MINISTRY OF EDUCATION AND SCIENCE OF UKRAINE
NATIONAL AVIATION UNIVERSITY
FACULTY OF AIR NAVIGATION, ELECTRONICS, AND TELECOMMUNICATIONS

DEPARTMENT OF AVIONICS

APPROVED
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‘___’___________2022

GRADUATION WORK

(EXPLANATORY NOTES)

FOR THE DEGREE OF BACHELOR
SPECIALTY 173 ‘AVIONICS’

Theme: “Operational factors influencing the maintenance of airworthiness of the aircraft”

Done by: __________ (signature) N.I. Romaniyk

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Kyiv 2022

МІНІСТЕРСТВО ОСВІТИ І АУКИ УКРАЇНИ
НАЦІОНАЛЬНИЙ АВІАЦІЙНИЙ УНІВЕРСИТЕТ
ФАКУЛЬТЕТ АЕРОНАВІГАЦІЇ, ЕЛЕКТРОНІКИ ТА ТЕЛЕКОМУНІКАЦІЙ
КАФЕДРА АВІОНІКИ

ДОПУСТИТИ ДО ЗАХИСТУ
Завідувач випускової кафедри
_________С.В. Павлова
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ДИПЛОМНА РОБОТА

(ПОЯСНЮВАЛЬНА ЗАПИСКА)

ВИПУСКНИКА ОСВІТНЬОГО СТУПЕНЯ
БАКАЛАВР ЗА СПЕЦІАЛЬНІСТЮ 173
«АВІОНІКА»

Тема: “Експлуатаційні фактори, що впливають на підтримання льотної придатності ПС”

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Київ 2022

NATIONAL AVIATION UNIVERSITY

Faculty of Air Navigation, Electronics and Telecommunications

Department of avionics

Specialty 173 ‘Avionics’

APPROVED

Head of department

_________S.V. Pavlova

‘___’___________2022

TASK for execution graduation work

N.I. Romaniyk

1. Theme: "Operational factors influencing the maintenance of airworthiness of the aircraft”, approved by order №352/ст of the Rector of the National Aviation University on 04 April 2022.
2. Duration of which is from 16.05.2022 to 16.06.2022.
3. Input data of graduation work: the research is theoretical and practical, based on the analysis of literary and Internet sources.
4. Content of explanatory notes: List of conditional terms and abbreviations; Introduction; Chapter 1. Airworthiness of aircraft; Chapter 2. Factors influencing on the airworthiness of aircraft; Chapter 3. Ways to reduce the impact on the aircraft; Conclusion.
5. The list of mandatory graphic material: figures, charts, graphs.

6. Planned schedule

№	Task	Duration	Signature of supervisor
1.	Validate the rationale of graduation work theme	16.05-20.05	
2.	Carry out a literature review	21.05-24.05	
3.	Develop the first chapter of diploma	25.05-29.05	
4.	Develop the second chapter of diploma	30.05-02.06	
5.	Develop the third chapter of diploma	03.06-05.06	
6.	Develop the fourth chapter of diploma	06.06-08.06	
7.	Tested for anti-plagiarism and obtaining a review of the diploma	09.06-16.06	

7. Date of assignment: ‘____’___________ 2022

Supervisor ______________
(signature) (surname, name, patronymic)

The task took to perform ______________
(signature) (surname, name, patronymic)

ABSTRACT

Explanatory notes to the thesis "Violations and their elimination during aircraft maintenance" contained 56 pages, 21 drawings, 1 table, 3 flowcharts, and 0 reference books.

Actuality of the graduate work: modern aircraft are affected by many factors. It is extremely important to cover this topic in order to save human and material resources; it is also important to investigate the factors of influence for the further introduction of new technologies which in turn will reduce the impact on the aircraft.

Keywords: airworthiness, weather factor, technical factor, human factor, aviation.

The purpose of the thesis: is to study the operational factors affecting the aircraft.

The object of research: study of the effects of operational factors on the aircraft.

The subject of research: consideration of the factors influencing the aircraft and the consequences of their impact.

Research method: analysis of theory, statistics, law

The scientific novelty of the study: these materials are recommended for use in cases of research and study of the effects on the aircraft

The importance of the thesis, conclusions, and recommendations for the implementation of the results: the thesis considers the impact of various factors on the aircraft, research, and information about these effects

CONTENTS

LIST OF ABBREVIATIONS

ICAO - International Civil Aviation Organization

EASA - European Aviation Safety Agency

Chapter 1. Airworthiness of aircraft.

1.1 Basic concepts.

What is airworthiness?

Many sources give different meanings of this concept, for example:

"For an airplane or part of an airplane (airworthiness) - this is the presence of requirements for flights in safe conditions, within acceptable limits." - Italian technical regulations RAI-ENAC

"Status of the airplane, engine, propeller or part if they conform to the approved design and are in a condition for safe operation." - ICAO Annex 8

"Airworthiness" means the ability of an aircraft or other on-board equipment or system to operate in flight and on the ground without significant danger to the crew, ground crew, passengers, or third parties; it is a technical attribute of the material throughout its life cycle. "- Ministry of Defence of the United Kingdom

These definitions have common elements: safe conditions, the presence of the necessary requirements, and acceptable limits.

We can take for granted the safe conditions of a normal course and satisfactory completion of the flight. According to one definition, safety is the absence of conditions that can cause death, injury or disease, damage/loss of property, or harm to the environment.

The presence of the necessary requirements means that the aircraft or any part of it is designed and constructed according to the studied and tested criteria for flights in safe conditions, as described above. The rules should promote safety by eliminating or mitigating conditions that could cause death, injury, or damage. These rules shall be established by the airworthiness authorities designated by the States. They are obtained through the publication of airworthiness standards, which contain several design requirements: from structural strength to flight requirements, criteria for good design practice, systems, and fatigue. and flutter, necessary tests, contents of the flight and maintenance manual. These standards are different for different types of aircraft.

As a rule, the standard does not precede aviation progress; she follows her and sometimes accompanies her. A "blocked" standard will hinder the progress of air navigation. It follows that the rules must constantly correspond to the technical evolution of aviation. Moreover, very often accident analysis leads to additional rules that, if applied to a project, can prevent an accident or at least limit its consequences; this process can be considered "late thinking", but it is better to consider it as "experience". Changing standards makes compliance more expensive, but that's the price to pay for security.

Permissible limits. Aircraft are designed to operate within a certain "flight", which depends mainly on the speed and load factors of the structure. In addition, the maximum weight of the aircraft can be set differently for different types of operations. The conditions of operation of the aircraft are also established, such as the rules of day visual flight, night flight, flight by instruments, in icing conditions or outside it. Exceeding these conditions and limits can lead to accidents. Overweight take-offs, flight manoeuvres with unmanned load factors, unprotected ice flights, and speeding are just a few examples of the importance of flying within acceptable limits. Pilots learn about these limitations through flight guidance, markings, cockpit posters and, of course, training.

The defect can have a significant impact on safety and, if left unchecked or partially remedied, can also lead to an accident later. Improper actions of the crew in response to a malfunction that occurs during the flight can also lead to a worse result. In such cases, the investigation should analyse the responses of the crew, as well as the main problems of airworthiness. However, in many cases, the flight crew successfully recovers the aircraft from anomalies.

1.2 Laws and regulations governing this area.

The International Civil Aviation Organization (ICAO) was officially founded on April 4, 1947. At the invitation of the Government of Canada, Montreal was chosen as the location for its headquarters. At present, the number of Contracting States is over 180.

Fig. 1.1

The goals and objectives of ICAO are to develop the principles and methods of international air navigation and to promote the planning and development of international air transport in order to:

- Ensure the safe and orderly growth of international civil aviation around the world.
- Encourage the art of designing and operating aircraft for peaceful purposes.
- Encourage the development of airways, airports and air navigation facilities for international civil aviation.
- To meet the needs of the peoples of the world in safe, regular, efficient and economical air transport.
- Prevent economic waste caused by unreasonable competition.
- Ensure full respect for the rights of the Contracting States and that each Contracting State has a fair opportunity to operate international airlines.
- Avoid discrimination between Contracting States.
- Promote flight safety in international air navigation.
- In general, promote the development of all aspects of international civil aeronautics.

Since the establishment of ICAO, the main technical task of the organization has been to achieve standardization in the operation of safe, regular and efficient air services. This has led to a high level of reliability in many areas that together form international civil aviation, including aircraft, their crews, and ground facilities and services.

Standardization has been achieved through the creation, adoption and amendment of 18 annexes to the Convention, defined as international standards and recommended practices.

Standards are directives that ICAO members agree to abide by. If a member has a standard other than the ICAO standard, that member shall notify ICAO of the difference. Recommended practices are desirable but not required. The basic principle for deciding whether a particular issue should be a standard is the affirmative answer to the question: "Is it necessary to apply it equally to all Contracting States?"

Under the Convention, Contracting States shall participate in achieving the highest practical level of uniformity of rules worldwide, in the organization of procedures for aircraft, personnel, airways and ancillary services, if this will promote and improve air safety, efficiency and regularity.

18 applications are described as follows:

- Annex 1. Personnel Licensing - provides information on the licensing of flight crews, air traffic controllers and aircraft maintenance personnel, including medical standards for flight crews and air traffic controllers.
- Appendix 2. Flight rules - contains rules relating to visual and instrument flights.
- Annex 3. Meteorological Service for International Air Navigation - provides meteorological services for international air navigation and reporting of meteorological observations from aircraft.

- Annex 4. Aeronautical charts - contains specifications for aeronautical charts used in international aviation.
- Appendix 5. Units of measurement to be used in air and ground operations - lists the systems of dimensions that will be used in air and ground operations.
- Annex 6. Aircraft Operations - Lists specifications to ensure a level of safety above the established minimum during similar operations worldwide.
- Annex 7. Nationality of aircraft and registration marks - determines the requirements for registration and identification of aircraft.
- Annex 8. Airworthiness of aircraft - defines uniform procedures for certification and inspection of aircraft.
- Annex 9. Facilitation - provides standardization and simplification of border crossing formalities.
- Annex 10. Aeronautical telecommunications - Volume 1 standardizes communication equipment and systems, and Volume 2 standardizes communication procedures.
- Annex 11. Air Traffic Services - includes information on the installation and operation of air traffic control (ATC), flight information and alert services.
- Appendix 12. Search and rescue operations - provide information on the organization and operation of facilities and services required for search and rescue operations.
- Annex 13. Investigation of aviation accidents and incidents - provides unification in the notification, investigation and reporting of plane crashes.
- Annex 14. Aerodromes - contains specifications for the design and equipment of aerodromes.

- Annex 15. Aeronautical Information Services - includes methods of collecting and disseminating aeronautical information necessary for flights.
- Annex 16. Environmental Protection - Volume 1 contains specifications for aircraft noise certification, noise monitoring and noise exposure units for land use planning, and Volume 2 contains specifications for aircraft engine emissions.
- Annex 17. Security - Protection of international civil aviation from acts of unlawful interference determines the methods of protection of international civil aviation from unlawful acts of interference.
- Annex 18. Safe Carriage of Dangerous Goods by Air - Defines the requirements necessary to ensure the safe transport of hazardous materials in the aircraft, ensuring a level of safety that protects the aircraft and its passengers from undue risk.

As aviation technology is constantly evolving, applications are constantly reviewed and updated as needed. The typical content of the application is based on the following:

- Standards designed as specifications when their application is considered necessary for the safety and regularity of international air navigation.
- Recommended methods are intended as specifications when their application is considered as a recommendation in the interests of safety, regularity and efficiency of international air navigation.
- Appendices relating to the preceding paragraphs.
- Definition of terminology used.

The Contracting States have issued rules which do not strictly copy the content of the Annex, which essentially define certain principles or objectives to be achieved. Standards contain requirements that are used to achieve goals.

In addition, although the principles remain the same, the requirements are often influenced by the current state, they are likely to improve and change.

The relevant airworthiness standards of the Joint Aviation Authorities (JAA) / Federal Aviation Administration (FAA) / European Aviation Safety Agency (EASA) for the certification of aircraft to be recognized internationally are issued in accordance with ICAO annexes. Then, from a practical point of view, the certification process is based on these airworthiness standards and not (directly) on ICAO international standards.

We will consider the content of four applications directly related to airworthiness:

Annex 6. Operation of aircraft. This annex contains standards and guidelines for the operation of aircraft for international commercial air transportation, including provisions for the certification of operators. It also contains technical and operational rules for the activities of general international aviation, including maintenance.

The essence of Annex 6 is that the operation of aircraft engaged in international air transportation should be as standardized as possible to ensure the highest level of safety and efficiency. The purpose of Annex 6 is to promote the safety of international air transport by providing criteria for safe operation and to promote the efficiency and regularity of international air navigation by encouraging

ICAO Contracting States shall facilitate the passage through their territories of commercial aircraft belonging to other countries which comply with these criteria. In order to keep up with the new and vital industry, the initial provisions have been constantly reviewed and are being revised.

Appendix 8. Airworthiness of the aircraft. This annex contains standards specifying the minimum level of airworthiness for the development of type certification requirements as a basis for the international recognition of aircraft airworthiness certificates for flights and landings in the State Contract. Each State is free to develop its own comprehensive and detailed code of airworthiness or to choose, adopt or adopt a code established by the other Contracting State. The level of airworthiness to be maintained by the national code is specified in the general standards of Annex 8.

Technical standards related to aircraft certification include requirements related to performance, flight performance, structural design and construction, design and installation of engines and propellers, design and installation of systems and equipment, and operational limitations, including procedures and general information to be provided in the airplane flight manual, aircraft impact and cabin safety, operating environment, and human factor and safety in aircraft design. Particular attention is paid to the requirements for design features that affect the ability of the flight crew to maintain controlled flights. The flight crew compartment layout shall be such as to minimize the possibility of malfunction due to confusion, fatigue or obstruction. It must provide a sufficiently clear, wide and undistorted field of view for the safe operation of the airplane.

Appendix 13. Investigation of plane crashes and incidents. This appendix contains international requirements for the investigation of aviation accidents and incidents.

The purpose of an accident investigation is to prevent it. Subsequently, the causes of the plane crash or serious incident must be determined to prevent recurrence.

According to Annex 13, the specific State in which the accident or incident occurred will direct the investigation, but it may delegate all or part of the investigation to another State. If the event takes place outside the territory of any state, and the state of registration is responsible for conducting the investigation.

Representatives of the state of registration, the operator, and the manufacturer have the right to participate in the investigation. The investigation process is aimed at determining the cause of the accident or incident and leads to the issuance of a final report containing appropriate safety guidelines to prevent such incidents.

ICAO operates a computerized database known as the Accident / Incident Reporting System, which allows the exchange of safety information in any Contracting State. The safety instructions are assessed by the airworthiness authorities for the publication, if deemed necessary, of the airworthiness directives, changes to the relevant airworthiness requirements, useful information, and instructions.

Annex 16. Environmental protection. This annex contains a standard applicable to aircraft noise certification for different noise levels proportional to the type of aircraft. It defines test procedures for efficient and unambiguous measurement. The standard contained in this appendix is usually used as proposed, as it directly applies to all technical requirements. The annex contains a standard for the certification of aircraft engine emissions concerning the toxicity of certain chemical components, such as nitrogen oxides.

Fig. 1.2

EASA is an independent body of the European Community with legal personality and autonomy in legal, administrative, and financial matters. The main tasks of the Agency at the moment are:

1. Regulatory activities: development of aviation security legislation and provision of technical advice to the European Commission and the Member States;

2. Inspection, training, and standardization programs to ensure uniform implementation of European aviation safety legislation in all Member States;

3. Safety and environmental certification of aircraft, engines, and parts;

4. Approval of aircraft design organizations worldwide and production and maintenance organizations outside the EU;

5. Authorization of the third country (non-EU) operators;

6. Coordination of the European Community safety assessment program for foreign aircraft using Community airports;

7. Data collection, analysis and research to improve aviation safety.

Under Regulation (EC) № 1592, EASA is responsible for approving the design of products, parts and appliances designed, manufactured or used by persons under the supervision of EU Member States, except those excluded by Annex II7.

The European Commission then adopted Regulation (EU) 1702/2003, which sets out, inter alia, the requirements applicable to products, parts, and appliances, and provides for the transfer of existing certificates under conditions designed to ensure their compliance with the level of safety. required. required by the Basic Regulation (EU) № 1592/2002 and its implementing rules.

The main provisions recognize the need for some transition to facilitate the transfer of powers from national administrations to the Agency. Thus, the article of the Basic Regulation established the possibility for the Member States to continue to issue certificates and approvals during the transitional period by derogating from the provisions of the Basic Regulation under the conditions set out in its implementing rules, in particular the Commission Regulation. 1702/2003. This transition period ended on March 28, 2007.

As a result, the Agency's responsibilities for design activities (type certificates, additional type certificates, approval of changes and repairs, and other activities after type certification, including AD) now include:

• Products with type certificates issued by EASA by Commission Regulation 1702/2003 of 30 March 2007.

• l Products with type-certificates issued by the EU Member States, which are considered to be is by with Commission Regulation (EU) (1702/2003).

• l Products with airworthiness specifications issued by EASA by Regulation (EC) № 1592/2002 to support limited airworthiness certificates.

In addition, EASA is responsible for approving the flight conditions under which a permit to fly may be issued by a body designated by the Member State of the registry.

I also want to add about the Part - M

Part M concerns, inter alia, the maintenance of the airworthiness of aircraft and aircraft products, parts, and appliances, and the approval of organizations and personnel involved in these tasks.

In 2002, based on the European Commission Regulation EC 1592/2002, EASA created the European Commission Regulation EC № 2042/2003, which, together with several amendments, provided us with Part M of this EASA Regulation. Defining airworthiness requirements for EU carriers and private aircraft owners regarding the obligation to manage airworthiness support. In 2014, this was further strengthened by the introduction of the updated Regulation 1321/2014, which, together with additional changes, is in force today (June 2016).

EASA generates a notice of proposed changes to an existing or new requirement, which, once approved, is issued as a "Commission Regulation". After a transitional period, the applicable legislation (Implementing Rule), together with the appropriate means of compliance, becomes a legal requirement in all Member States.

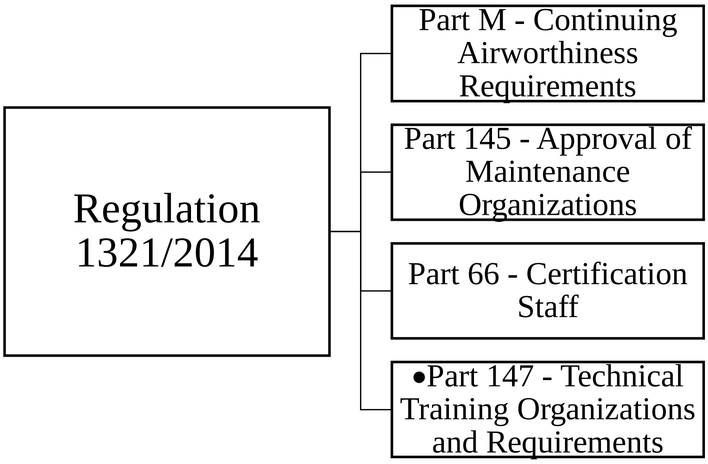

Fig. 1.3

Part M is presented in two sections. Section A (so-called "Technical Requirements" applies to industry) and Section B ("Procedure for Competent Authorities" applies to the Regulator - Competent Authority).

Each Part-M designates an Airworthiness Management Manager (CAM), who will be responsible for organizing the Airworthiness Management (CAMO) by the regulatory requirements described in Part-M and the procedures contained in the Airworthiness Management Annex.

Section A	•Subsection A - General provisions
	•Subsection B - Accountability
	•Subsection C - Airworthiness support
	•Subsection D - Maintenance standards
	•Subsection E - Components
	•Subsection F - Organization of maintenance
	•Subsection G - Airworthiness management organization
	•Subsection H - Certificate of Approval - CRS
	•Subsection I - Certificate of Airworthiness

Fig 1.4

Chapter 2. Factors influencing on the airworthiness of aircraft

2.1 Classification factors which impact on flight conditions

I would like to highlight three main factors that affect the airworthiness of an aircraft: man, environment, and machine.

Improvements in technology will not have the greatest impact on aircraft safety in the future. Rather, it will teach the employee to recognize and prevent human error. A review of crash data shows that approximately 75-80 percent of all plane crashes are the result of human error. About 12 percent of these accidents are related to maintenance. Although pilot/co-pilot errors tend to have immediate and noticeable consequences, maintenance errors are usually more hidden and less obvious. However, they can be just as deadly.

“The human factor aims to optimize productivity ... including reducing errors to achieve and maintain the highest level of security.” - Ron Lofaro, Doctor of Philosophy, FAA

“The human factor is the study of how people interact with the environment.” - FAA-H-8083-25, Aviation Pilot Handbook, 2003.

“Human factors are the elements that affect our behavior and productivity, especially those that can cause mistakes.” - Ministry of Defense of Canada

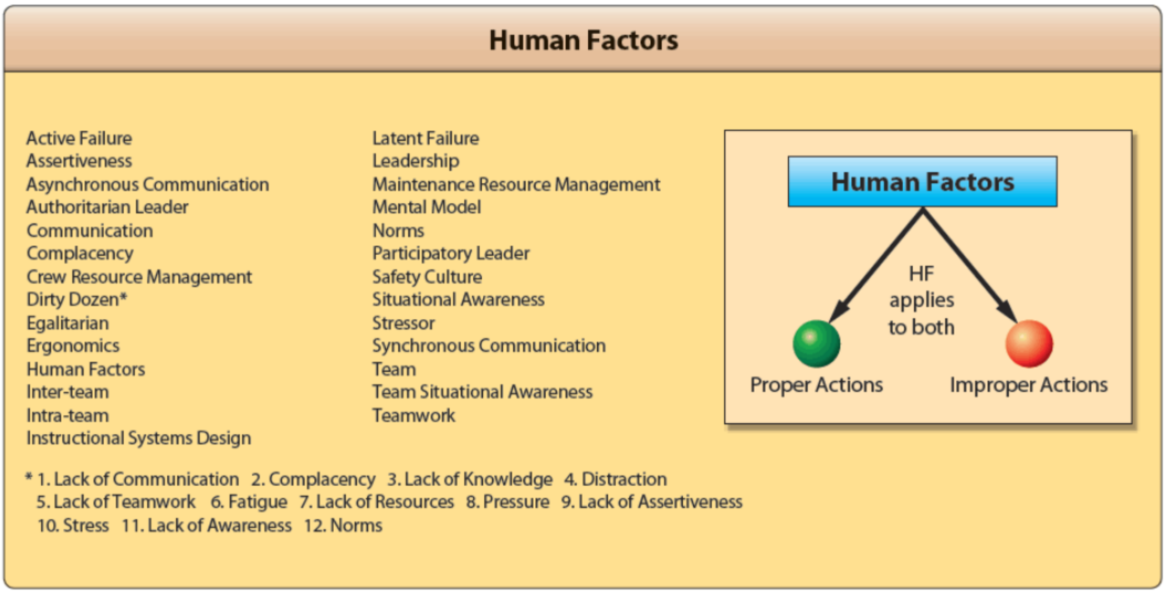

Fig 2.1

Human error is an unintentional act of the improper performance of a task that could potentially impair system performance. There are three types of human error:

- Omission: failure to perform an action or task.
- Commission: incorrect performance of the task.
- Third parties: the task is unauthorized.

There are also four consequences of human error:

- Small effect or no effect at all.
- Damage to equipment/hardware.
- Trauma.
- Destructive.

Why are human conditions such as fatigue, complacency, and stress so important for aviation maintenance? These conditions, among many others, are called human factors. Human factors directly cause or contribute to many plane crashes. It is well known that 80 percent of maintenance errors are human-related. If left unchecked, they can cause accidents, injuries, loss of time and even accidents.

Fig 2.2

Aviation safety depends largely on maintenance. Failure to do so will lead to a significant proportion of aviation accidents and incidents. Some examples of maintenance errors are incorrectly installed parts, missing parts, and necessary checks. Compared to many other threats to aviation security, aviation specialist mistakes are harder to detect. Often these errors are present but not noticeable, and can remain hidden, affecting the safe operation of the aircraft for a long period.

AMT faces a set of unique human factors in aviation. They can work in the evening or early morning, in confined spaces, on high platforms, and in a variety of adverse temperature/humidity conditions. Work can be physically stressful, but it also requires attention to detail. Due to the nature of maintenance tasks, AMTs usually spend more time preparing for a task than actually performing it. Proper documentation of all maintenance work is a key element, and AMT typically spends as much time updating maintenance logs as it does.

Awareness of the human factor can lead to improved quality, an environment that ensures the safety of workers and aircraft, and a more involved and responsible workforce. Reducing even minor errors can provide measurable benefits, including reduced costs, fewer missed deadlines, reduced work-related injuries, reduced warranty claims, and reduced more significant events that can be traced to maintenance errors. This section discusses many aspects of the human factor related to aviation services. The most common human factors are presented, as well as ways to mitigate the risk so that it does not become a problem.

There are many concepts related to the science and practice of the human factor. However, from a practical point of view, it is best to have a single point of view or model of what we should be concerned about when considering the human factor in aviation. For more than ten years, the term "PEAR" has been used as a commemorative runner or mnemonic to describe the human factor in aviation. The PEAR regime encourages four important considerations of the human factor programs listed below:

- People who do the work.
- The environment in which they work.
- The actions they perform.
- Resources needed to do the job.

Human aviation maintenance programs focus on the people who do the work and focus on physical, physiological, psychological, and psychosocial factors.

Fig. 2.3

Programs should focus on individuals, their physical capabilities, and the factors that affect them. They must also take into account their mental state, cognitive abilities, and conditions that may affect their interaction with others. In most cases, human factor programs are developed around the people who work for the company. You cannot apply the same standards of strength, size, endurance, experience, motivation, and certification to all employees equally.

The company must meet the physical characteristics of each person, and the tasks that everyone performs. The company must take into account factors such as the size of each person, strength, age, vision, etc. to ensure that each person is physically able to perform all the tasks that make up the job. A good human factor program takes into account people's limitations, and the project works accordingly. An important element of taking into account the human factor in the work are the planned breaks for rest. People can experience physical and mental fatigue under many working conditions. A sufficient number of breaks and rest periods ensures that the intensity of the task does not overload their capabilities. Another recommendation for "People", which is also related to "E" for "Environment", is to provide sufficient lighting for the task, especially for older workers. Annual vision tests and hearing examinations are excellent active measures to ensure optimal physical performance.

There are at least two environments in aviation maintenance. There is a physical workplace on the ramp, in the hangar, or the shop. In addition, there is an organizational environment within the company. The human factor program should pay attention to both environments.

Fig. 2.4

The physical environment is obvious. It includes temperature, humidity, lighting, noise control, cleanliness, and ranges of workplace design. Companies need to be aware of these conditions and work with the workforce to adapt or change the physical environment. Corporate commitment is needed to address the physical environment. This theme coincides with the PEAR Resources component when it comes to providing portable heaters, coolers, lighting, clothing and good workplace and task design.

The second, less tangible, environment is organizational. Important factors in the organizational environment are usually cooperation, communication, shared values, mutual respect, and company culture. An excellent organizational environment fosters leadership, communication, and common goals related to security, profitability, and other key factors. The best companies guide and support their people and cultivate a culture of safety. A safe culture is a culture where there are common values and attitudes towards security. In a safe culture, everyone understands that their role contributes to the overall security of the mission.

Successful human factor programs carefully analyze all the actions that people must take to perform their work efficiently and safely. Job Analysis (JTA) is a standard human factor approach for determining the knowledge, skills, and attitudes required to perform each task in a particular job. JTA helps determine what instructions, tools, and other resources are needed. Adherence to the JTA helps to ensure proper training of each employee, and each workplace has the necessary equipment and other resources to perform the work. Many regulators require that the JTA be the basis for a common service manual and training plan. Many human factors issues related to the use of work cards and technical documentation fall under "Actions". Clearly understood documentation of actions ensures that instructions and checklists are correct and usable.

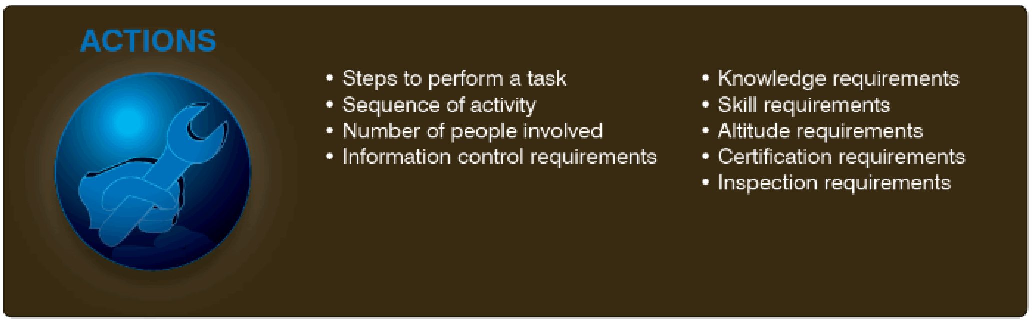

Fig. 2.5

The final letter PEAR is "R" for "Resources". Sometimes it is difficult to separate resources from other elements of PEAR. In general, the characteristics of people, environment, and actions dictate resources. Many resources are tangible, such as lifts, tools, test equipment, computers, technical manuals, and so on. Other resources are less tangible. Examples include the number and qualifications of staff to perform the work, the amount of time allotted and the level of communication between the team, managers, suppliers and others. Resources should be considered from a broad perspective. A resource is all the necessary equipment to do a job. For example, protective clothing is a resource. A mobile phone can be a resource. Rivets can be resources. Important for the Resource element in PEAR is the focus on determining the need for additional resources.

Fig. 2.6

The SHEL model is another concept of research and evaluation of service errors.

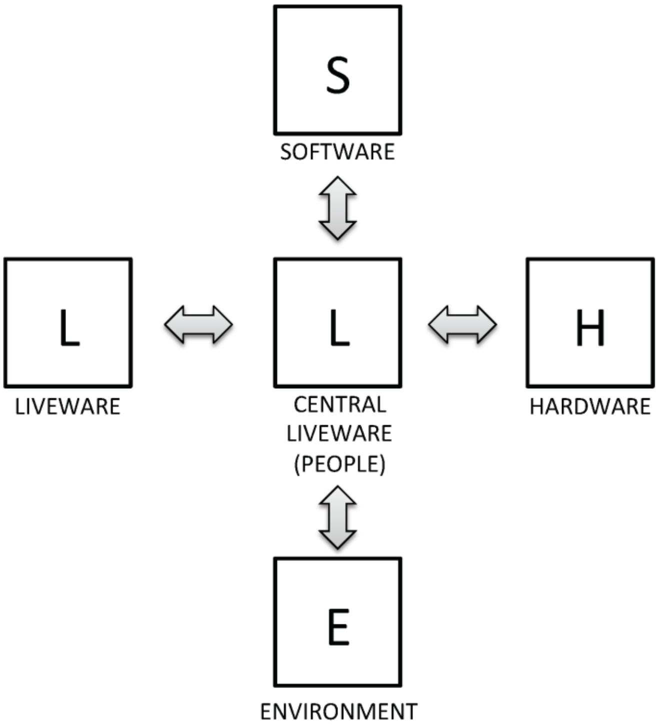

Fig. 2.6

Like other tools of the human factor, its purpose is to determine not only what the problem is, but where and why it exists. The abbreviation SHEL means:

- Software
- Hardware
- Environment
- Liveware

The model examines the interaction with each of the four components of SHEL and does not take into account interactions that do not involve the human factor. The term "software" does not refer to the general use of the term for computer programs. Instead, it includes a broader view of the manual layout, checklist layout, symbols, language, and computer programs. Equipment includes elements such as the location of components, and the availability of components and tools. The environment takes into account temperature, humidity, sound, light and time of day. Liveware connects technical staff with other people both at work and abroad. These include leaders, peers, family, friends, and myself.

There are two possible types of failures - active and hidden. An active failure occurs instantly. An example of this type is an aircraft that slips out of one of the lifting jacks due to improper placement by a technician. In this example, the aircraft jack is an approved element of ground-based ancillary equipment and is properly maintained.

A latent failure occurs as a result of a decision or action is taken long before the incident or accidently occurred. The consequences of such a decision may remain inactive for a long time. An example of a hidden fault could be a skidding of an aircraft, but in this case an unauthorized jack can be used, as funding for the purchase of relevant ground equipment has not been approved.

The field of the human factor, especially in aviation services, is a growing field of study. This section of this chapter presents only a small part of the numerous observations and presentations on this topic. If a specialist wants to know more, there are many books, and a review of Internet data will give a lot of information.

Aircraft operate in conditions that contribute to the dangers of aviation. Environmental factors are the main cause of aviation accidents and incidents. To reduce accidents, researchers are tackling the problem from a variety of perspectives, including improving meteorological forecasting methods, automatically collecting additional weather data using onboard sensors and flight modems, and improving weather data dissemination and methods visualization. Environmental factors are all factors related to weather, factors related to atmospheric conditions, factors related to geographical and metrological conditions, factors related to natural disasters, factors related to altitude and other factors, such as laser light, cosmic radiation, etc., become operational and are responsible for an accident or incident. To fly in this complex environment, a pilot needs a lot of concentration, experience and information. It is very important to identify and clarify the circumstances and causes of plane crashes that occur due to environmental factors, which will help avoid similar accidents in the future.

Weather is one of the main causes and obvious factors of aviation accidents and incidents. Aviation is highly dependent on the weather. Weather factors contribute to accidents and increase the likelihood and impact of other factors, such as severe weather and poor visibility, which can increase the likelihood of pilot error and collisions with terrain or other aircraft. Restless flights caused by weather conditions, which can cause serious discomfort and even injuries, are the subject of the common experience of many passengers. In adverse weather conditions, it is very difficult for a pilot to make a decision. Weather can also increase flight delays.

Various significant atmospheric factors cause serious air disasters, as well as frequent disruption of disruptions dules. The main atmospheric hazards are thunderstorms and lightning, ice, wind shear, heavy rainfall, heavy rain, low clouds, etc. Many accidents and incidents are caused by thunderstorms. Thunderstorms are dynamic phenomena with well-defined life cycles that begin in environments where a deep unstable atmosphere exists from scratch. Hail is more dangerous for aircraft engines and structures due to its solid nature ahigh-water content, and in extreme cases it causes engine fires. Kulesa noted that icing is very dangerous in flight, as structural icing on the wings and control surfaces increases the weight of the aircraft, impairs lift, generates false readings and impairs, control of the aircraft. The presence of ice and snow on the runway reduces friction between the tire and the surface, which is necessary to slow down and control the direction of the aircraft. Rain causes visibility problems, and one of the main problems of heavy rain is the combustion of aircraft engines. Wind shear is defined as the spatial as well as the temporal rate of change of wind speed and/or Wind shear causes rough flights, problems with piloting aircraft, and sometimes an irreversible loss of control leads to an accident.

The aircraft is very difficult and expensive to work on a plateau with low pressure, difficult climate, and uneven terrain. The change of weather in the mountains is very fast. In the morning, flight conditions in the mountains will improve, and in the afternoon, there may be more clouds and stronger winds. The pilot needs to understand the basic patterns of airflow during flights in mountainous areas. During pre-flight planning flight must read the maps carefully to know the steepness of glaciers and mountain slopes. A plane crash also occurs due to a collision with the terrain, ie hills or mountains. To prevent CFIT accidents, it is very important to know the position of the crew and the monitoring of navigation systems.

Natural disasters negatively affect aircraft flights and airport infrastructure. Volcanic eruptions and earthquakes are natural disasters that affect aircraft. Earthquakes are the most devastating disasters for airports and aircraft. They can lead to even greater injuries and damage to structures. The volcano emits a large number of very small fragments of rocks known as volcanic ash. Volcanic ash poses a threat to aviation security. Volcanic ash consists of a mixture of sharp angular fragments of rapidly fading volcanic glass, as well as minerals and rock fragments ranging in size from fine powder to fragments up to eight inches. diameter. The ash is very hard and small in size, it can scratch and damage parts of the fuselage, engine parts and ash injection. can cause serious consequences. deterioration of the engine or even engine failure in very extreme conditions. It can also be a harmful electronic aviation system.

Aerodynamic characteristics correlate with height. Air density increases at lower altitudes, decreasing altitude increases aircraft performance, and air density decrease at higher altitudes, increasing altitude reduces aircraft performance, so air density and altitude greatly affect engine and aircraft performance. The aircraft needs long runways to take off at airports at higher altitudes, as the aircraft speed is lower than its approach, and the true airspeed higher than the specified air speed, so the roll will airspeed. As the aircraft moves to greater altitudes, the temperature and density of the air decrease.

Atmospheric temperature also affects the characteristics of the aircraft. Take-off will require a long runway, low set speed, and faster landing when the temperature is very high, which will lead to a longer roll. When the high temperature is combined with high altitude, a situation arises that aerodynamically reduces the characteristics of the aircraft. Sometimes humidity also becomes a factor that degrades the performance of the aircraft. Humidity means the maximum amount of water in the atmosphere. At higher humidity, the water content in the atmosphere will be higher, which will affect engine power, which will lead to loss of performance of the aircraft. Therefore, all these factors reduce the efficiency of the aircraft.

There are several different types of mechanical failures that lead to catastrophic aviation accidents, and dents that lead to serious injuries, and deaths.

The main causes of aviation accidents due to mechanical failures are:

- Production defect (aircraft or component)
- Defect design (aircraft or component)
- Failure to properly inspect the aircraft
- Improper maintenance of the aircraft
- Untimely replacement of components
- Metal fatigue
- Corrosion

Production defects include:

- Complete set
- Resin hungry areas
- Areas rich in resin
- Bubbles, air bubbles
- Wrinkles
- Emptiness

• Thermal decomposition

Industrial damage includes anomalies such as porosity, microcracks, and delamination due to inconsistency of processing. This also includes items such as unintentional cuts on the edges, dents and scratches on the surface, damaged mounting holes and impact damage. Examples of manufacturing defects include contaminated bonding or embedding surfaces, such as prepreg backing paper or separating film, which accident remains between layers during installation. Unintentional damage may occur during the assembly, transportation or operation of parts or components.

Aviation industry research has shown that maintenance errors can be traced to 20% of all engine stops in flight.

Typical maintenance errors include:

• Inconsistency of publication.

• Unfastened items remain on the plane.

• Incorrect installation of components.

• Installation of inappropriate parts.

• Insufficient lubrication.

• Access panels, fairings, or hoods are not attached.

• Fuel or oil caps and fuel panels are not attached.

An analysis of maintenance error data collected by a group of UK maintenance organizations showed that when the type of error was classified, the four categories accounted for 78% of errors. These were installation errors - 39%, inattention (damage) - 16%, poor inspection standards - 12% and non-compliance with the approved data - 11%.

The presentation of these data was accompanied by some solutions for both "people" and "processes" for all major types of errors found.

Many aircraft structures are made of metal, and the most insidious form of damage to these structures is corrosion. From the moment of manufacture, the metal must be protected from the harmful effects on the environment. Such protection may include the introduction of certain elements into the parent metal, the creation of a corrosion-resistant alloy, or the addition of a surface coating with a chemical conversion coating, metal or paint. Additional moisture barriers, such as viscous lubricants and protectors, may be added to the surface during use.

The introduction of gliders, built mainly of composite components, did not eliminate the need for careful monitoring of aircraft for corrosion. Although the glider itself may not corrode, the use of metal components and accessories inside the glider means that the aircraft maintenance technician should be aware of the signs of corrosion when inspecting any aircraft.

There are two general classifications of corrosion, which cover the most specific forms: direct chemical attack and electrochemical. In both types of corrosion, the metal is converted into metallic compounds such as oxide, hydroxide, or sulphate. The corrosion process always involves two simultaneous changes: the metal that is exposed or oxidized undergoes what can be called an anodic change, and the corrosive agent decreases and can be considered to undergo a cathodic change.

Fig. 2.7

Direct chemical attack, or pure chemical corrosion, is an attack that occurs as a result of direct exposure to the bare surface of aggressive liquids or gaseous agents. Unlike an electrochemical attack, where anodic and cathodic changes can occur at a measured distance from each other, changes in a direct chemical attack occur simultaneously at the same point. The most common agents that cause a direct chemical attack on aircraft are: spilled battery acid or battery vapor; residual flux deposits as a result of insufficiently cleaned, welded, soldered, or soldered joints; and captured caustic cleaning solutions. With the introduction of sealed lead-acid batteries and the use of nickel-cadmium batteries, the problem of spilled battery acid becomes less. Using these closed units reduces the risk of acid spillage and battery evaporation.

Many types of fluxes used in soldering, brazing, and welding are corrosive and chemically affect the metals or alloys with which they are used. Therefore, it is important to remove the remnants of the flux from the metal surface immediately after the operation of the seam. Flux residues are hygroscopic; that is, they absorb moisture, and if not removed carefully, they tend to cause strong dimples.

An electrochemical attack can be chemically compared to an electrolytic reaction that occurs during galvanization, anodizing, or in a dry cell battery. The reaction in this corrosion attack requires an environment, usually water, that is able to conduct a tiny current of electricity. When a metal comes in contact with a corrosive agent and combines in a liquid or gaseous way through which electrons can flow, corrosion begins when the metal is destroyed by oxidation. During the attack, the amount of corrosive agent decreases, and if it is not renewed or removed, it can completely react with the metal, becoming neutralized. Different parts of the same metal surface have different levels of electrical potential, and if you connect them with a conductor, such as salt water, several corrosion cells will form and corrosion will begin.

All metals and alloys are electrically active and have a certain electrical potential in a given chemical environment. This potential is usually called the "nobility" of the metal. The less precious the metal, the easier it is corroded. The metals selected for use in aircraft design are a compromise studied in terms of strength, weight, corrosion resistance, performance, and cost, balanced with the design needs.

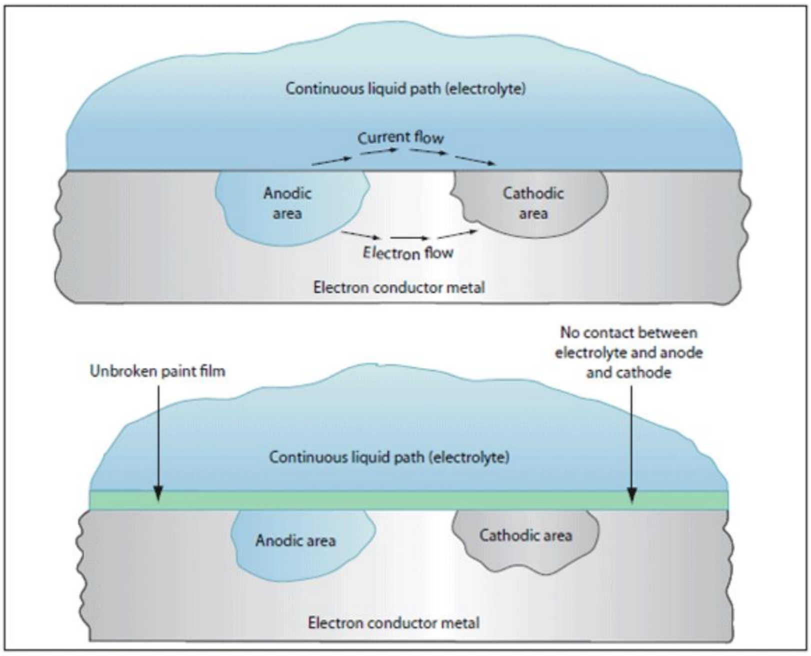

Fig. 2.8

Alloy components also have specific electrical potentials, which usually differ from each other. Influence on the surface of the alloy conductive corrosive medium leads to the fact that the more active metal becomes the anode, and the less active metal becomes the cathode, thus creating conditions for corrosion. They are called local cells. The greater the difference in electrical potentials between the two metals, the greater the intensity of corrosion, if the appropriate conditions are created.

Conditions for these corrosion reactions are the presence of conductive fluid and metals with different potentials. Corrosion cannot occur if the surface is removed and a small electrical circuit is removed by regularly cleaning and sanding the surface. This is the basis of effective corrosion control. Electrochemical attack is the cause of most forms of corrosion of the aircraft structure and its components.

Surface corrosion is manifested by general roughening, etching, or excavation of the metal surface, which is often accompanied by powdery deposits of corrosion products. Surface corrosion can be caused by both direct chemical and electrochemical effects. Sometimes corrosion spreads under the surface coating, and it is impossible to recognize it either by the surface roughness or by powdery deposits. Instead, a closer inspection will reveal that the paint or coating is removed from the surface in the form of small bubbles, which are the result of the pressure of the accumulation of corrosion products.

Fig. 2.9

Filamentous corrosion creates a series of small worms beneath the surface of the paint. It can often be seen on surfaces that have been improperly treated with chemicals before painting.

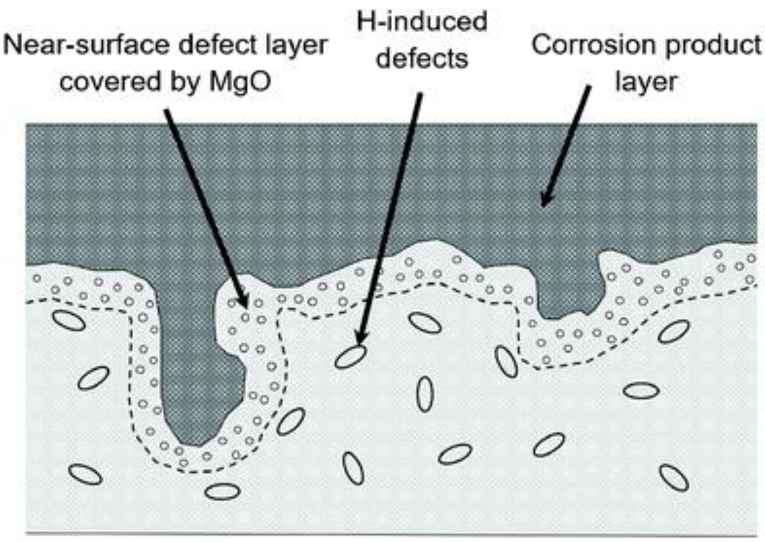

Fig. 2.10

Large damage to the pit can occur as a result of contact between dissimilar metal parts in the presence of a conductor. Although surface corrosion may or may not occur, the galvanic action, in contrast to the galvanic coating, occurs at points or areas of contact where the insulation between the surfaces has been broken or missed. This electrochemical attack can be very serious, because in many cases the action takes place out of sight, and the only way to detect it before the destruction of the structure is through disassembly and inspection.

This type of corrosion is an attack along the grain boundaries of the alloy and usually occurs due to the insufficient homogeneity of the alloy structure. Aluminium alloys and some stainless steels are particularly susceptible to this form of electrochemical exposure. The lack of homogeneity is caused by changes in the alloy during heating and cooling during production.

Stress corrosion occurs as a result of the combined action of prolonged tensile stresses and corrosive environments. In most metal systems, stress corrosion cracking occurs; however, it is particularly characteristic of aluminium, copper, some stainless steel, and high-strength alloys (over 240,000 pounds per square inch). This usually occurs along the cold processing lines and may be trans granular or intergranular aluminium alloy cranks with corrugated bushings, chassis and shock absorbers with lubricating fittings, such as pipe threads, pin connections, heat shrinkage and overstrained pipe nuts B, are examples of parts prone to stress corrosion cracking.

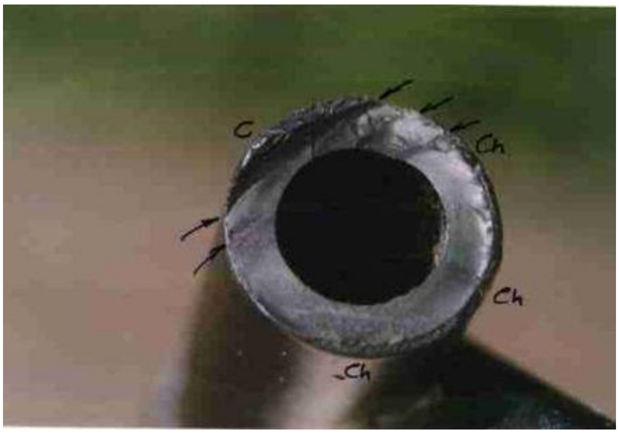

Fig 2.11

Fretting corrosion is a particularly harmful form of corrosion that occurs when two connecting surfaces, which are usually at rest relative to each other, undergo a slight relative displacement. It is characterized by point surfaces and the formation of a significant amount of small debris. Because the limited movement of both surfaces prevents debris from escaping very easily, extremely local abrasion occurs. The presence of water vapor significantly increases this type of damage. If the contact points are small and sharp, deep grooves may appear on the friction surface, resembling traces of brine or depressions. As a result, this type of corrosion is also called false brine.

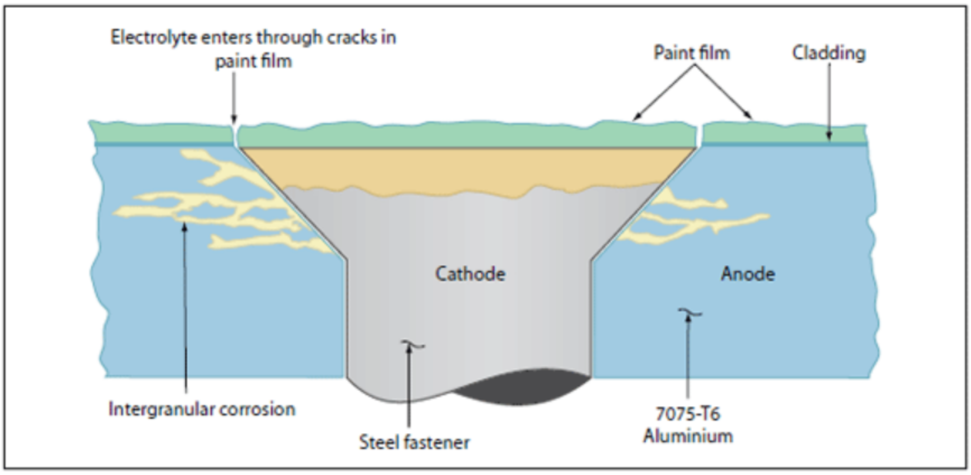

Fig. 2.12

2.2 Analysis of plane crashes caused by the above factors

Asiana Airlines flight 214 was a regular trans-Pacific passenger flight from Incheon International Airport near Seoul, South Korea. On the morning of July 6, 2013, a Boeing 777-200ER crashed during a final landing at San Francisco International Airport in the United States. Of the 307 people on board, 3 died; another 187 were injured, 49 of them seriously. Among the severely wounded were four flight attendants who were thrown onto the runway while they were still on the spot when their tails came off from hitting a wall near the runway. It was the first fatal Boeing 777 crash since commissioning in 1995.

An investigation by the US National Transportation Safety Board (NTSB) concluded that the crash was caused by inadequate control of the flight crew during the last landing. Deficiencies in Boeing's documentation on sophisticated flight control systems and the training of Asiana Airlines pilots have also been cited as contributing factors.

Fig 2.13

On July 6, 2013, flight OZ214 departed from Incheon International Airport (ICN) at 17:04 local time (08:04 UTC), 34 minutes after the scheduled departure time. He was scheduled to land at San Francisco International Airport (SFO) at 11:04 Pacific Standard Time (18:04 UTC).

Vertical guidance of the 28L runway chassis system was not available as it was decommissioned on 1 June and a message was sent to the pilots. Therefore, an accurate ILS approach to the runway was not possible.

The flight was allowed to visually land on the 28-liter runway at 11:21 Pacific Standard Time and was instructed to maintain a speed of 180 knots (330 km / h; 210 mph) until the aircraft was 5 miles away. 8.0). km) from the runway. At 11:26 a.m., TRACON from Northern California ("NorCal Approach") delivered a flight to the San Francisco Tower. The tower dispatcher confirmed the second call of the crew at 11:27, when the plane was at a distance of 2.4 km and permitted land.

Preliminary analysis showed that the plane was approaching too slowly and too low. Eighty-two seconds before the collision, at an altitude of about 1,600 feet (490 m), the autopilot was turned off, throttles were set to idle, and the aircraft was operated manually during the last descent. NTSB chairman Deborah Hersman said the pilots did not "set the plane to land automatically ... They were allowed to visually approach, and they operated the plane manually," adding: "Stay on the glide path, then on what is under the glide path.". All of these statements were made at the approach to San Francisco ... "Based on preliminary data from the flight recorder, the NTSB found that the speed of the aircraft at the final approach was much lower than the speed of its target approach. FAA radars did not show an abnormally steep decline curve, although the crew acknowledged that they started high in the final west.

Fig. 2.14

At an altitude of 125 feet (38 m), eight seconds before the collision, the airspeed dropped to 112 knots (207 km / h; 129 mph). According to initial reports from the pilots, the automatic throttle was set to the correct reference speed, but until the PAPI showed them well below the glide path, the pilots did not know that the throttle could not maintain this speed. The pilot instructor stated that the PAPI indicated a deviation under the glide path at an altitude of about 500 feet (150 m) above ground level, and he was trying to correct this at this time. Between 500 and 200 feet (152 and 61 m), the pilot instructor also reported a lateral deviation that the crew was trying to correct. Seven seconds before the impact, one pilot called for increased speed. FDR showed that the throttles at this time were switched to idle mode. The pilot instructor said he had called for increased speed, but the pilot had already released the gas by the time he reached for the throttle. The sound of trembling could be heard four seconds before hitting the cabin recorder. The air speed reached a minimum of 103 knots (191 km / h; 119 mph) (34 knots below the target speed) three seconds before the collision, with the engines running at 50% power and increasing. 1.5 seconds before the collision, the co-pilot called to go to the side. During the collision, their speeded increased to 106 knots (196 km / h; 122 mph). At 11:28 HL7742 crashed, and did not reach the threshold the runway 28L.

Flight 261 Alaska Airlines was a McDonnell Douglas MD-83 Alaska Airlines flight that crashed into the Pacific Ocean about 2.7 miles (4.3 km; 2.3 miles) north of Anacapa Island, California. altitude control, killing all 88 people on board: two pilots, three flight attendants, and 83 passengers. The flight was a regular international passenger flight from Licenciado Gustavo Diaz Ordas International Airport to Puerto Vallarta, Jalisco, Mexico, to Seattle-Tacoma International Airport in Seattle, Washington, USA, with a transfer at San Francisco International Airport., investigation by the National Transportation Safety Board (NTSB) found that improper maintenance led to excessive wear and tear and ultimately the failure of a critical flight control system. The probable cause was the loss of control of the inclination of the aircraft as a result of the failure of the thread of the trapezoidal nut of the horizontal stabilizer in flight.

Fig. 2.15

Flight 261 of Alaska Airlines took off from Licenciado Gustavo Diaz Ordas Puerto Vallarta International Airport at 13:37 Pacific Standard Time (21:37 UTC) and climbed to a planned altitude of 310 flight levels (31,000 feet or 9,400 mm). The plane was to land at San Francisco International Airport (SFO). Shortly before 3:49 p.m. (11:49 p.m. UTC), the crew contacted the airline's air traffic control services at CTC, Washington, on the company's radio frequency, and with operational and technical facilities at Los Angeles International Airport (LAX) to discuss congestion. on the horizon. The stabilizer can be redirected to LAX. The jammed stabilizer interfered with the restraint system, which would normally have to adjust the flight control surface to maintain the stability of the aircraft in flight. At cruising altitude and jamming speed, the stabilizer position required pilots to pull on their clamps with a force of approximately 10 pounds (44 N) to maintain the level. Neither the flight crew nor the company's maintenance were able to determine the cause of the congestion. Repeated attempts to overcome congestion with basic and alternative processing systems have failed.

During this time, the flight crew had several discussions with the company's dispatcher about whether to send him to LAX or continue as planned to SFO. As a result, the pilots decided to deviate. The NTSB later found that while "the flight crew's decision to redirect the flight to Los Angeles ... was reasonable and appropriate," Alaska Airlines' air traffic control seemed to be trying to persuade the crew to continue flying to San Francisco. instead of moving to Los Angeles. (CVR) shows that the dispatcher was concerned about the impact on the schedule ("flow") in case of flight cancellation.

Fig. 2.16

Chapter 3. Innovations in the field of airworthiness maintenance

3.1 Innovations in law

Date	**Title**	*
11/03/2022	Commission Implementing Regulation (EU) 2022/410	
15/11/2021	Commission Implementing Regulation (EU) 2021/1963	
28/04/2021	Commission Implementing Regulation (EU) 2021/700	
06/08/2020	Commission Implementing Regulation (EU) 2020/1159	
27/02/2020	Commission Implementing Regulation (EU) 2020/270	
04/09/2019	Commission Implementing Regulation (EU) 2019/1384	
04/09/2019	Commission Implementing Regulation (EU) 2019/1383	

16/08/2018	Commission Regulation (EU) 2018/1142	
16/09/2015	Commission Regulation (EU) 2015/1536	
10/07/2015	Commission Regulation (EU) 2015/1088	
17/12/2014	Commission Regulation (EU) No 1321/2014	Amended

According to Commission Implementing Regulation 2022/410:

Regulation (EU) № 1321/2014 is amended as follows:

Article 1

- in Article 2, the following point (t) is added:

- "Harmonization of management systems" means a coordinated process by which the management systems of two or more organizations interact and exchange information and methods to achieve common or consistent objectives of security and compliance monitoring. ';

- Annex I (Part-M) has been amended by Annex I to this Regulation;

- Annex Vc (Part-CAMO) has been amended by Annex II to this Regulation.

ANNEX I

Annex I (Part-M) to Regulation (EU) № 1321/2014 is amended as follows:

1. following points are added to point MA201:
   1.1. By way of derogation from point (e) (2), at least two operators that are part of a single air carrier business group may use the same CAMO to assume responsibility for maintaining the airworthiness of all aircraft they operate, provided that all of the following requirements are met:

1.1.1. The CAMO is approved by Annex Vc (part of the CAMO) for the controlled aircraft;

1.1.2. CAMO is part of the same airline business group as the respective operators;

1.1.3. bye with Annex I to this Annex, a contract is concluded between the CAMO and the owner of the AOC, who is not himself approved as a CAMO;

1.1.4. CAMO has its principal place of business in the territory to which the Treaties apply;

1.1.5. individual management systems of the organizations concluding the contract are coordinated among themselves.

1.2. By way of derogation from point (e) (2), where the termination or revocation of an operator's certificate results in a situation where an air carrier licensed by Regulation (EC) № 1008/2008 and part of an air carrier business group no longer complies with point MA201 (ea), that licensed air carrier shall establish and implement an action plan to be satisfied by the competent authority to implement point MA201 (e) (2) as soon as possible.

2. The following amendments have been made to Annex I:

2.1. paragraph 4 shall be worded as follows:

It should state the following:

"The owner or operator shall instruct CAMO or CAO to manage the airworthiness management of the aircraft, including, but not limited to, the development of the AMP to be approved by the competent authority as detailed in paragraph M.1 and the organization of aircraft maintenance by the AMP.

Under this agreement, both parties undertake to fulfill their respective obligations.

The owner or operator declares, to the best of his knowledge, that all information provided to CAMO or CAO regarding the continuing airworthiness of the aircraft is and will remain accurate, and that the aircraft will not be repaired or modified without the prior consent of CAMO or CAO.

In the event of any non-compliance with this contract by any of the signatories, the CAMO or CAO and the owner or operator shall assess whether this affects the extension of the contract and inform the competent authority (ies) of such organizations. Organizational assessments should take into account the importance of non-compliance for safety, and if it is repetitive. If, after this assessment, any of the signatory parties conclude that they are unable to perform their duties due to their own limitations or due to the signature errors, the contract will be terminated and the competent authority (ies) organizations should be informed immediately. In this case, the owner or operator retains full responsibility for each task related to maintaining the airworthiness of the aircraft, and the owner or operator shall notify the competent authorities of the Member State of register try within 2 weeks of such non-compliance. In the case of a contract concluby with MA201 (ea), the competent authority of the Member State of registry shathell be informed immediately. ";

2.2.the introductory part of paragraph 5 shall be worded as follows: "When the owner or operator enters into a CAMO or CAO contract by MA201, the contract shall specify the obligations of each party as follows:";

2.3.in paragraph 5.1 (2), paragraph (e) is replaced by the following establish and order the necessary maintenance to ensure proper communication with the previous aircraft maintenance program; ';

2.4.in paragraph 5.1 (2), paragraph (i) is replaced by the following: coordinate the implementation of scheduled maintenance, including component inspection, replacement of service life parts and the implementation of any applicable AD, as well as compliance with operational requirements affecting continuing airworthiness, airworthiness requirements established by the Agency, and measures, required by the competent authority to respond immediately to the security problem; ';

2.5. in paragraph 5.1 (2), paragraphs (j), (k), and (l) are replaced by the following:

2.5.1 inform the owner or operator each time the aircraft is delivered to an approved maintenance organization

2.5.2. keep and archive records on the airworthiness of the aircraft

2.5.3. coordinate with the operator or owner any request to the appropriate competent authority for any deviation from the aircraft maintenance program;

2.6. in paragraph 5.1 (2), the following paragraph (m) is added:

support the operator or pilot-owner in maintaining the airworthiness of the aircraft when performing a maintenance check. ';

2.7. in paragraph 5.2, the following paragraphs 13, 14, and 15 are added:

2.7.1. provide compliance with the approved maintenance program and coordinate with the CAMO or CAO any request to the relevant competent authority for any one-time extension of the maintenance program interval;

2.7.2. inform the CAMO or CAO of any non-compliance with operational requirements that may affect the continuing airworthiness of the aircraft

2.7.3. inform the CAMO or CAO of any operational requirements (such as specific approvals) that need to be met to maintain the aircraft in the required configuration.

2.8. point 7 is added:

2.8.1 Additional requirements in case of application of MA201 (ea)

In addition to the above requirements and obligations in paragraphs 5.1 and 5.2, where the contract between CAMO and the operator is concluded by paragraph MA201 (ea), the airworthiness management agreement must also meet the requirements of paragraphs 7.1. to 7.3.

Before signing a contract, the operator must evaluate the CAMO to ensure that the CAMO has the capacity and ability to perform the contract.

2.8.1 Suitability

A contract to maintain airworthiness by MA201 (ea) shall be concluded only if the air carrier concerned is licensed in accordance with Regulation (EC) № 1008/2008 and CAMO is part of the same air carrier business group. The airworthiness management contract should contain a clear description of how the conditions described in MA201 (ea) are met. In particular, it should describe how individual management systems of organizations harmonize with each other.

2.8.2 Additional CAMO obligations:

- get acquainted with the operator's procedure related to contract monitoring;
- obtain the consent of the operator before subcontracting
- airworthiness management tasks
- immediately inform the competent authority of the Member State of the registry when the operator does not present the aircraft to an approved maintenance organization, as required by CAMO, when this contract is not complied with or when either party denounces the contract;
- provide training to operations personnel to ensure that they have an understanding of CAMO:
    - policies and procedures, responsibilities, obligations, responsibilities, and areas of interaction;

- communication lines (eg aircraft records, timely exchange of accurate airworthiness information, including outside normal business hours);
- CAMO-specific procedures, such as the use of special software, reliability monitoring, the use of the airplane technical log system, and compatibility provisions.

2.8.3 Additional responsibilities of the operator:

- develop procedures for interaction with CAMO to resolve the issue and renew the airworthiness review certificate;
- in the event of unexpected maintenance needs in places where no contract has been concluded with a maintenance organization approved in accordance with Annex II (Part-145) to this Regulation, notify CAMO immediately;
- immediately inform the competent authority of the Member State of registration when either party denounces the contract;
- provide training to CAMO staff to make sure they understand:
  - policies and procedures, responsibilities, obligations, responsibilities, and areas of interaction;
  - communication lines;
  - Operator-specific procedures, such as operating procedures, use of special software, use of the aircraft technical log system and compatibility provisions.

After reviewing all the laws and changes to them, we can conclude that the law is constantly changing. Amendments are being made or the law is completely changed to improve and ensure flight safety, which in turn focuses on maintaining airworthiness.

3.2 Inventions that will reduce the impact on the aircraft

The next generation of aviation professionals (NGAP), who are now entering the aviation industry, represent a new generation of students. To attract and meet their needs, the aviation community uses innovative technologies to go beyond traditional teaching methods and improve the workforce.

One of the most popular technologies used in aviation is the integration of mixed reality (MR) with holograms and digital headsets. Although virtual and augmented reality (AR) is not new superimposed digital content in our real-world environment, it promises to change the way we teach NGAP to operate and maintain aircraft. This can provide a mobile cost-effective solution to improve the real environment, create virtual simulations, accelerate learning and increase content.

Fig. 3.1

Operation and maintenance of modern aircraft require an understanding of several interrelated human and machine components that require practice and immersion. This exciting experience can be created or expanded with augmented reality (AR) or virtual reality (VR). As for the current task, they both contract with NGAP, which allows the student to practice, provide real-time feedback, improve skills transfer efficiency and increase knowledge retention. They are different, as is our perception of our presence, our ability to work without obligation, and our ability to train our crew.

Virtual reality (VR) can transpose the user through closed visors or glasses that block the real environment. VR can be useful for certain operations, such as a specially qualified airport inspection, to allow the pilot to feel the terrain and surroundings before the actual flight before landing;

study the procedure or checklist, and practice maintenance or other operational functions. On the other hand, MR combines virtual reality content with real content and allows the user to interact with the content through hand gestures or voice commands.

The most important thing about aviation training is that, unlike virtual reality, the user is not excluded from the environment of mixed reality. Whether you share physical space or not, mixed reality allows you to see, listen, and talk to others, while all participants see the same holograms at the same time. As a result, users can interact with virtual content while continuing to be in touch with the real-life around them.

Operational tasks (such as aircraft maintenance) can also be supplemented by manual procedures, checklists, and hands-free information.

This experience is achieved by wearing MR headsets such as Microsoft HoloLens. MR adds interactive holographic enhancements applied by the computer to the real user environment. This technology also allows you to remotely train crew and maintenance technicians, which can change the game for the entire industry.

MR Technologies is now widely used in the medical, petroleum, aerospace, and automotive fields and has recently been adapted for operational use in the aerospace industry by many companies (Lockheed Martin, Pratt & Whitney, Bell Helicopter, Air New Zealand, TAE Aerospace, and Japan Airlines, for example).

Although manufacturers and operators have already experienced the benefits of augmented and mixed reality, the use of MR in aviation training is a recent innovation. Several studies have been published on its effectiveness compared to conventional teaching methods. Research in the medical arena has concluded that advanced learning methods and the 3D environment can be options for increasing productivity, reducing errors, and increasing safety. To evaluate the benefits of MR to attract NGAP and improve aviation training, the University of Western Michigan (WMU), College of Aviation (USA) has created a HoloLens application called JetXplore. WMU now uses mixed reality in the classroom to teach aviation systems.

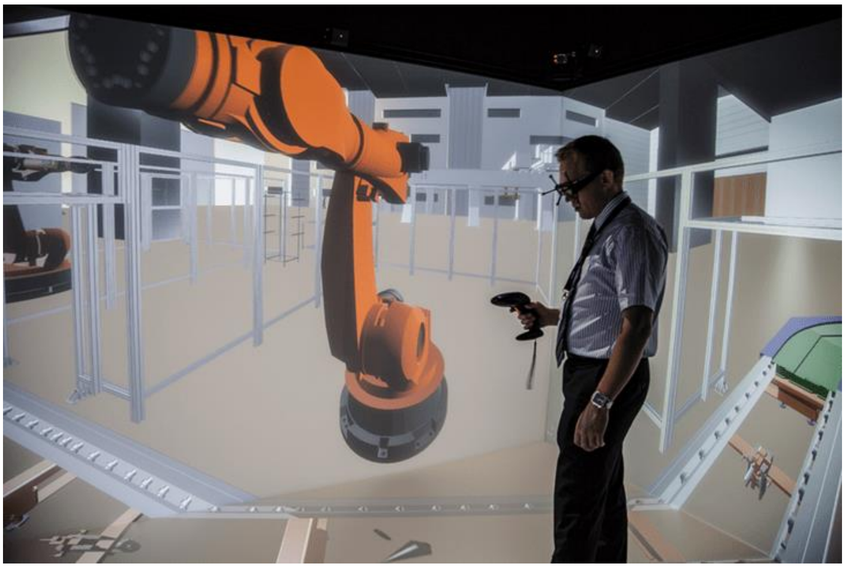

Fig 3.2

The program was designed to teach aviation operations and procedures for the CRJ-200, B787, A380, and SR20 regional aircraft to bridge the gap between classroom simulation and flight; use NGAP, and allow students to practice in the environment. The JetXplore interactive program includes customized scripts, turbocharged engines, and 360-degree interactive cabins to study aircraft systems, flows, and checklists, and allow students to practice the Quick Reference Guide (QRH). In addition to setting up JetXplore for the virtual environment, an important goal of this project is to explore subjective presence, as it affects the performance of tasks, reducing the gap between expensive simulators and class.

The development of pedagogical material extended to the informational and explanatory technological learning environments.

Microsoft HoloLens MR devices and dive headsets are at the forefront of dive technology, and instead of replacing existing simulators, they can improve them. Interacting with holograms through walking, interacting, and even modifying can increase motor excitability and increase working muscle memory. We can safely simulate dangerous or difficult to repeat scenarios; require participants to actively participate in the exercises; evaluate based on performance or relevant tasks with data transmitted to the training department or instructor of the company; Virtually create new equipment at no extra cost or location, and allow yourself to learn anywhere, anytime with MR headsets.

In view of this, it can be assumed that MR offers the potential for deeper retention of knowledge in aviation training, while actively involving NGAP.

Unlike other advanced technologies, HoloLens is intuitive and offers natural means of interaction. No mouse, wire or touch screen. All you need are simple gestures to create and change holograms, your voice to communicate with applications and your eyes to navigate and analyze. JetXplore allows students to use real cab movements when interacting with buttons, switches, dials or traction levers to avoid negative training and improve muscular memory.

Such technologies create a new environment for aviation training, a new paradigm of mixed reality. For the first time, we have the opportunity to take an analog world and impose a digital artifact, creating aviation modelling of mixed reality. Instructors can be anywhere, and students can bring highly realistic holographic images, such as a giant B787, A380, or turbofan engine, directly to their home, school, school, university, or wherever they learn to interact with them. 'facility for the study and testing of procedures, pre-flight operations and other information necessary for the operation or maintenance of equipment.

While not everyone has the ability to have technology like HoloLens in the classroom, most of us have a smartphone. With image recognition technology, we can improve our current and future print media and "impose" our own experiences, such as checklists, 3D models, videos, procedures, or interactive learning modules. This is similar to an invisible QR code that is mapped to a corresponding image or URL. Now WMU professor Lori Brown and his colleagues at Purdue are creating a textbook on augmented reality aviation systems to allow students to interact with the images in the textbook.

Students simply download an application (similar to a QR code reader) and use the camera on their phone or tablet to see hidden content.

This method can also be used by airlines and training providers to overlay content such as videos with procedures or streams of checklists or information manually. In addition, this process enjoys the benefits of 3D. Aviation training can get rid of the limitations of 2D, making it easier for people to visualize the finished project, reducing design errors, saving time and allowing the premises to open faster.

Fig. 3.3

Companies that rely on engineers and technicians in their workforce can also benefit significantly from the immersive potential of AR and MR. As this potential becomes more and more realized, engineers can see how entire industries are becoming a mixed reality, both in terms of operations and training. Where the traditional model of aviation training relies heavily on memorization, the education system shifts the focus from what students learn to how well students can apply knowledge. As we redefine the aviation learning environment through technology and innovation, we can prepare the NGAP to meet current expectations in the workplace and prepare for tomorrow's challenges.

CONCLUSION

The field of aircraft construction is not standing still. More and more aircraft are being invented, and with them the maintenance industry is evolving. Improvement, maintenance and proper use of the aircraft in turn ensures safety. In turn, the plane is affected by many factors such as man, environment and the car itself. By implementing the latest inventions, changing laws and controlling operation, we will be able to reduce the number of disasters and thus save many lives.

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