communicated or messages are misinterpreted.
- Improper communication may cause frustration and high levels of stress.

Abbreviations

AMTs	Aviation Maintenance Technicians
CPM	Critical Path Method
CRM	Cockpit Resource Management
ERP	Enterprise Resource Planning
FAA	Federal Aviation Administration
HFIM	Human Factor In Maintenance
MRO	Maintenance Repair and Overhaul
MRP	Material Requirement Planning
MRM	Maintenance Resource Management
NFF	No Fault Found
PERT	Program Evaluation and Review Technique

Conclusion

After narrow down such studies, I agree that aircraft maintenance is indeed a tough responsibility. Moreover, every aircraft has to go through heavy maintenance checks note only every year but should be every two years. It increases the aircraft safety by the time and due to every other light inspection, it makes an aircraft foolproof. From a couple of research paper, I examined the aircraft maintenance problems but it can be even handled by expanding aircraft maintenance hangar at every possible location. As our main concentration was handing maintenance by proper scheduling and planning. There have been many traditional ways that actually help in future planning and in addition there are some approaches which tend to improvements in scheduling and planning also. Approaching prior studies indicates that elaboration of aircraft maintenance category is more likely used to find a problem. Purpose of the human element is to find the problem as well as a solution to getting the problem. In aviation maintenance industry, there were some statistics that defined human causes more error than machine due to the language barrier, chemical hazards, improper fluency in communication skills etc. Improvisation in human error in maintenance by working on several points was only possible after happened Aloha B-737 crashed and invented MRM.

Overall, summing both tradition and current approaches, it is possible to get over aircraft maintenance problem but on the fact side, the human being is not perfect so there are always chances to happen incidents or accidents.

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