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АЕРОКОСМІЧНИЙ ФАКУЛЬТЕТ
Кафедра підтримання льотної придатності повітряних суден

ДОПУСТИТИ ДО ЗАХИСТУ
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ДИПЛОМНА РОБОТА

(ПОЯСНЮВАЛЬНА ЗАПИСКА)
ВИПУСКНИКА ОСВІТНЬОГО СТУПЕНЯ МАГІСТРА
ЗА ОСВІТНЬО-ПРОФЕСІЙНОЮ ПРОГРАМОЮ
«ТЕХНІЧНЕ ОБСЛУГОВУВАННЯ ТА РЕМОНТ ПОВІТРЯНИХ СУДЕН І АВІАДВИГУНІВ»

Тема: «Удосконалення системи підтримання льотної придатності повітряних суден сімейства Boeing на основі ідентифікації загроз і управління ризиками при технічному обслуговуванні»

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Нормоконтролер : ______________________ /_____________________ /

КИЇВ 2020

MINISTRY OF EDUCATION AND SCIENCE OF UKRAINE

NATIONAL AVIATION UNIVERSITY

AEROSPASE FACULTY

DEPARTMENT OF THE AIRCRAFT CONTINUINING AIRWORTHINESS

PERMISSION FOR DEFENCE

Head of the Department
PhD (Engineering), Associated Prof.
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“_______” __________ 2020

MASTER DEGREE THESIS

ON THE EDUCATIONAL PROFESSIONAL PROGRAM "MAINTENANCE AND REPAIR OF AIRCRAFT AND AIRCRAFT ENGINE"

(EXPLANOTARY NOTE)

Theme: “Improvement of airworthiness retaining system of Boeing family aircrafts based on threat identification and risks management at maintenance”

Performed by: ______________________________________ **Tverytinov Y.**

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Kyiv 2020

NATIONAL AVIATION UNIVERSITY

Faculty: Aerospace Faculty

Department of Aircraft Continuing Airworthiness

Educational and Qualifications degree: Master

The specialty: 272 Maintenance and Repair of Aircraft and Aero engines

APPROVED BY

Head of the Department
_____________ O.V. Popov
"____"_____________2020___

Graduation Work Assignment

Student's name: TVERYTINOV YEHOR

1. The Work (Thesis) topic: *Improvement of airworthiness retaining system of Boeing family aircrafts based on threat identification and risks management at maintenance* approved by the Rector's order of __________ "___" , 2020 №________/ст.

2. The Graduation Project to be performed: *05.10.20 - 13.12.2020.*

3. Initial data for the project: *Development of the proposals for the improvement of airworthiness retaining system of Boeing family aircrafts based on threat identification and risks management at maintenance.*

4. The content of the explanatory note (the list of problems to be considered): *Diploma work assignment; Determination of the parameters of the object of study, analyzing project part; scientific research part; labor precaution; environmental protection; general conclusions; recommendations; references.*

5. The list of mandatory graphic materials: *(posters): research methodology; safety managment system; risk assessment and hazard identification; safety policy, assurance, promotion; reliability of Boeing family; risk assesment; flight safety; aircraft airworthiness; aviation safety reporting system; audit system; flight safety integrated managment system; target indicators of European companies.*

6. Time and Work Schedule

Stages of Graduation Project Completion	Stages Completion Dates	Remarks
Literary review of materials in the scientific direction of the thesis	06.10.20-12.10.20	
ICAO Approach to the Risks Management	13.10.20-19.10.20	
Boeing Family Reliability	20.10.20-26.10.20	
ICAO Approach to Hazard Identification and Risk Assessment	27.10.20-06.11.20	
Target Indicators	07.11.20-18.11.20	
Maintenance Organization Staff Optimization	19.11.20-29.11.20	
Labor precaution	30.11.20-02.12.20	
Environmental protection	03.12.20-05.12.20	

7. Advisers on individual sections of the work (Thesis):

Section	Adviser	Date, Signature	
		Assignment Delivered	Assignment Accepted
Labour precaution	Konovalova O.V.		
Environmental protection	Radomska M.M.		

8. Assignment issue date ______________________________

Graduate Project Supervisor *MAKSYMOV V.O.* ____________________
(supervisor signature)

Assignment is accepted for performing:

Graduate student *TVERYTINOV Y.* ____________________
(graduate student's signature) (Date)

ABSTRACT

Explanatory note to the diploma work "*Improvement of airworthiness retaining system of Boeing family aircrafts based on threat identification and risks management at maintenance*":

… pages, … figures, and …tables … references

Key words: Safety managment system; risk assessment and hazard identification; safety policy, assurance, promotion; risk assesment; flight safety; aircraft airworthiness; aviation safety reporting system; audit system;

Research subject: Development of the proposals for the improvement of airworthiness retaining system of Boeing family aircrafts based on threat identification and risks management at maintenance.

CONTENT

LIST OF CONVENTIONAL ABBREVIATIONS, DESIGNATIONS, SYMBOLS

This is list of abbreviations and designations which are used in text of explanatory note.

ICAO – International Civil Aviation Organization

SMS - Safety Management System

SMM - Safety Management Manual

ERP - Emergency Response Plan

SRM - Safety Risk Management

SMI - Safety Management Implementation

SSP - State Safety Programmes

SARP - Standard and Recommended Practice

ECAST - European Commercial Aviation Safety Team

EASA - European Aviation Safety Agency

ATC - Aircraft Type Certificate

CMR - Certificate of Maintenance Review

VIRP - Voluntary Incident Reporting Program

ASAP - Aviation Safety Action Program

IATA - International Air Transport Association

IACA - International Air Carriers Association

ERAA - European Regions Airlines Association

USOAP - Universal Safety Oversight Audit Programme

SAR - Service Arrangement Regulation

FSIMS - Flight Safety Integrated Management System

TAWS - Terrain Avoidance and Warning System

ACAS - Airborne Collision Avoidance System

UW - Unskilled Worker

QM - Qualified Mechanic

INRODUCTION

Threat identification and risk management are fundamental to safety, while safety is the foundation and roof of all aviation. The hazard to flight safety is the most basic issue, and this is exactly what each airline seeks to reduce. Despite the fact that aviation accidents and incidents cannot be excluded from aviation, since there is a human factor everywhere, risks and threats can be controlled and predicted. If we neglect the safety of flights in airlines, then the demand for aviation relocation will fall, which at the same time is simply unrealistic, paradoxical, people are simply accustomed to airplanes.

1 ICAO APPROACH TO THE RISKS MANAGEMENT

1.1 Safety Management System definition

Safety Management System (SMS) is a systematic approach to managing safety, including the necessary organizational structures, accountabilities, policies and procedures. It is a systematic and explicit approach defining the activities by which safety management is undertaken by an organization in order to achieve acceptable or tolerable safety.

SMS is commonly known as a list of operations and instruments for the management of a structural safety program. The SMS is not a just-released subject for thought nowaday. The SMS began its life in previous century else. Even before our days, people began to fly, and they realized that for the development of aviation in the future, a lot of attention should be paid to aviation security. A lot of aviation service providers have operations to degrade risk to an allowable level. In fact, every operator has SMS; however, when we talk about a SMS, commonly referred to as SMS, we are referring to safety management processes. Nowaday operators do not fly without SMS aviation standards and recommendations are based on ICAO.

1.2 ICAO Approach to the Safety Managment System

There are four components of an SMS that represent the two core operational processes underlying an SMS, as well as the organizational arrangements that are necessary to support the two core operational processes. The four components of an SMS are:

- safety policy and objectives;
- safety risk management;
- safety assurance;
- safety promotion.

1.2.1 Safety Policy and Objectives description

1.2.1.1 Management Commitment

Management Commitment - infers the coordinated cooperation by the most elevated level management in all specific and basically vital points such as security, quality, environment, security, etc., or programs of an organization. It is critical that the obligation for authority and for making the environment of persistent enhancement has a place for all levels of management and individuals, but especially to the most elevated.

1.2.1.2 Safety Accountability and Responsibility

Safety accountability - the commitment to illustrate the task accomplishment and take obligation for the safety execution in accordance with concurred desires. Accountability is the commitment to reply to an action.

Safety responsibility - the commitment to carry forward an doled out safety related assignment to its successful conclusion. With obligation goes specialist to coordinate and take the essential activity to guarantee success.

Clear and accurately apportioned safety accountabilities and duties are prerequisites for accomplishing the organization's safety goals and for actualizing a successful safety management and safety enhancement process.

Safety accountabilities and responsibilities should be distributed to the management and staff included in safety-related errands. This incorporates assignment of accountabilities and responsibilities for the safety of operations (safety execution of the organization), but moreover for the usage and operation of the SMS of the operator/service supplier in line with the characterized safety management parts. The previous one is frequently characterized in a devoted annex to the work depiction, while the last mentioned is ordinarily depicted within the Safety Management Manual (SMM) of the organization.

Safety responsibility can be delegated, inside the list of the characterized work duties, given such delegation is recorded. Safety accountability can not be delegated. It characterizes the commitment of the capable individual to illustrate the satisfactory release of his/her safety responsibilities.

Safety management accountabilities and responsibilities are apportioned in accordance with the organization's common management structure and SMS organizational structure. Ordinarily, the SMS does not characterize safety accountabilities and responsibilities exterior its scope. The SMM does not depict the common arrangement of the assignment of responsibilities inside the operational and specialized divisions and their inner safety organization. In numerous organizations, safety accountabilities and responsibilities in connection to SMS are limited to supervisors and staff performing safety management capacities as it were.

According to the International Civil Aviation Organisation (ICAO) Annex 19 necessities relating to the execution of SMS, the aviation service suppliers should recognize the responsible official who, independent of other capacities, has extreme obligation and accountability, for sake of the association, for the execution and maintenance of the SMS. Service supplier are moreover required to delegate a safety supervisor who is capable for the execution and maintenance of a successful SMS. The operators/service suppliers are moreover required to recognize the safety accountabilities of all individuals of management, independent of other capacities.

"ICAO Doc 9859 – Safety Management Manual" prompts aircraft operators and aviation service suppliers to maintain, in any case of the list of their operation, a formal statement of safety obligations and accountabilities. This statement ought to clarify the formal and casual announcing lines of the authoritative structure and ought to indicate accountabilities for specific exercises. For example, the Safety director might be responsible to the executive for the release of his/her safety obligations (improvement, maintenance, observing of SMS; planning of particular security strategies; etc.).

In arrange to guarantee the required security mindfulness and commitment of all faculty included in safety related errands, the safety accountabilities and obligations shall be clearly and comprehensively characterized, reported and communicated all through the organisation.

1.2.1.3 Appointment of Key Safety Personnel

Regularly the safety personnel should have operational management ability and an understanding of the operations-critical assignments and frameworks inside the organization. The operational foundation, exclusively, isn't adequate for the successful safety personnel. He/she must have competency with respect to safety management standards. A few key abilities must be taken into consideration to complement the proficient ability of the safety personnel: Professional knowledge of the organization's specific operations and environment; Analytical thinking and problem-solving abilities; Inter and intra-organization venture management skills; People-oriented abilities such as objectivity, reasonableness, etc.; Communication abilities, both composed and oral. When those abilities are coordinated with an individual's characteristics such as authority and the capacity to set an individual example of "how to do the proper thing", an imperative the step is made towards a building positive security culture.

1.2.1.4 Coordination of Emergency Response Planning

To begin with, the service supplier must create, facilitate and maintain the Emergency Response Plan (ERP) inside the hazard management plan, which guarantees a smooth and effective move from typical operations to emergency operations, and return to typical operations after the emergency circumstance is over. ERP should coordinate into the SMS of the organization. Besides, it must adjust to the size, nature, and complexity of the activities of the pertinent organizations.

ERP must guarantee the following:

- timely, orderly, and effective transition from ordinary operations to the operations in case of danger;
- determination of threat responsibility;
- determination of obligation within the case of danger;

- the powers of key personnel decided to be responsible to carry out the exercises contained within the plan;
- coordination of endeavors with the objective of expelling the threats inside the crisis situation;
- safe continuation of ordinary exercises or return to ordinary operations as before long as conceivable.

ERP should characterize the duties, parts, and activities of different bodies and people included within the procedures in emergency situations and any case of threat.

An efficient ERP process should include the following:

- communicating with the stakeholders;
- establishing the context for making the analysis;
- identifying the hazards;
- analyzing the hazards;
- evaluating the hazards;
- assessing the risks;
- mitigating the risks;
- monitoring and reviewing the situation with the goal to continuously improve the emergency response plan.

1.2.1.5 SMS Documentation

An explicit include of the SMS is that all safety management exercises are required to be archived and obvious. Formal documentation is required to supply the definitive basis of the SMS. Moreover, it is utilized to clarify the relationship between safety administration and the other capacities of the association, the way in which safety administration exercises coordinated with those other capacities and how these exercises connect to the organization's security arrangement.

SMS documentation ought to incorporate or make reference to, as suitable, all important and appropriate national and worldwide directions. It should incorporate depictions of: safety mangement forms, procedures and specific formats, such as announcing forms; lines of accountability, responsibility and authority with respect to the management of safety, the structure of the safety management association and the SMS yields. The SMS documentation should contain explicit rules for records management, counting get to, taking care of, storage, recovery and conservation.

The foremost important piece of documentation of an SMS is the SMS manual. The safety management manual (SMM) may be a major implies for communicating the organization's approach to safety to all workers. It should not be a static document. It should be frequently surveyed to reflect changes within the organisation, procedures, equipment, etc. According to [1] the normal content of an SMM incorporates:

- safety policy and objectives of the organisation;
- scope of the safety management system;
- safety accountabilities and responsibilities;
- key safety personnel;
- documentation control procedures;
- coordination of emergency response planning;
- hazard identification and risk management schemes;
- safety assurance;
- safety performance monitoring;
- safety auditing;
- management of change;
- safety promotion;
- contracted activities.

1.2.2 Safety Risk Management description

Safety Risk Management (SRM) is an significant procedure within the framework of a safety management concept, consisting of concept mapping, threat disclosure, risk assessment, risk consideration and risk management. The SRM procedure is embedded in the movements applied in order to provide a product / service. “Risk management - detection, investigation and prevention (also / or reduction to the applicable or possible extent) of these threats, but also further risks that threaten the viability of the company.” [1].

The objective of Risk Management is to guarantee that the risks related with dangers to flight operations are methodicallly and formally recognized, evaluated, and overseen inside worthy safety levels. The operation of Risk Management is presented in Fig. 1.1:

Fig. 1.1 - Risk Management Process

Moreover, successful Risk Management requires that the safety “cost-benefit” of the arranged and implemented course of activities is examined, counting the case of choosing a “do nothing” methodology. In the event that it is chosen to act for restricting the presentation to the recognized risks, each chance control measure has to be assessed, to uncover possible latent hazards and torpid dangers which will emerge from enacting that measure. Once these control measures are executed, the association should guarantee they are locked in in a correct way, and usually accomplished through a set of courses of action, forms, and efficient activities, which construct the Safety Assurance space of the SMS.

Risk Management is based on an variety of risk identification means. According to [1] this SMS component may incorporate both proactive and reactive strategies and methods. Safety occurrence reporting and investigation, being assigned to the reactive category, are well known fundamental implies for distinguishing key risk zones and remedial hazard relief measures. In expansion, the expanding integration, computerization and complexity of flight operations require a proactive, efficient and organized approach to risk evaluation and moderation using predictive and checking procedures. Risk assessment have to be be conducted for any changes which will affect the safety of services given by the operator/service provider.

The risk management concept is similarly important in all aviation segments and should be executed in a reliable way by aircraft operators, air navigation service suppliers, certified aerodrome operators, maintenance organisations and preparing organisations. Its techniques incorporate identifying the risk, evaluating the risk, avoiding or decreasing the hazard and tolerating certain dangers.

1.2.2.1 Hazard Identification

Hazard identification - identification of undesired or antagonistic occasions that can lead to the event of a danger and the examination of instruments by which these occasions may happen and cause hurt. Both reactive and proactive strategies and techniques should be used for risk identification.

1.2.2.2 Risk Assessment

Risk assessment - distinguished dangers are assessed in terms of the criticality of their destructive impact and positioned in arrange of their risk-bearing potential. They are evaluated frequently by experienced personnel, or by using more formal strategies and through analytical skill. The seriousness of results and the probability (frequency) of events of dangers are determined. In case the hazard is considered satisfactory, operation proceeds without any mediation. In case it isn't acceptable, the chance relief prepare is locked in.

1.2.2.3 Risk Mitigation

Risk mitigation - if the risk is considered to be unsatisfactory, at that point control measures are taken to fortify and increment the level of resistances against that hazard or to maintain a strategic distance from or remove the hazard, in case this is financially doable.

1.2.3 Safety Assurance description

1.2.3.1 Safety Performance Monitoring and Measurement

Safety performance monitoring and measurement - is one of three elements that comprise the safety assurance component of the ICAO SMS framework. Safety assurance consists of processes and activities undertaken by the service provider to determine whether the SMS is operating according to expectations and requirements.

Safety performance monitoring and measurement represents the means to verify the safety performance of the organisation and to validate the effectiveness of safety risk controls [1].

The guidance material suggests the following basic steps for establishing effective safety monitoring and measurement processes:

- identification of indicators to be monitored

The scope of monitoring should cover operational, technical, and organizational (safety management) aspects. Safety indicators can be quantitative or qualitative, leading (proactive) or lagging (reactive).

- collation of the information for safety monitoring

There should be a systematic collation and evaluation of results from all safety monitoring activities to ensure that interrelationships can be detected.

- analysis of indicators

The evolution of the indicators should be analyzed, trends and related causes and influencing factors established.

- application of the corrective action process

Corrective actions should be determined, taken, and followed up wherever the monitoring shows that an element is approaching a point which may affect safety to an unacceptable extent; coordination with relevant units/organizations should take place wherever necessary; the indicators and their evolution should be documented as well as actions taken and their results.

1.2.3.2 Management of Change

Aircrafts and airplane terminals are required to create and maintain a formal handle to distinguish changes inside the organization and its operation, which may influence built-up forms and services, to depict the courses of action to guarantee safety performance sometime recently executing changes and to eliminate or modify safety hazard controls that are now not required to effective due to changes within the operational environment.

- airlines and airplane terminals got to build up forms and perform formal risk investigations and hazard evaluations for major operational changes, major organizational changes, and changes in key personnel;
- safety case/risk evaluations are aviation safety focused;
- key partners are included within the change management process;
- during the change management process past hazard evaluations and existing risks are checked on for possible impact.

1.2.3.3 Continuous Improvement of SMS

Continuous improvement of the SMS thus aims at determining the immediate causes of below standard performance and their implications in the operation of the SMS, and rectifying situations involving below standard performance identified through safety assurance activities. Continuous improvement is achieved through internal evaluations, internal and external audits and applies to:

- Proactive evaluation of facilities, equipment, documentation and procedures, for example, through internal evaluations;

- Proactive evaluation of an individual's performance, to verify the fulfilment of that individual's safety responsibilities, for example, through periodic competency checks;
- Reactive evaluations in order to verify the effectiveness of the system for control and mitigation of safety risks, for example, through internal and external audits.

As a conclusion, continuous improvement can occur only when the organisation displays constant vigilance regarding the effectiveness of its technical operations and its corrective actions. Indeed, without ongoing monitoring of safety controls and mitigation actions, there is no way of telling whether the safety management process is achieving its objectives. Similarly, there is no way of measuring if an SMS is fulfilling its purpose with efficiency.

1.2.4 Safety Promotion description

Safety promotion is a major component of the SMS and at the side the organization's Safety Policy and Safety Objectives is an imperative enabler for nonstop security change achieved primarily through the two "operational components" of the SMS: risk management and safety assurance. Safety risk management, safety assurance and safety promotion give the implies for an organisation to control the safety risks and maintain the proper balance between production and protection [10].

Safety promotion sets the tone that inclines both person and organisational conduct and fills within the blank spaces within the organization's approaches, procedures and processes, giving a sense of reason to security efforts. Through safety promotion an organisation embraces a culture that goes beyond just avoiding accidents or decreasing the number of incidents, in spite of the fact that these are likely to be the most clear measures of success. It is more to do the proper thing at the correct time in response to ordinary and emergency circumstances [10].

Safety Promotion supports safety culture communication, spread of lessons learned and enables the persistent improvement process. The Safety Promotion requirements apply not only to aviation service provider organisations but moreover to States. In reality safety promotion is recognized as one of the four components of the State Safety Programme (SSP).

The safety promotion process should be applied at national, regional and worldwide level and incorporates all efforts to modify structures, environment, attitudes and behaviours pointed at improving safety [10].

According to ICAO, SMS framework and Safety Promotion has two elements, notably:

- training and education, and
- safety communication.

1.2.4.1 Training and Education

Aviation service providers should develop and maintain a safety training programme that ensures that personnel are trained and competent to perform their SMS duties. Training programmes should be adapted to fit the needs and complexity of the organisation. The scope of the safety training shall be appropriate to each individual's involvement in the SMS. The provision of appropriate training to all staff, regardless of their level in the organisation, is an indication of management's commitment to an effective SMS. The quality and effectiveness of training have a significant influence on the attitude and actual performance (the professionalism) the employees will subsequently demonstrate in their everyday work [10].

According to [1], safety training and education should consist of the following:

- a documented process to identify training requirements;
- a validation process that measures the effectiveness of training;
- initial (general safety) job-specific training;
- indoctrination/initial training incorporating SMS, including Human Factors and organisational factors;
- recurrent safety training.

The Fig. 1.2 illustrates the scheme of Training and Education:

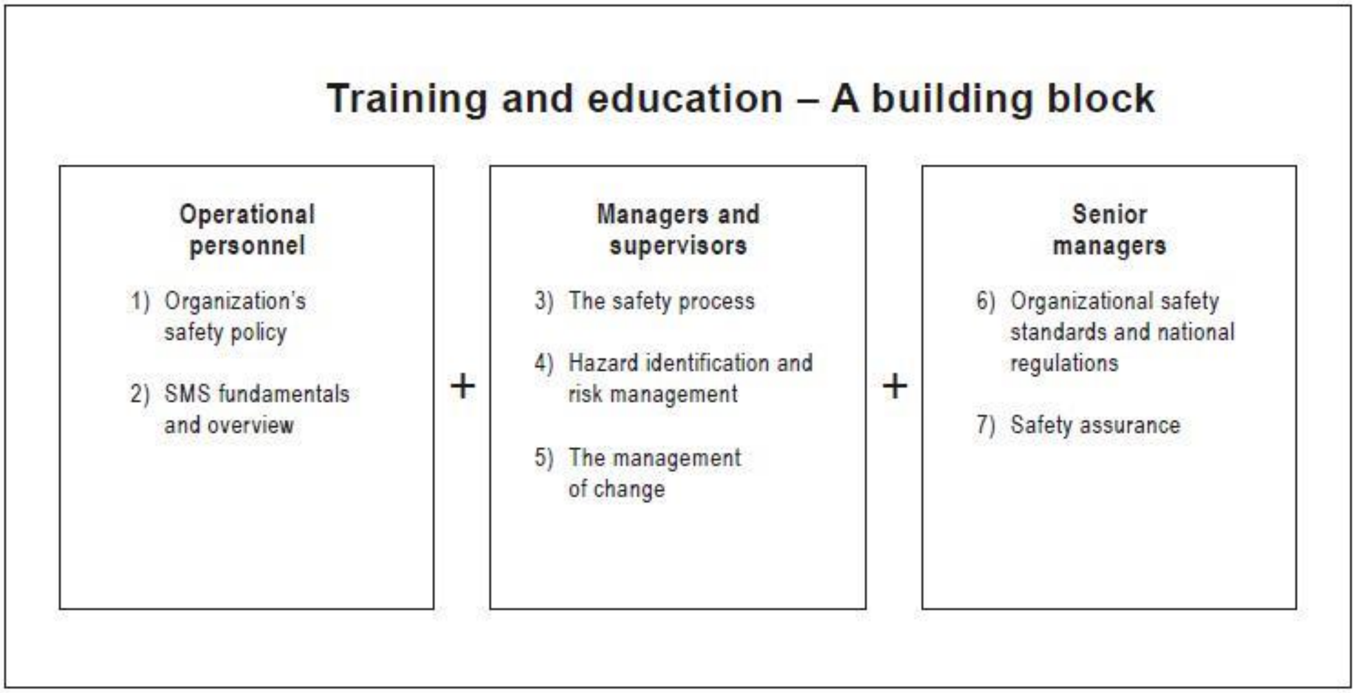

Fig. 1.2 – Block Scheme of Training and Education

1.2.4.2 Safety Communication

Aviation service providers should develop and maintain formal means for safety communication that enable a continuous safety improvement loop and ensure that all personnel are fully aware of the SMS.

According to [1], safety communication should aim to:

- ensure that all staff are fully aware of the SMS;
- convey safety-critical information;
- explain why particular actions are taken;
- explain why safety procedures are introduced or changed; and
- convey “nice-to-know” information.
- Safety communication could take various forms. The internal (to the organisation) means of safety communication include, but are not limited to:
- safety bulletins
- safety notices

- newsletters
- briefings
- seminars and workshops
- refresher training
- intranet.

Safety Communication also encompasses the distribution of SMS manual and safety procedures within the organisation.

Examples of external means of safety communications are:

- meetings, workshops and networking
- websites, online fora and e-mail distribution lists
- magazines and other articles.

Safety communication is an important enabler for improved safety performance. Safety lesson dissemination is a vital element of safety communication because lessons learned from past experiences implemented within the organisation reduce the chances of accident and incident recurrence and thus improve safety. Many factors, such as time, distance, environment and a sense of complacency often result, unfortunately, in lessons being either not learnt or lost. Lesson dissemination could be considered as an indirect form of safety training [10].

1.3 ICAO Safety Management Manual

Development of the ICAO Safety Management Manual, Fourth Edition - 2018 (Doc 9859-AN/474), was initiated after the adoption of Agreement 1 to ICAO Annex 19, Safety Management, to address changes introduced by the amendment and to reflect the knowledge and experience gained since the publication of the third edition in May 2013. The fourth edition supersedes the third edition in its entirety.

To address the needs of the diverse aviation community implementing safety management and a recommendation stemming from the second High-level Safety Conference held in 2015, the Safety Management Implementation (SMI) has been developed to complement the SMM and serves as a repository for the sharing of best practices. Practical examples, tools, and supporting educational material will be collected, reviewed and posted on the website on an ongoing basis. The fourth edition of Doc 9859 is intended to support States in implementing effective State Safety Programme (SSP). This includes ensuring that service providers implement SMS in accordance with the provisions of Annex 19. In order to be consistent with Safety management principles, a concerted effort was made to focus on the intended outcome of each Standard and Recommended Practice (SARP), purposely avoiding being overly prescriptive. Emphasis has been placed on the importance of each organization tailoring the implementation of safety management to fit their specific environment [2].

The fourth edition is divided into nine chapters that are intended to progressively build the reader's understanding of the fundamental principles underpinning safety management. Chapters are grouped into three themes [2]:

- Safety management fundamentals – Chapters 1 to 3 build the reader's understanding of the fundamental principles
- Developing safety intelligence – Chapters 4 to 7 build on the fundamentals and comprise interrelated topics about leveraging safety data and safety information to develop actionable insights to make data-driven decisions.
- Safety management implementation – Chapters 8 and 9 explain how to apply the concepts from the preceding chapters to institutionalize safety management at the State and service provider level.

CONCLUSION

SMS is a flexible management tool that helps any management system focus on improving safety. The security management system is an integral part of aviation, since aviation cannot develop without security. The SMS also analyzes and demonstrates the potential threats and complex challenges that any aviation operator faces.

2 BOEING FAMILY RELIABILITY

In this chapter, I want to show statistics of aviation accidents and incidents from 2010 to 2020 based on Boeing 737, Boeing 767 and Boeing 777 aircraft, and I want to show more detailed statistics on the causes of those aviation events.

Table 2.1 shows the accidents and incidents causes and presented below:

Table 2.1 - Boeing 737

25.01.2010	ET-ANB	Mediterranean Sea	90/90	Contrary to the instructions of the dispatcher, he flew through the storm front.
01.03.2010	5H-MVZ	Mwanza	0/80	When landing, I got off the runway, the nose landing gear broke. Decommissioned.
04.13.2010	PK-MDE	Manokwari	0/109	Rolled out of the runway when landing in a rainstorm and collapsed.
22.05.2010	VT-AXV	Mangalore	159/166	Attempt to land from the middle of the runway, failed to go around.
28.07.2010	TS-IEA	Conakry	0/97	Rolled out of the runway when landing in a rainstorm.
08.16.2010	HK-4682	San Andres	2/131	Collapsed into three parts upon landing. Lightning strike.
02.11.2010	PK-LIQ	Pontianak	0/174	When landing, rolled out of the runway. Decommissioned.
04.11.2010	XA-UHY	Puerto Vallarta	0/54	Landing with an unreleased front landing gear. Decommissioned.

Continuation of Table 2.1

09.12.2010	PK-GWO	Jakarta	0 n/a	Damaged by a tractor at the gate.
17.03.2011	5A-DKY	Benghazi	0/0	Damaged at the airport by rebel forces duringcivil war...
10.01.2011	ZS-SGX	Hoedspruit	0 n/a	Drove off the taxiway into a ditch. Decommissioned.
30.07.2011	9Y-PBM	Georgetown	0/163	Rolled out of the runway when landing in a rainstorm and fell apart.
08.20.2011	C-GNWN	Resolve	12/15	Crashed into a hill while landing.
10.10.2011	TC-SKF	Antalya	0/156	When landing, the landing gear broke.
12.20.2011	PK-CKM	Yogyakarta	0/131	When landing in a rainstorm, I got off the runway, two landing gear struts broke.
04.20.2012	AP-BKD	Islamabad	30 + 127/127	Crashed while making an emergency landing in bad weather. Fell on residential buildings.
14.10.2012	TC-TJK	Antalya	0/196	Fire in the cockpit after the start of towing from the apron, passengers and crew were evacuated, 27 people were hospitalized.

Continuation of Table 2.1

02.11.2013	AP-BEH	Muscat	0/108	On the run after landing, the left main landing gear was formed. Decommissioned.
04.13.2013	PK-LKS	Denpasar	0/108	Fell in shallow water 1.1 km from the runway end. From hitting the water, it broke into two parts.
11.17.2013	VQ-BBN	Kazan	50/50	Crashed during go-around, losing height abruptly.
01.26.2014	ZK-TLC	Honiara	0/3	Cargo flight. Destruction of the right main landing gear during landing. Decommissioned.
05.08.2014	YA-PIB	Kabul	0 n/a	When landing, it rolled out of the runway and crashed into the navigation equipment. Decommissioned.
10.01.2015	ET-AQV	Accra	0/3	Cargo flight. When landing, it rolled out of the runway and partially collapsed.
16.06.2015	LY-FLB	Aktau	0 n/a	Burned out in the parking lot. Destruction of the oxygen hose when refueling with compressed oxygen.
22.11.2015	EX-37005	Osh	0/153	When landing in dense fog, it rolled out of the runway. The landing gear broke, the left engine came off.

Continuation of Table 2.1

19.03.2016	A6-FDN	Rostov-on-Don	62/62	Crashed during go-around due to crew errors.
04.04.2016	PK-LBS	Jakarta	0/56	During acceleration on the runway collided withATR 42local airline. Restored.
08.05.2016	HA-FAX	Milan	0/2	Cargo flight. During landing in adverse weather conditions, he slipped the runway, broke through the airport fence and entered the highway. The liner was badly damaged. Decommissioned.
28.01.2017	PK-YSY	Wamena	0/3	When landing, the landing gear broke. Decommissioned.
28.01.2017	HK-5197	Cobo	0/4	When landing, a tire exploded, its fragments broke the brake hose. Decommissioned.
03.29.2017	OB-2036	Hauha	0/141	Destruction of the landing gear during landing, resulting in a fire.
18.07.2017	PK-YGG	Wamena	0/5	Landing in excess of vertical speed, the main landing gear broke.
13.01.2018	TC-CPF	Trabzon	0/168	Rolled out of the lane when landing. The liner was badly damaged and was decommissioned.
04.17.2018	N772SW	Burnville	1/149	Failure and destruction of the engine No. 1.

Continuation of Table 2.1

05.18.2018	XA-UHZ	Havana	112/113	Collapsed shortly after take-off due to a technical malfunction.
08.16.2018	B-5498	Manila	0/165	Rolled off the runway after landing in difficult weather conditions.
01.09.2018	VQ-BJI	Sochi	1 + 0/170	When landing in the rain, it rolled out of the strip and caught fire, injuring 18 people. During the liquidation of the consequences of the accident, one of the airport employees died of a heart attack.
28.09.2018	P2-PXE	Vienna	1/47	During a thunderstorm landing, he rolled out of the runway and rolled into the ocean.
10.29.2018	PK-LQP	Javan sea	189/189	Dived due to erroneous MCAS data.
22.11.2018	OB-2041-P	La Paz	0/127	When landing, both main landing gear broke.
10.03.2019	ET-AVJ	Addis Ababa	157/157	Dived due to erroneous MCAS data.
05.03.2019	N732MA	Jacksonville	0/143	He rolled off the runway after landing and slid into the river.
11.21.2019	TC-JGZ	Odessa	0/136	Drove off the runway after landing in a strong crosswind, the front landing gear broke.

Ending of Table 2.1

01.08.2020	UR-PSR	Tehran	176/176	The Iranian air defense was shot down, which mistakenly mistook the plane for a cruise missile.
02.05.2020	TC-IZK	Istanbul	3/183	When landing, it rolled out of the runway, collapsed into three parts and partially burned out.
02.09.2020	VQ-BPS	Usinsk	0/100	When landing with a large overload, he broke the landing gear, left the runway and received significant damage.
05.07.2020	N401WN	Austin	1 + 0/58	While landing, he shot down a man who was right on the runway.
08.07.2020	VT-AXH	Kozhikode	18/190	When landing, it rolled out of the runway and collapsed.

Table 2.2 shows the accidents and incidents causes and presented below:

Table 2.2 - Boeing 767

03.10.2010	G-OOBK	Bristol	0/270	Hard landing.
07.14.2011	N185DN	Boston	0/214	During taxiing, the wing cut off the stabilizers atCRJ 900...
01.11.2011	SP-LPC	Warsaw	0/231	Due to the failure of the hydraulic systems, the landing gear did not come out, made a belly landing.

Ending of Table 2.2

20.06.2012	JA610A	Tokyo	0/193	Damaged landing gear during landing.
04.16.2013	XA-TOJ	Barajas	0/163	Due to the incorrect calculation of the speed during takeoff, the tail hooked the runway, the interior ceased to be airtight. Decommissioned.
07.05.2014	VQ-BSX	Barcelona	0 n/a	I left the runway during the landing approachA340that he almost collided with.
29.10.2015	N251MY	Fort Lauderdale	0/101	While taxiing onto the runway, the aircraft's engine caught fire due to a fuel leak.
28.10.2016	N345AN	Chicago	0/161	Aborted takeoff. Burned out as a result of the fire of the engine No. 2. Decommissioned.
02.23.2019	N1217A	Anahuac	3/3	Crew error (loss of spatial orientation in the co-pilot).
09.25.2019	VP-BUV	Barnaul	0/344	Landing damage during landing. The reasons are being specified.
28.08.2020	N423AX	Bucharest	0 n/a	After landing, the left main landing gear broke. The plane flew fromKabulinBucharest, and after refueling had to go toWashington...

Table 2.3 shows the accidents and incidents causes and presented below:

Table 2.3 - Boeing 777

07.29.2011	SU-GBP	Cairo	0/317	Due to a short circuit in the electrical wiring of the oxygen equipment, a fire started in the cockpit of a standing aircraft.
06.07.2013	HL7742	San Francisco	3/307	During landing, due to a crew error, it dropped below the glide path, caught the breakwater at the end of the runway with its tail, turned 180 ° and caught fire.
03.08.2014	9M-MRO	Indian Ocean	n/a / 239	Missing (alleged version - fell from the echelon due to the pilot's suicide).
17.07.2014	9M-MRD	Grabovo	298/298	Downed onechelonnearfighting...
09.08.2015	G-VIIO	Las Vegas	0/170	During acceleration down the runway, engine # 1 caught fire, the fire partially burned the fuselage. After repair and replacement of the engine, he returned to operation.
06.27.2016	9V-SWB	Singapore	0/241	Emergency landing after jet fuel leak. After landing, engine # 2 caught fire.
08.03.2016	A6-EMW	Dubai	1 + 0/300	Made a rough landing and caught fire. A firefighter died on the ground.
11.29.2017	9V-SQK	Singapore	0/1	A tow truck caught fire next to the plane.
03.09.2019	VP-BGK	Moscow	0 n/a	Collided wings with an Airbus A330

Ending of Table 2.3

07.22.2020	ET-ARH	Shanghai	0 n/a	Cargo flight caught fire at the airport.

As a result, we can plot the number of failures per unit of time and get a graph (look at Fig. 2.1) that will show us how often Boeing aircraft are exposed to accidents and incidents:

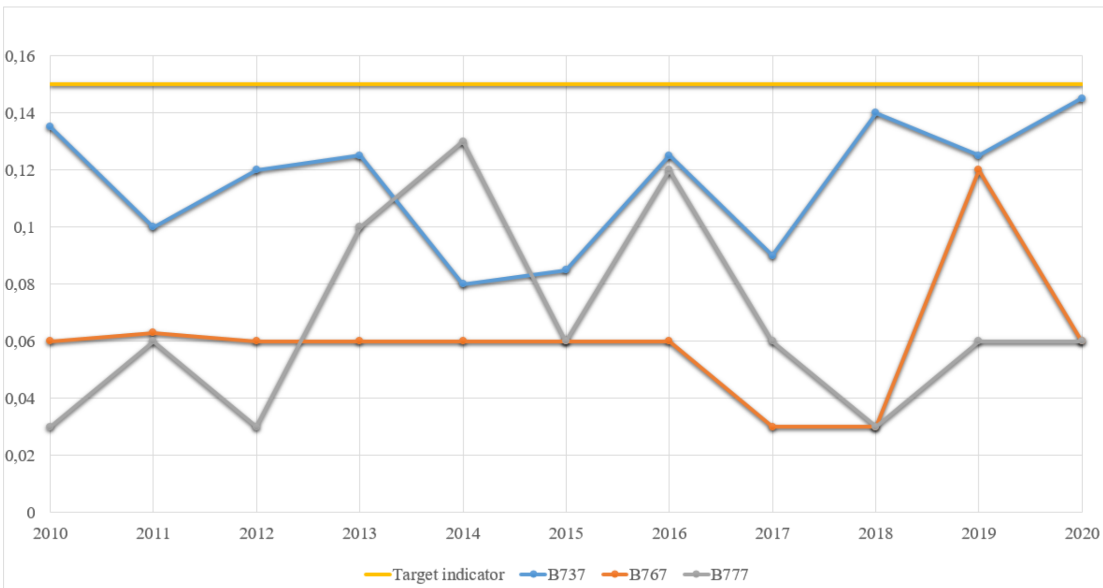

Fig. 2.1 - Failures Per Unit of Time

CONCLUSION

Reliability is the main pillar of safety. Without improving the reliability of its aircraft, the manufacturer cannot provide high safety. Therefore, in commercial aviation, safety is not just immediately after income, but it stands in parallel or even ranks higher in this priority.

3 ICAO APPROACH TO HAZARD IDENTIFICATION AND RISK ASSESSMENT

3.1 Hazard Identification

A hazard is anything with the potential to cause harm.

A hazard is any condition, occasion, or circumstance which may initiate a mishap.

A hazard is any existing or potential condition that can lead to damage, sickness, or death to individuals; harm to or misfortune of a framework, hardware, or property; or harm to the environment.

A hazard could be a condition that might cause (could be a prerequisite to) a mischance or occurrence.

Three essential and recorded forms for weakness danger distinguishing proof:

Predictive - Recognize fatigue dangers by looking at the group (e.g., bio-mathematical models).

Proactive - Recognize fatigue dangers inside the current flight (e.g., group weakness overviews).

Reactive - Recognize the commitment of fatigue risks to reports and occasions related to potentially negative security result (e.g., weakness reports).

3.1.1 ICAO Requirements

As of late affirmed changes to Annexes of the Chicago Convention present blended necessities for the execution and operation of SMS by airplane operators and aviation service providers. Inside the authoritative system of the SMS, operators/service suppliers “shall create and maintain a formal process for successfully collecting, recording, acting on and producing input almost risks in operations, based on a combination of reactive, proactive and predictive strategies of safety data collection”.

3.1.2 Hazard Identification Sources

The safety assessment process in the Design and Certification process identifies and classifies most of the hazards, assesses the risks, and introduces controls - this is a good starting point for identifying the hazards to the operation and there should ideally be a clear link between design and certification and operations [10]:

- safety reporting - includes safety occurrence reporting through mandatory and voluntary reporting schemes;
- internal investigation of safety occurrences;
- safety occurrence trend analysis;
- information provided by personnel, from operational perspective and training;
- analysed data from automated data collecting tools (e.g. flight data analysis (FDA) in the airline industry);
- results from safety surveys and operational oversight safety audits carried out internally (by the operator/service provider) and by States;
- monitoring of "day-to-day" normal operations and environment;
- official State investigation results of accidents and serious incidents; and
- information-exchange practices between operators/service providers.

3.1.3 Hazard Identification Methods

The SMS Working Group of the European Commercial Aviation Safety Team (ECAST) has delivered direction material on risk distinguishing proof for airline operators. The report gives a rundown of a number of particular devices and strategies for risk distinguishing proof and records their advantages and disadvantages.

Depending on the hazard identification sources and the approach to hazard identification, two groups of methods for identifying hazards can be defined [10]:

- **Reactive hazard identification methods** - hazards are recognised through trend monitoring and investigation of safety occurrences. Incidents and accidents are clear indicators of systems' deficiencies and should be therefore investigated to determine the hazards that played role in that event.

- **Proactive hazard identification methods** - hazards are identified analysing systems' performance and functions for intrinsic threats and potential failures. The most commonly applied proactive methods are the safety surveys, operational safety audits, safety monitoring and safety assessments. In real life scenarios, both reactive and proactive methods provide an effective means of hazard identification. Incident investigation is still one of the largest contributors in identifying hazards. In successful SMS, the proactive approach for hazard identification is utilised extensively, so the hazard is recognised and addressed before it could turn into an occurrence.

Three complementary approaches should be used to identify hazards that affect safety of the global aviation system [10]:

- the "historic" approach is based on accident and incident investigation and analysis. It uses proven investigative techniques to discover all facts pertinent to a past aviation incident or accident, and thus identify opportunities for improvements meant to avoid future, similar accidents.
- the "diagnostic" approach is targeted at identifying accident pre-cursors within the larger collections of information in various aviation safety reporting systems. There are many diagnostic processes being developed for application to the global aviation system.
- a "prognostic" or "Predictive" approach is aimed at discovering future hazards that could result as a consequence of future changes inside or outside the global aviation system, and then initiating mitigating action before the hazard is introduced. Prognostic hazard identification informs design processes so that the hazards can be eliminated from the future, avoided in the future, or mitigated in the future.

European Aviation Safety Agency (EASA) has as of late published a conclusion on Operational Suitability Information that addresses the issue of the connect between certification and operation. Hazards identification performed at the operations arrange ought to in a perfect world refer to Design and Certification, where dangers were first considered and dangers evaluated and relieved. In hone, this interface is at times done and should therefore be energized.

3.1.4 Scope of Hazards in Aviation

The scope of hazards existing in aviation operation environment is very wide. That is why hazard identification is a complex process as it considers extensive range of possible sources of failure. Depending on the nature and size of the organisation, its operational scope and environment, there are different factors to consider during hazard identification. The following factors listed in [1] are examples of common hazard sources in aviation [10]:

- design factors, including equipment and task design;
- procedures and operating practices, including their documentation and checklists, and their validation under actual operating conditions;
- communications, including the medium, terminology and language;
- personnel factors, such as company policies for recruitment, training and remuneration;
- organisational factors, such as the compatibility of production and safety goals, the allocation of resources, operating pressures and the corporate safety culture;
- work environment factors, such as ambient noise and vibration, temperature, lighting and the availability of protective equipment and clothing;
- regulatory oversight factors, including the applicability and enforceability of regulations; the certification of equipment, personnel and procedures; and the adequacy of surveillance audits; and
- defences, including such factors as the provision of adequate detection and warning systems, the error tolerance of equipment and the extent to which the equipment is hardened against failures.

3.1.5 Hazard Classification

Hazard Classification, the classification of the seriousness of Risks, is half way to Risk Assessment. Each danger that's distinguished must be evaluated and classified. Typically exhausted arrange to determine whether the risk is individual (i.e. bears results for specific operation/s) or systemic. Risks are classified in terms of the seriousness of results emerging within the case of event and are recorded in a danger log. This handle is reported and composed into a database that encourages the capacity and recovery of risk data. Hazard classification networks are utilized by the operators/service suppliers and aircraft producers for evaluating risks. Dangers are assigned to 5 non specific classes depending on their impact. It should be noted that the precise depiction of the conceivable impacts may vary depending of the sorts of the aviation service provided. Table 3.1 shows the Case of Hazard Severity Classification and presented below:

Table 3.1 - Case of Hazard Severity Classification

Hazard Class	1 (most severe)	2	3	4	5(least severe)
Effect on Operations	Normally with hull loss. Total loss of flight control, mid-air collision, flight into terrain or high speed surface movement collision.	Large reduction in safety margins or aircraft functional capabilities.	Significant reduction in safety margins or aircraft functional capabilities.	Slight reduction in safety margins or aircraft functional capabilities.	No effect on operational capabilities or safety.
Effect on Occupants	Multiple fatalities.	Serious or fatal injury to a small number of passengers or cabin crew.	Physical distress, possibly including injuries.	Physical discomfort.	Inconvenience.
Effect on Air crew	Fatalities or incapacitation.	Physical distress or excessive workload impairs ability to perform tasks.	Physical discomfort, possibly including injuries or significant increase in workload.	Slight increase in workload.	No effect on flight crew.
Effect on Air Traffic Service	Total loss of separation.	Large reduction in separation or a total loss of air traffic control for a significant time.	Significant reduction in separation or significant reduction in air traffic control capability.	Slight reduction in separation or slight reduction in air traffic control capability. Significant increase in air traffic controller workload.	Slight increase in air traffic controller workload.

Another imperative characteristic of dangers is their probability (frequency) of event. The danger seriousness and its probability of event are utilized to survey the hazard that a risk can pose to the provision of an aviation service, specific to aircraft operations and inevitably to human life. An organized approach to the identification of dangers guarantees that, to the degree possible, all potential dangers are distinguished and evaluated. The appraisal of dangers ought to take into thought all possible results - from the slightest likely to the foremost likely. Danger identification determines to a incredible degree the adequacy of an organization's risk management process, because it gives the input for the other two risk management components, strikingly the Risk Assessment and Risk Mitigation.

3.2 Risk Assessment

The risk management process is preceded by the control of the activity process (monitoring), the identification of hazards, the definition of threats characteristic of each hazard. For each threat, measurable indicators are introduced, which should not exceed the limits established for this activity, and the risks of each threat are calculated.

The risk assessment process includes the following stages of work:

- risk analysis;
- risk calculation;
- assessment of its admissibility;
- in case of exceeding the permissible level, exclusion of the threat;
- residual risk assessment.

Risk analysis of each threat - is the process of investigating the properties and characteristics of the risk. The purpose of threat analysis is to determine the risk of each identified threat in relation to the acceptable consequences.

Calculation of the risk level - combination of the probability and severity of the consequences of the hazard manifestation. Risk criteria are based on two main indicators of risk: probability and severity (severity) of consequences:

- at the first stage, the probability of its manifestation is determined for each threat, after which they are ranked in accordance with
- the established scale of probability and criteria of severity of consequences and the location of the characteristic is found.

- at the second stage, the level of risk is determined in accordance with given division.

Probability - as an integral element of the risk measurement process, is defined as the frequency of occurrence of an adverse effect or result of a hazard and / or hazardous factor in a given period (per month, quarter, year) and / or within a given flying rate.

Probability Assession, a scale is used, which will be displayed in the Table 3.2 below:

Table 3.2 – Probability Assession

Probability level	Description	The frequency characteristic of hazard appearance
A	The possibility that the event will happen, practically excluded.	Less than 1 manifestation (unsafe event) during the reporting period
B	The probability that happens small (information that happened, no).	Exactly 1 manifestation (unsafe event during the reporting period)
C	It is possible that will happen (rarely happened).	2 to 10 manifestations (unsafe events) during the reporting period
D	Can happen occasionally (happened infrequently).	11 to 100 manifestations (unsafe events) during the reporting period

Ending of Table 3.2

E	Can happen often (happened often).	More than 100 manifestations (unsafe events) during the reporting period

The severity of consequences - as an integral element of the risk measurement process, is defined as the degree of harm that an object (item) can cause as a result of its activity.

Consequences Severity Assession, the criteria are used, which are given in the Table 3.3 below:

Table 3.3 – Consequences Severity Assession

The severity of consequences	Special situation	Influence at safety
5	Catastrophic situation	Security threat flight
4	Emergency situation	Strong influence
3	Difficult situation	Average degree influence
2	Complicating conditions flight	Low degree influence
1	Potential Impact	Do not affect safety, but may lead to development events affecting flight safety

To determine the level of risk, the results of assessing the likelihood and severity of consequences are used.

The level of risk is defined as the ratio of the level of probability and severity of consequences and is a point value (from 1 to 25).

The risk matrix is used to determine the level of risk.

A risk matrix is a tool for classifying and representing risk by ranking the likelihood of severity of consequences.

The Fig. 3.1 illustrates risk matrix which often used in most airlines:

		Consequence				
		Insignificant	Minor	Moderate	Major	Severe
Likelihood	Almost certain	Medium	High	High	Extreme	Extreme
	Likely	Medium	Medium	High	Extreme	Extreme
	Possible	Low	Medium	Medium	High	Extreme
	Unlikely	Low	Low	Medium	High	High
	Rare	Low	Low	Low	Medium	High

Fig. 3.1 – Risk Matrix

Assessment of risk tolerance. Produced by comparison with a given risk level. For each service provider, the government sets a predetermined level of safety performance. Each service provider (including airlines) adopts a predetermined level of security for their activities, taking into account the specifics of their implementation. Acceptable risk when performing mixed types of activity, is established by the method chosen by its leadership.

If the acceptable level of risk is exceeded, taking corrective action and reducing or exclusion of the threat.

Residual risk assessment. After completing each of a corrective action, an organization, service, department, performer (specialist) assesses the residual level of risk. The fact of reaching an acceptable level of risk is recorded in the "Hazard Operation Control Card" issued by the Airline.

3.2.1 Residual risk assessment

Residual risk in the area of flight safety contains not identified risk. Its control through monitoring the effectiveness of the selected measures is an integral part of the risk management process. It is made after a set time after the implementation of corrective measures.

Security risk mitigation measure activity is assessed as effective if the category of significance of the residual risk does not imply the need for additional measures to reduce the risk.

3.2.2 Impact on risk

The main types of measures to influence the risk in the field of flight safety are:

- technical measures;
- administrative and organizational measures;
- (including changes in regulatory documents);
- professional training of personnel.

3.2.3 Formation of a positive safety culture

It is obvious that every specialist will become an active participant

SMS if he is confident that the airline has created a “non-punitive” disciplinary work environment in which involuntary errors, provoked violations and incident reporting are not punishable.

The current stage in the development of safety culture is called positive safety culture.

A positive safety culture is fundamentally new a culture based on sensitivity to hazards and / or hazards, encouraging people to report them. It implies shared responsibility for safety, wide dissemination of information about hazards and their factors, a systematic approach to their elimination, and welcome fresh ideas.

3.3 Flight safety

Flight safety is a state of an aviation system or organization in which the risks associated with aviation activities related to the operation of aircraft or directly supporting such operation are reduced to an acceptable level and are controlled.

Flight safety is determined by the ability of the aviation transport system to carry out air transportation without a threat to human life and health. Aviation transport system includes an aircraft (helicopter), crew, flight preparation and support service, air traffic control service. The outcome of the flight is influenced by a large number of factors, the patterns of occurrence of which are very complex and in many cases have not yet been sufficiently studied. Flight safety in a broad sense can be characterized as a set of measures taken during the creation of an aircraft and its operation in order to preserve the health of crews and passengers. To ensure flight safety, it is necessary to envisage and practically carry out all the necessary measures regarding special training and accurate performance of duties by flight and dispatch personnel, reliability, aviation technology and preparation for flight of an aircraft, as well as correct forecasting and assessment of the situation and meteorological conditions in which there will be the flight is carried out. These measures, determined on the basis of research, practical flight experience and comprehensive accident analysis, are included in the documentation regulating flight operations. To solve the problem of safety in air transport, work and measures are being carried out aimed at improving the organization, technical equipment and advanced training of personnel of all air transport services, at creating a potentially safe aircraft corresponding to the level and conditions of operating organizations, at ensuring the survival of passengers and crew when hit aircraft in an emergency. The assessment of the state of flight safety is carried out according to quantitative indicators, as which the International Civil Aviation Organization uses the level of flight safety, determined by absolute (the number of aviation accidents) and relative (the number of accidents per 100 thousand flight hours or per 100 thousand flights) and other indicators. According to available estimates, the level of safety of air passenger transportation is average and safer than rail and road transport. On average, the probability of an accident for a passenger does not exceed 1 in 500 thousand flights.

Not a single type of human activity and not a single artificial system can be absolutely safe, that is, free from risks. Security is a relative term that assumes the presence of risks in a "safe" system at an acceptable level. Accordingly, safety is considered as a result of risk factor management, that is, a state in which the risks of harm to persons or damage to property are reduced to an acceptable level and maintained at this or a lower level by systematically identifying sources of danger and controlling risk factors.

Basic principles of ensuring a high level of flight safety:

- strict regulation of design, construction, testing and certification parameters of aircraft, engines and equipment;
- organization of aircraft technical operation based on design, production and operational documentation. The use of regulations for maintaining airworthiness for each type of aircraft and the aircraft fleet as a whole, including lists of rules for their preparation for flights and periodic maintenance;
- operation of airports, civil airfields, airways and their equipment based on government regulations and technical requirements;
- development and control over the implementation of the rules establishing air traffic services;
- organization of meteorological flight support;
- organization of measures to ensure the safe flight operation of aviation equipment;
- maintaining in constant readiness the system for ensuring the survival of passengers and crew members in the event of special situations in flight;

- organization and improvement of the system of investigations of aviation accidents and incidents;
- creation of effective state control over ensuring flight safety at all stages of the creation and operation of civil aircraft.

3.3.1 Safety strategy development flights based on risk assessment

Enhancing global aviation safety the air transport system is fundamental and the most important strategic goal of the ICAO. ICAO is continually working towards to ensure and improve performance the state of aviation safety around the world for through the implementation of the following types of coordinated activities:

- monitoring the main trends and indicators in the field of flight safety;
- safety analysis;
- policy and standardization initiatives;
- implementation of programs to resolve issues related to flight safety.

The second printed edition of the ICAO State of Global Aviation Safety Report is intended to provide ICAO States, the aviation community and passengers with a comprehensive account of the ambitious global aviation safety programs implemented by ICAO and its partners. This unique approach is achieved by defining and monitoring global safety metrics that underpin practical risk analysis and provide the basis for the Organization's actions and programs to improve safety. This publication provides an overview of the achievements and initiatives that drive safety improvements, and that also encourage and inspire air travel operators to participate in the development and implementation of innovative and practical programs to improve all aspects of aviation safety.

3.4 Aircraft airworthiness

Airworthiness is a characteristic of an aircraft, which is ensured by the principles envisaged and implemented in its design and performance parameters and allows a safe flight to be carried out under the expected conditions and under established operating methods.

Airworthiness has a number of aspects which relate to the legal and physical state of an aircraft. The term airworthy "is when an aircraft or one of its component parts meets its type design and is in a condition for safe operation."

A definition includes a wider definition, which includes people on the ground (third parties) – "Airworthiness is the ability of an aircraft or other airborne equipment or system to be operated in flight and on the ground without significant hazard to aircrew, ground crew, passengers or to third parties; it is a technical attribute of materiel throughout its lifecycle."

Additionally, an aircraft must be operated within the limits laid down in the Flight Manual; an aircraft which exceeds any limit may compromise its airworthiness. In service, an aircraft must also be maintained according to its Approved Maintenance Schedule for it to remain airworthy; through-life maintenance would be included in the term Continuing Airworthiness [10].

The airworthiness standards establish the requirements for the functional systems of the aircraft, which follow from the analysis of their impact on flight safety:

- functional systems should be practically reliable, since failures lead to emergency or catastrophic situations, and their redundancy should ensure the continuation of a safe flight after two consecutive failures;
- the structurally functional aircraft system must be designed so that the crew can detect the failure in time, prevent its negative consequences and fly with the failed element or system;
- the functional system should be easy to operate, be able to switch to any operating mode provided for in the flight manual, and be equipped with an alarm and means of monitoring its performance;
- the means for monitoring the performance of the functional system or its elements, built into the aircraft structure, should not reduce the reliability of the functional system and its components;

- the design of the functional system, together with the elements of its control and management, can reduce to a minimum the possibility of making mistakes both during flight operation and during maintenance.

3.4.1 Aircrfat airworthiness as the important part of Flight safety

The association between airworthiness and flight safety is a self-evident but complex one. The plan action, other than assembly the appropriate certification code, regularly looks for to progress the aircraft's financial matters and fetched benefit to both the producer and the operator. Certification authorities will in this manner look at all perspectives of the plan and development of an airplane, indeed when there's clear enhancement to least measures. When an airplane sort is to begin with judged to meet all the certification necessities it'll be issued with a Aircraft Type Certificate (ATC).

Insufficiencies in airworthiness may be shown following an in-service occurrence or mischance. These may relate to obscure failures, mistakes or impediments of the Type plan and/or failure to meet the conditions for safe operation. Known as the Commercial Plane Certification Process Study, their work could be a valuable meta-analysis of interfacing between certification, operations and maintenance, and created 15 findings and two observations for proposed enhancements.

3.4.2 Defects, failures and threats

A defect may have a significant effect on safety and, if not rectified, or only partly rectified, may also be a cause for an accident at a later time. Inappropriate crew actions in response to a malfunction which arises in flight may also lead to a worse outcome. In such cases, an investigation should analyse the crew responses as well as the underlying airworthiness issues. However, in many cases, the flight-crew successfully recovers an aircraft after anomalies occur. Some are physical process e.g. overload and fatigue, whereas some relate to human factors and obsolescence. Below is the list of possible failures or threats which may affect the airworthiness of an aircraft [10]:

- overload;

- operation outside the certificated limits such as those laid down for flight in ice or snow conditions;
- component degradation due to fatigue, creep, fretting, wear or corrosion, depending on the system or component;
- accidental damage and environmental damage;
- procedural (design, manufacturing, maintenance or supply) error and human factors;
- inadequate or incomplete maintenance;
- errors in maintenance which may result in a fault becoming obvious a long period after the error was originally made;
- ageing components;
- change of usage or unmonitored operation;
- lack of configuration control;
- obsolescence and/or legislation change;
- fuel and fuel system hazard;
- lack of adequate oversight of the operator, its practices and policies including training, operation and maintenance by the regulator;
- deficiencies in the process which led to the issue of the original aircraft Type Certificate.

3.4.3 Process for obtaining a certificate

The first defence is the process of aircraft type certification, leading to the issue of the Type Certificate. This work is documented so that it remains an accessible foundation for the continuing airworthiness of the aircraft type thereafter. Wherever practicable, the original design will embody redundancy features; i.e. an allowance for the failure of a system or component without any reduction in airworthiness. In some cases, the failure only becomes observable after an aircraft has landed, and requires rectification before further flight. In more extreme cases a major failure, such as an in-flight failure of an engine on a multi-engine aircraft, should not lead to an accident - the design combined with the training of the crew should allow safe continuation of the flight. The same criteria apply to flight in adverse weather and when affected by human factors in either operations or maintenance. High standards of flight crew training, proficiency and crew resource management can also serve to minimise the incorrect management by flight-crew of the onset of any in-flight reduction in airworthiness. A full understanding of the human factors issues involved in engineering and maintenance is therefore valuable. The effective management of continuing airworthiness is an excellent defence. Defined as all of the processes ensuring that, at any time in its operating life, the aircraft complies with the airworthiness requirements in force and is in a condition for safe operation. As part of continuing airworthiness management, each aircraft must hold a Certificate of Airworthiness to prove that it conforms to the certificated type design and is in a condition for safe operation. In the European Union (EU), all aircraft must also be subject to a regular audit which leads to an airworthiness review certificate (ARC). The regulator will require that the operator has in place a system to ensure compliance with the activities below. Some airworthiness authorities cover the following items with the term Certificate of Maintenance Review (CMR) [10]:

- compliance with the maintenance programme;
- embodiment of mandatory modifications and inspections;
- rectification of reported defects and investigation of adverse reliability matters.

3.4.4 Issuance and maintenance of validity of the airworthiness certificate

An airworthiness certificate is issued by a Contracting State on the basis of satisfactory proof that the aircraft meets the design requirements of the relevant airworthiness regulations.

A Contracting State will not issue or validate a certificate of airworthiness that it expects to be recognized in accordance with Article 33 of the Convention on International Civil Aviation if it does not have sufficient evidence that the aircraft complies with the applicable Standards of this Annex, having ensured that the relevant airworthiness regulations are met.

The certificate of airworthiness shall be renewed or maintained in accordance with the laws of the State of Registry, provided that the State requires the continued airworthiness of the aircraft to be determined through regular inspections at appropriate intervals, taking into account the duration and nature of operation, or on the basis of such a system. control adopted by the state, which will ensure at least equivalent results.

When an aircraft holding a valid airworthiness certificate issued by one Contracting State is entered on the register of another Contracting State, the new State of Registry, by issuing its certificate of airworthiness, may, in whole or in part, consider the previous certificate of airworthiness to be sufficient evidence of the aircraft's compliance with the applicable Standards. of this Annex due to its compliance with the relevant airworthiness regulations. Note. Some Contracting States facilitate the transfer of aircraft to the register of another State by issuing an "export certificate of airworthiness" or a document with a similar name. Such a document, although not valid for the purpose of the flight, serves as confirmation by the exporting State of the positive results of the last airworthiness test of the aircraft. Guidance material regarding the issuance of an "Export Airworthiness Certificate" is contained in the Airworthiness Manual (Doc 9760).

Where the State of Registry, instead of issuing its own certificate of airworthiness, recognizes the certificate of airworthiness issued by another Contracting State as valid, it shall establish its validity by an appropriate document that must be kept with that certificate, recognizing it as the equivalent of the national certificate. The validity of the recognition document does not exceed the validity period of the valid airworthiness certificate. The State of Registry shall ensure that aircraft continue to be airworthy.

3.4.4.1 Standard form of certificate of airworthiness

The Fig. 3.2 illustrates standart form of certificate of airworthiness:

UNITED STATES OF AMERICA
DEPARTMENT OF TRANSPORTATION FEDERALAVIATION ADMINISTRATION

STANDARD AIRWORTHINESS CERTIFICATE

1. NATIONALITY AND REGISTRATION MARKS	2. MANUFACTURER AND MODEL	3. AIRCRAFT SERIAL NUMBER	4. CATEGORY
N12345	Boeing 747-400	197142	Transport

5. AUTHORITY AND BASIS FOR ISSUE
This airworthiness certificate is issued pursuant to the Federal Aviation Act of 1958 and certifies that as of the date of issuance, the aircraft to which issued has been inspected and found to conform to the type certificate, therefor, to be in condition for safe operation, and has been shown to meet the requirements of the applicable comprehensive and detailed airworthiness code as provided by Annex 8 to the Convention on International Civil Aviation, except as noted herein:

EXEMPTION NO. 1013A FAR 25.471(b): Allows lateral displacement of C.G. from airplane centerline.

6. TERMS AND CONDITIONS
Unless sooner surrendered, suspended, revoked, or a termination date is otherwise established by the Administrator, this airworthiness certificate is effective as long as the maintenance, preventive maintenance, and alterations are performed in accordance with Parts 21, 43, and 91 of the Federal Aviation Regulations, as appropriate, and the aircraft is registered in the United States.

DATE OF ISSUANCE	FAA REPRESENTATIVE	DESIGNATION NUMBER
11/29/92	John Q. Publican John Q. Publican	DMIR ANM 1234

Any alteration, reproduction, or misuse of this certificate may be punishable by a fine not exceeding $1,000, or imprisonment not exceeding 3 years, or both. THIS CERTIFICATE MUST BE DISPLAYED IN THE AIRCRAFT IN ACCORDANCE WITH APPLICABLE FEDERAL AVIATION REGULATIONS.

FAA Form 8100-2

Fig. 3.2 - Standard Form of Certificate of Airworthiness

According to Article 29 of the Convention on International Civil Aviation, a certificate of airworthiness must be carried on board every aircraft engaged in international air navigation.

3.4.4.2 Aircraft restrictions

Each aircraft is accompanied by flight manuals, tables, charts or other documents containing the approved limitations within which the aircraft is considered airworthy, as defined by the relevant airworthiness requirements. It also provides additional instructions and information necessary to ensure its safe operation.

3.4.4.3 Temporary loss of airworthiness

Failure to maintain an aircraft's airworthiness, as determined by the relevant airworthiness requirements, results in the aircraft becoming unusable until its airworthiness is restored.

3.4.4.4 Aircraft damage

In the event of damage to an aircraft, the State of Registry will decide whether the damage is such that the aircraft is no longer airworthy as determined by the relevant airworthiness regulations.

If damage occurred or was discovered while an aircraft was in the territory of another Contracting State, then the authorities of that State have the right to prevent the aircraft from continuing to fly, provided that the State of Registry is immediately notified and all the necessary details are sent to it for making a decision.

When a State of Registry considers that damage inflicted on an aircraft has rendered it unfit to fly, that State shall prohibit the resumption of flights of that aircraft until its airworthiness is restored. However, in exceptional cases, the state

check-in may, subject to specific restrictions, authorize the aircraft to operate a non-commercial flight to an airfield where it will be restored to airworthiness. In setting specific restrictions, the State of Registry shall take into account all restrictions proposed by the Contracting State that originally prohibited the aircraft from continuing to fly. This Contracting State shall authorize such flight or flights subject to the established restrictions.

When the State of Registry considers that the damage inflicted on an aircraft does not render it unfit to fly, the aircraft is allowed to continue flying.

3.5 Aviation Safety Reporting System

Voluntary reporting is a widely recognized element of any modern regulatory system. Today, accidents with US airline aircraft are so rare that further improvements in flight safety increasingly depend on identifying new risks as potential prerequisites for real disasters. Basically, such events are known only to those who directly participated in them, and the leaders, if the corresponding message is not received, may not know about them. The main programs in this area are:

- the Voluntary Incident Reporting Program (VIRP) used by airlines and other regulated entities;

- the Aviation Safety Action Program (ASAP) used by operators, including programs for pilots, mechanics, flight attendants and air traffic control services;
- flight Operations Quality Assurance Program (OQAP).

The group reaffirmed the value of voluntary reporting programs as vital to the continuous improvement of aviation safety. These programs are consistent with current regulatory practice and have clear boundaries of application. The Panel also reaffirmed the importance for the adhering to the rules and restrictions regarding voluntary reporting programs to ensure their confidentiality and to prevent industry incentives for non-compliance.

Members of the Group expressed concern about possible misinterpretations of many of the problems, including those faced by airlines. They stressed that it is wrong and dangerous to arbitrarily interpret concepts like “good” or “bad” without applying a systematic or scientific approach to them. It is also important that participation in all voluntary reporting programs is accompanied by guarantees of confidentiality of information sources.

3.5.1 European Voluntary Safety Reporting System

In October 2005, Voluntary Incident Reporting Program (VIRP) was established. The members of the Group stated that voluntary reporting and sharing of safety databases are mandatory parts of improving safety levels.

Over the past ten years, 22,300 messages from 340 aircraft operators and 22,200 messages from air navigation service providers were collected and processed. There is engages not only airlines and air navigation service providers in its VIRP system, but also international organizations such as the International Air Transport Association (IATA), the International Air Carriers Association (IACA) and the European Regions Airlines Association (ERAA). Safety data are exchanged at joint meetings, analyzes and new risk trends are discussed. Recently, the seventeenth VIRP newsletter was released, which examines the period from 2011 to 2015.

Prompt identification of factors that could negatively affect flight safety in the future allows you to take proactive measures and eliminate or minimize such factors even before they become a real threat.

VIRP program managers highlight the main areas of work: missed approach (being a normal phase of flight, missed approach is usually the result of other safety issues), runway incursions, unauthorized climb, TCAS RA triggering, similar radiotelephone call signs, loss of communication, blinding lasers, remotely controlled aircraft systems (drones) and loss of GPS signals.

3.5.2 Applicable ICAO Standards

Contracting States of the International Civil Aviation Organisation (ICAO) have agreed in Annex 13, Aircraft Accident Investigation, to the Chicago Convention that States shall investigate all accidents to aircraft within their territorial limits. In addition, "…a State shall establish a mandatory incident reporting system to facilitate collection of information on actual or potential safety deficiencies". Further, it is recommended that "a State should establish a voluntary incident reporting system to facilitate the collection of information that may not be captured by a mandatory incident reporting system. A voluntary incident reporting system shall be non-punitive and afford protection to the sources of the information". In addition, it is required that "…a State having established an accident and incident database and an incident reporting system shall analyse the information contained in its accident/incident reports and the database to determine any preventive actions required". The requirements for national reporting systems are therefore clear, and accompanied by a further requirement to establish an analysis capability to maximise the safety benefit from lessons learned from occurrences and their investigation [13].

3.5.3 Applicable European Requirements

Announcing, examination and follow-up of events in civil aviation has the particular objective to progress aviation safety by ensuring that pertinent safety data relating to civil aviation is reported, collected, stored, secured, exchanged, spread and analysed.

The regulation requires states to enact national legislation by which occurrences are reported to the competent authorities by a wide range of aviation practitioners including [13]:

- operators or commanders of turbine-powered or public transport aircraft;
- designers, manufacturers, or those maintaining or modifying turbine-powered or public transport aircraft,
- those who sign certificates of maintenance review, or release to service in respect of a turbine-powered or a public transport aircraft;
- managers of airports offering access for Community air carriers to intra-Community air routes;
- those who install, modify, maintain, repair, overhaul, flight-check or inspect air navigation facilities;
- persons involved in the ground-handling of aircraft, including fuelling, servicing, loadsheet preparation, loading, de-icing and aircraft towing.

The Regulation further requires that Member States shall "…designate one or more competent authorities to establish a mechanism to independently collect, evaluate, process, analyse and store details of occurrences reported…". At European level, further legislation is being developed which will require national reporting systems to report data to the EASA. All relevant data must be reported to a European Central Repository managed by the Commission [13].

3.5.4 Coordination of Requirements

The different necessities which bear upon European States as a result of their participation of European bodies has been perceived and tended to. The worldwide associations concerned have locked in in broad coordination to guarantee that all appropriate requirements are aligned to the maximum possible degree, which the definitions and scientific categorizations utilized are as reliable as possible. Beyond this, progresses in innovation have expanded the opportunities for data trade, and can help to limit the number of partitioned reports to be submitted by a State.

3.5.5 Non-Punitive Reporting

A feature of all the above international provisions is that they are accompanied by a requirement for all reporting to be non-punitive. In this context, ICAO Annex 13 and: "The sole objective of occurrence reporting is the prevention of accidents and incidents and not to attribute blame or liability" [13].

In practice, it is now widely accepted that no system can, or should, be completely free of all blame. Situations involving gross negligence, wilful wrong-doing or criminal acts should be dealt with by appropriate penalties being applied to the individuals concerned. However, a line must be drawn between those situations and occurrences in which professionals are acting in good intent and within the limits of their capabilities - i.e. genuine slips, lapses and errors. It is equally accepted that it is crucial to get this balance right. If not, the inappropriate handling of such cases can be vastly detrimental to the viability of national reporting systems [13].

3.6 Audit system

Safety auditing is a center safety management action, giving a implies of identifying potential problems some time recently they have an affect on safety. Safety regulatory audit implies a precise and independent examination conducted by, or on sake of, a national supervisory authority to determine whether total safety-related arrangements or elements thereof, related to forms and their results, items or services, comply with required safety-related arrangements and whether they are implemented successfully and are reasonable to realize expected results.

Safety audits are conducted in arrange to evaluate the degree of compliance with the appropriate safety regulatory necessities and with the procedural arrangements of a SMS in case one is in place. They are aiming to supply affirmation of the safety management functions, including staffing, compliance with appropriate directions, levels of competency and preparing.

Safety audits are carried out by a single individual or a team of people who are competent (adequately qualified, experienced and trained) and have a satisfactory degree of independence from the audited organisation or unit. The frequency of the audits depends on the regulatory/management policy. For example some State authorities may conduct annual safety audits; others may consider that a full safety audit is only necessary at a few years interval. Ad-hoc safety audits may be conducted to verify the compliance of a particular system component or activity, or may be initiated following an incident. In accordance with ICAO SARPs safety audits are to be conducted on a regular and systematic basis. Usually the frequency and scope of safety audits is fixed in a dedicated annual safety audit (inspection) programme of the responsible authority/organisation. Safety audits are one of the principal methods for fulfilling the safety performance monitoring requirements. Often audits are integrated, i.e. they include not only safety but also other business processes and performance areas, such as quality, capacity, cost efficiency etc. Safety auditing is an element of safety management which subjects the activities of airline operators/service providers to a systematic critical evaluation. An audit may include one or more components of the total system, such as safety policy, change management, SMS as a whole, operating procedures, emergency procedures, etc. The aim is to disclose the strengths and weaknesses, to identify areas of non-tolerable risk and devise rectification measures. The outcome of the audit will be a report, followed by an action plan prepared by the audited organisation and approved by the regulator/supervisory authority. The implementation of the agreed safety improvement measures shall be monitored by the supervisory authority. Safety audits are used to ensure that [10]:

- organization’s SMS has a sound structure and adequate staffing levels;
- approved procedures and instructions are complied with;
- the required level of personnel competency and training to operate equipment and facilities, and to maintain their levels of performance, is achieved;
- equipment performance is adequate for the safety levels of the service provided;

- effective arrangements exist for promoting safety, monitoring safety performance, and processing safety issues;
- adequate arrangements exist to handle foreseeable emergencies.

All audits should be pre-planned and supporting documentation (ordinarily within the form of checklists) of the audit content arranged. Among the primary steps in arranging an audit will be to verify the possibility of the proposed plan and to identify the data that will be required some time recently commencement of the audit. It'll also be essential to indicate the criteria against which the audit will be conducted and to create a detailed review plan along side checklists to be utilized during the audit. The conduct of the genuine audit is basically a preparation of assessment or fact-finding. Data from nearly any source may be surveyed as part of the audit. The procedures for gathering the data incorporate:

- review of documentation;
- interviews with staff;
- observations by the audit team.

The results from the safety auditing show prove of the performance and the common condition of the organization's SMS. Audits which constrain perceptions to things of regulatory non-compliance are of restricted value, since they will not empower the inspected organisation to act proactively. The review the report should be an objective introduction of the results of the safety audit. The key standards to be watched within the improvement of the audit report are:

- consistency of perceptions and recommendations;
- conclusions substantiated with references;
- observations and suggestions expressed clearly and concisely;
- avoidance of simplifications and unclear observations;
- the objectivity of observations;
- avoidance of feedback of people or positions.

According to [1] safety auditing is a proactive safety management action which gives implies for recognizing potential issues some time recently they have an affect on safety. Subsequently, safety auditing has the characteristics credited to both the safety assurance space of SMS, and the danger identification component of hazard management. Safety audits may be conducted remotely - by the assigned State regulatory authority, inside - by the aviation services provider organisation, or by a qualified outside safety auditor, for example a consultancy office. In any case of the driving constrain behind the audit, the activities and yield from both inside and outside audits are similar.

3.6.1 Regulatory Safety Audits (external auditing)

Under the Chicago Convention, States are required to put in place a safety oversight system to promote aviation safety by observing and assessing the compliance of aircraft operators/service providers with the applicable regulations, procedures and recommended practices. This is to be achieved through a mix of activities, including safety audits. Such audits conducted by a safety regulatory authority should take a broad view of the safety management procedures of the audited organisation. The key issues in such audits should be [10]:

- surveillance and compliance - the authority needs to ensure that international, national and local standards are complied with prior to issuing any licence or approval and continue to be complied with afterwards;
- areas and degree of risk - the audit should assess how risks are identified and how any necessary changes are made to ensure that all safety standards are met;
- competence - the audited organisation should have adequately trained staff for all safety related positions
- safety management - ensure that the organisation's SMS is based on sound principles and procedures, and that the organisation is meeting its safety performance targets.

ICAO Document 9734-A - The Establishment and Management of a State's Safety Oversight System defines Eight Critical Elements of a State's Safety Oversight System - as shown in the Fig. 3.3:

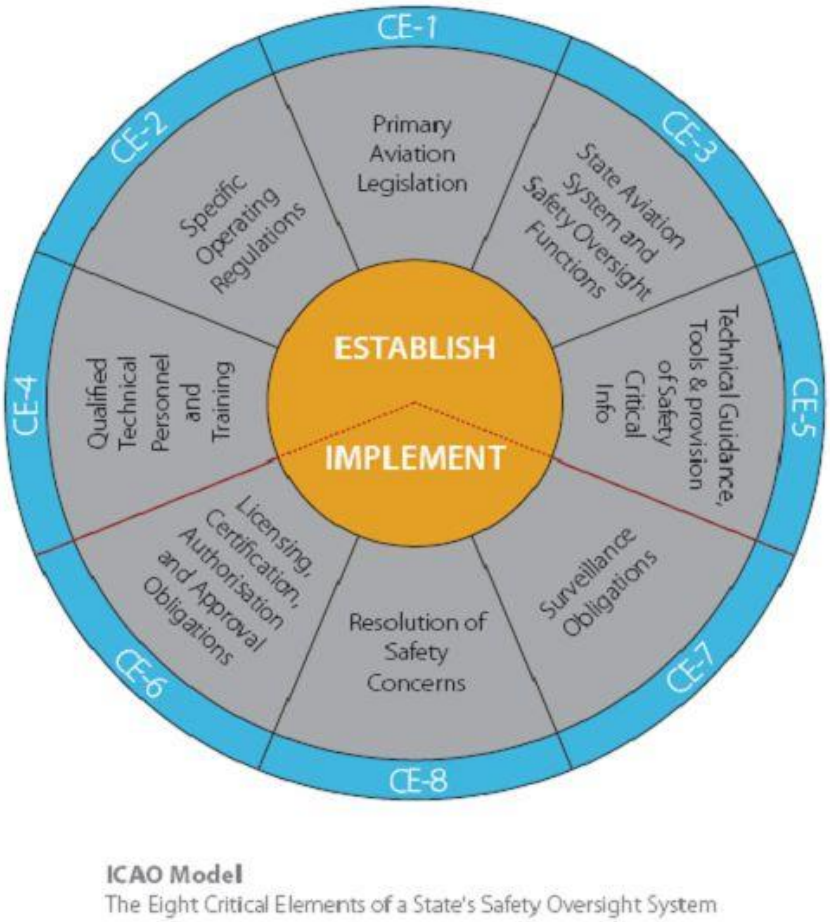

Fig. 3.3 - Eight Critical Elements of a State's Safety Oversight System

Ideally the State regulatory authorities should have established procedures and criteria to focus inspections, audits and surveys (in an annual audit programme) on those areas of greater safety concern or need, as identified by the analysis of operational hazard data and risk areas. Regulatory audits are independent of internal auditing activities undertaken by the organisation concerned within the framework of its SMS. Safety audit is an essential safety oversight tool for international and national regulatory and supervisory authorities. In

1999 ICAO established the Universal Safety Oversight Audit Programme (USOAP) with the objective to oversee the effective application of ICAO standards regarding the development of safety regulatory frameworks by Member States. Audits are focused on the States' overall safety oversight, including safety audit capabilities. In Europe, the two safety oversight programmes have been coordinated to achieve an efficient use of avialable resources. Audits had been carried out for a decade and were replaced by the EASA standartisation inspections [10].

3.6.2 Third Party Audits (external auditing)

The organisation's management or the regulator may choose to have an outside agency carry out an autonomous safety audit. [1] indicates that: "External audits of the SMS may be conducted by significant authorities capable for acknowledgment of the service provider's SMS. Moreover, audits may be conducted by industry associations or other third parties chosen by the service supplier. These outside audits improve the inside audit framework as well as give independent oversight." An organisation which has the fundamental ability and technical experience to confirm on sake of a State authority the compliance of an air navigation service provider with the appropriate administrative prerequisites is called a qualified entity. An organisation wishing to ended up qualified substance must be certified by a State specialist in understanding with the arrangements of the Service Arrangement Regulation (SAR).

3.6.3 Internal Safety Audits (self auditing)

According to ICAO Doc 9774 - Manual on Certification of Aerodromes, an aerodrome operator should arrange for an audit of the aerodrome SMS, including an inspection of the aerodrome facilities and equipment. For conducting such a large scale safety audit "the aerodrome operator should also arrange an external audit for the evaluation of aerodrome users, including aircraft operators, ground handling agencies and other organizations" operating at the aerodrome.

Internal safety audits and safety surveys should be used by the aviation service providers to assess the level of compliance with the applicable regulatory framework and the organisational SMS processes and procedures, to verify the effectiveness of such processes and procedures and to identify corrective measures if needed. Planning of the audits should take into account the safety significance of the processes to be audited and the results of previous audits. An annual audit program should include:

- definition of the audits, in terms of criteria, scope, frequency, and methods;
- description of the processes used to select the auditors;
- the requirement that individuals shall not audit their own work;
- documented procedures for assignment of responsibilities, planning and conduct of audits, reporting results and maintaining records;
- audits of contractors and vendors.

3.7 Flight safety integrated management system

Flight Safety Integrated Management System (FSIMS) combines all viewpoints of an organisation's frameworks, forms and Standards into one smart framework. This merger permits a trade to streamline its management, save time and increment productivity by tending to all components of the management system as a whole. A successful FSIMS cuts the pointless bother and work of numerous administration frameworks. For case, rather than holding audits for each Standard, you'll as it were got to hold one. An FSIMS permits these processes to be combined so that they at the same time cover all Standard-specific requirements. Below is Fig. 3.4 that illustrates Enterprise-Wide Safety Culture:

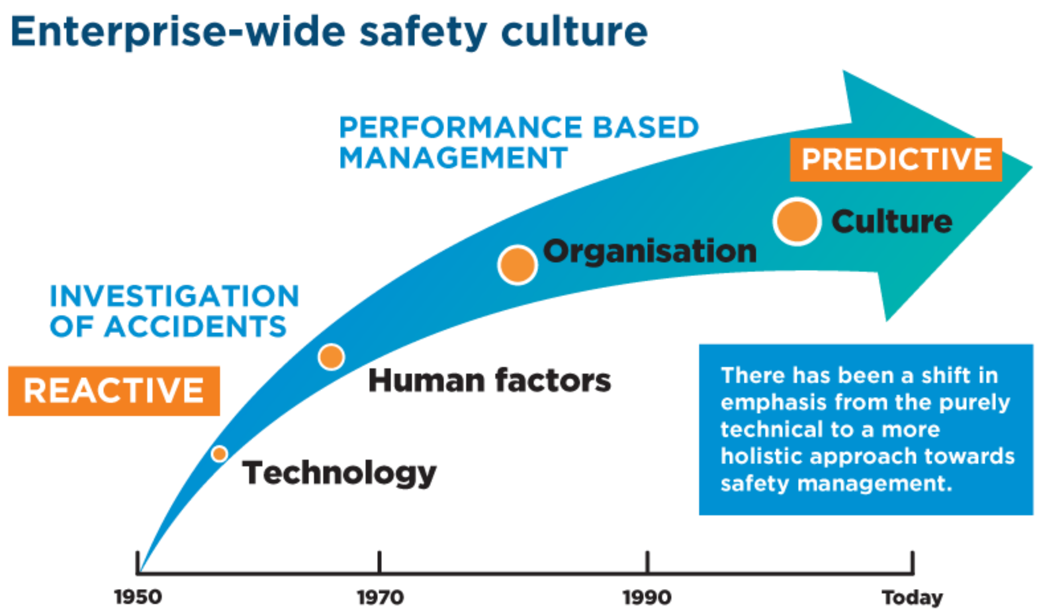

Fig. 3.4 – Enterprise-Wide Safety Culture

So what does the FSIMS cover? FSIMS seeks to integrate various elements of the operation into a "system of systems" - providing a holistic approach to operational excellence. Occurrences can have an effect on multiple aspects of the business - everything is tied to together. A safety event can have Quality implications, Environmental implication and Risk. The IAMS seeks to provide a big picture of all of these elements [11]:

- **Safety Management System: handling the overall safety reporting and occurrence tracking of events within the organization. Safety events are recorded, investigated and findings are reported.**
- **Security Management Systems: ensuring that all security protocols are followed, proper controls and measures are put in place, and all aspects of the operation are secure and safeguarded.**
- **Quality Management Systems: quality of the processes and equipment is of paramount importance to an airline. It is important to make sure that processes are managed and events related to quality are corrected and improved.**

- **Enterprise Risk Management: mitigating risk and identifying hazards is at the core of any organization, let along air carriers. Risk Management takes a top-down approach to risk and identifies all the potential hazards and harms within the organization and seeks ways to mitigate those risks.**
- **Supplier Management Systems: managing safety, risk and quality within the organization is important, but so too is managing these factors in the supply chain. With all the suppliers the airline industry employs, it is important than suppliers are monitored and tracked, logistics are managed, and supplier compliance is maintained.**
- **Environmental SMS: environmental impact is one of the core tenets of IATA, and airlines are held to a high standard of environmental risk mitigation. That, coupled with occupational safety of employees make having an ESMS a critical component to the FSIMS.**

Components of Integrated System illustrated on Fig. 3.5:

Fig. 3.5 – Components of Integrated System

When all these components are integrated into a single framework, organizations can see a bigger see of the full operation and make superior choices. Take the taking after illustration: a maintenance vehicle hits a plane on the landing area, fuel spills, the plane is damaged, and a flight orderly falls within the cabin, causing real harm. This event alone includes a Safety component, a quality component, an natural component, and potential security component. This single occasion can give perceivability into numerous zones of the organization, and coming about remedial activities will affect different operational zones.

With an FSIMS, this can all be dealt with in a single commerce framework, and can be tied together in a way that cannot be accomplished in a siloed set of free frameworks. The FSIMS is giving a single all encompassing event report that not as it were touches all ranges, but gives a level of perceivability into undertaking chance, and can offer assistance the organization make better decisions for future improvements. The FSIMS may be a leading edge concept, and IATA has taken the lead, besides a few trailblazers within the industry. As we start to see more transparency in airline operations, concepts just like the FSIMS will go beyond a siloed approach to safety, and give the enormous picture that the aviation industry is searching for.

CONCLUSION

The voluntary reporting system is a wise and highly intelligent system. Based on the fact that it is made anonymous, airlines and any aviation enterprises can eliminate their flaws and weaknesses as quickly as possible. With the help of this system, there will be fewer casualties in aviation, any kind of aviation accidents, incidents, and just any threats to human health.

Audit system is also mandatory, as any system, or organization, must be supervised to maintain and / or improve safety.

Threat identification and risk assessment are an integral part of not only flight safety, but aviation security in general. The first two topics are very broad and may even have their own separate and independent divisions, while flight safety is fundamental and fundamental. But aviation, especially civil aviation, must be more than just safe and therefore we can also encounter such a factor as the airworthiness of an aircraft. The airworthiness of an aircraft is an extremely important part of both the aircraft itself and the safety itself. This certificate confirms that the aircraft is fully operational, suitable and safe for use for the transport of goods and people.

4 TARGET INDICATORS

4.1 Target indicators definition and description

The minimum level of safety performance of civil aviation in a State, as characterized in its State safety program, or of a benefit supplier, as characterized in its SMS, communicated in terms of security execution targets and safety performance markers [1].

The acceptable level of safety performance to be accomplished is to be set up by the State.

Absolute safety is generally an unachievable and very expensive goal. Overallocation of resources to safety may result in any change being unfeasible. On the other hand, neglecting the safety aspect may lead to an accident. Therefore the concept of safety space has been adopted in aviation. The term "safety space" describes an area where both the protection (safety) and production (performance) objectives are met. This approach is also applicable to the State's management of its State Safety Programme (SSP), given the requirement to balance resources required for State protective functions that include certification and surveillance. For the purpose of an SSP, the target indicators are identified and established by the State's aggregate safety indicators. State safety indicators used for this purpose are those which have objective targets and alert settings incorporated. Therefore, it is the overarching concept while safety indicators with their corresponding alert and target levels are the actual metrics. The result of the safety management processes is "to facilitate achievement of an acceptable level of safety while balancing the allocation of resources between production and protection." [1]. Traditionally, in many industries including aviation, safety regulation has been carried out prescriptively, i.e. the regulator defines the rules and standards to be followed and uses audit and inspection to check compliance with them. This approach requires a great deal of specialist resource on the part of the regulator and is often over-constraining for the regulated entity, particularly in the introduction of new processes and technologies [13].

The target indicator concept complements this conventional approach to safety oversight with a performance-based approach that characterizes real safety performance levels inside a endorsed SSP system. Safety is much more clearly the obligation of the operator/service supplier, the regulator's part being basically to guarantee that the benefit supplier releases his obligations legitimately. The controller sets goals for the achievement and show of safety - satisfactory (or passable) safety levels - and the benefit provider needs to appear (by contention and prove) that those goals have been met.

Target indicators are expressed by two specific metrics, namely safety performance targets and safety performance indicators. Safety indicators are tactical monitoring and measurement tools while targets define long-term SSP safety performance objectives. A fully developed ALoSP monitoring and measurement process will [13]:

- identify all the safety-critical sectors and the safety indicators that define the level of safety in these areas;
- identify targets that define the level to be maintained or desired improvement to be achieved for relevant indicators in each sector;
- identify alerts that will indicate an actual or developing safety performance problem in a particular safety indicator or sector;
- review SSP safety performance to determine whether modifications or additions to existing indicators, targets or alerts are needed to achieve continuous improvement.

A State's basic safety indicators by and large comprise of high-consequence safety indicators (e.g. accident and genuine incident rates). Such information is regularly communicated in terms of rate rather than supreme numbers. Along these lines (at a develop target indicators organize), lower-consequence security markers may be created.

Once a package has been defined, it is possible to compile a summary of the performance outcomes of each safety indicator on a regular basis. The target and alert level for each indicator may then be checked for their respective performance (achievement) status. A consolidated summary of the overall performance outcome may then be compiled for a particular period [13].

To guarantee that the target indicators stay successful and fitting over time, they got to be reviewed intermittently and upgraded as fundamental.

4.2 Target indicators as per Global Civil Aviation Statistic

The Organizational indicators are presented ib the Table 4.1:

Table 4.1 - Organizational

Objectives	Indicators	Metrics	Target of 2020		
Serious incident	Airfase, reports	Rate per 1000FH	<0.07	0.07-0.13	≥0.14
Incident	Airfase, reports	Rate per 1000FH	<0.92	0.98-2.7	≥2.7
Bird strike	Reports, inspections	Number per year	<10	11-14	≥15
Compliance with IOSA Standard	Result IOSA audit	Percentage of Effective Implementation	98-100%	94%-99%	<96%
Reporting culture	Increase the voluntary reporting rates from each operational area	Number of reports	≥190	140-200	<150
MCAA audit	Result of audit	Number of finding	<5	6-9	≥10
		Number of observation	<15	17-20	≥20
Emergency response	Emergency drills	Number per year	≥3	2	<2
SMS	SMS training	Number per year	≥15	10-13	<10
	Action group meeting	Number per year	>19	17-20	<15

The Flight Operational indicators are presented ib the Table 4.2:

Table 4.2 - Flight Operational

Objectives	Indicators	Metrics	Target of 2020		
Long touch down	AirFase (B737)	Number of exceedance	≤0.04 (Quality index)	0.044-0.08 (Quality index)	>0.08 (Quality index)
	AirFase (B767)	Number of exceedance	≤0.04 (Quality index)	0.044-0.08 (Quality index)	>0.08 (Quality index)
GPWS triggering event	AitFase (B737)	Number of exceedance	≤0.012 (Quality index)	0.015-0.035 (Quality index)	>0.036 (Quality index)
	AirFase (B767)	Number of exceedance	≤0.012 (Quality index)	0.015-0.035 (Quality index)	>0.036 (Quality index)
Tail wind	AirFase (B737)	Number of exceedance	≤0.01 (Quality index)	0.012 (Quality index)	>0.014 (Quality index)
	AurFase (B767)	Number of exceedance	≤0.01 (Quality index)	0.012 (Quality index)	>0.014 (Quality index)
High acceleration touch down	AirFase (B737)	Number of high exceedance 2G	0	0	≥1
	AirFase (B767)	Number of high exceedance 2G	0	0	≥1
Non-Precision unstable approaches continued for landing	AirFase (B737)	Number of event	Data collection		
	AirFase (B767)	Number of event	Data collection		

The Cabin Operational indicators are presented ib the Table 4.3:

Table 4.3 - Cabin Operational

Objectives	Indictaros	Metrics	Target of 2020		
Reduction of error Cabin crew during flight	LOSA	LOSA treat and error	4≥/1	5-8/1	>9/1
Safety and Quality assurance	Result of audit	Number of audit findings	≤10	11-19	≥20
		Number of observations	≤10	11-19	≥20
Improving reporting culture	Safety/operational reports	Number of oluntary reports	>50	49-40	≤39
		MOR	≤3	4	≥5
Reduction of occurrence Cabin operation	Lithium battery occurrence	Number per year	1	2	≥3
	Unchecked OHB occurrence	Number per 100 flights	0	1	≥2

The Ground Operational indicators are presented ib the Table 4.4:

Table 4.4 - Ground Operational

Objectives	Indictaros	Metrics		Target of 2020		
Ground handling safety	Scheduled audit Non- scheduled audit	Number of nonconformity		0 significant <1 insignificant 3 observation	0 significant 2-4 insignificant 4-6 observation	>1 significant >4 insignificant >7 observation
	Scheduled inspection Non-scheduled inspection	Number of nonconformity		0 significant <1 insignificant 3 observation	0 significant 2-4 insignificant 4-6 observation	>1 significant >4 insignificant >7 observation
	Voluntary report	Number of report		≥35	15-34	≤14
	MOR	In	Number	0	1	≥2
		Out	Number	0	1	≥2
	In-depth trainig	Training completing		100%	80%-99%	≤79%
		Training quality		85%	75%-84%	≤74%
	Cabin baggage limitation occurrence	In	Number	<10	11-19	≥20
		Out	Number	<10	11-19	≥20
	Offence of Visa	Out	Number	<2	3-4	>5
	Lost baggage	In	Number	≤5	6-9	≥10
		Out	Number	≤5	6-9	≥10
	Deviation from actual baggage weight	In	Number	<8	9-14	≥15
		Out	Number	<8	9-14	≥15
Increase ramp safety	Fueling spillage	Number of occurrence		0	1-3	≥4
	GSE occurrence	Number of occurrence		1	2-4	≥5
	Deviation from planned loads	In	Number	≤8	9-14	≥15
		Out	Number	≤8	9-14	≥15

The Dispatch indicators are presented ib the Table 4.5:

Table 4.5 - Dispatch

Objectives	Indicators	Metrics	Target of 2020		
Increase Flight Operation Safety	Voluntary report	Number and rate of report received	>20	15-19	<15
	SMS Training	Training completing Training quality	100% 80%	80%-99% 70%-79%	<80% <69%
	Internal audit result	Number of nonconformity	0 significant <2 insignificant	0 significant 2-3 insignificant	>1 significant >3 insignificant
	External audit plan	Number of nonconformity	0 significant <2 insignificant	0 significant 2-3 insignificant	>1 significant >3 insignificant
Aeronautical data quality	Flight Operations Bulletins	Number of flights opereated without relevant bulletins or notifications to crew	Significant operational impact		
			0-2	3-4	>4
			Insignificant operational impact		
			0-12	13-25	>25
Reduction of occurrence relevant to flight operations irregularity	Operational Flight Plan	Number of non-complience	0	1-2	>2
		Number of irregularity	0-2	3-4	>4
	NOTAM	Number of irregularity	0-2	3-4	>4
	Weight and balance	Number of irregularity	0-2	3-4	>4
	Diversions	Number of diversions due to weather	0-8	9-14	>14
	Deviations	Deviations of PIC decisions compared to information provided be Aircraft Dispatchers	<5	6-10	>10

The Maintenance and Engineering indicators are presented ib the Table 4.6:

Table 4.6 - Maintenance and Engineering

Objectives	Indicators	Metrics	Targets of 2020		
Incidents	Reliability report (B737)	Number of event in 1000 flight cycle	≤0.002 Event/FC	0.003-0.005 Event/FC	≥0.005 Event/FC
	Reliability report (B767)	Number of event in 1000 flight cycle	<0.002	0.003-0.009	>0.01
Injury of Maintenance Personnel	Safety Hazard reports	Number of event in year	0 Event/Year	1 Event/Year	>2 Event/Year
Unapproved part	Rejected parts report	Number of event in year	≤4 Event/Year	5-12 Event/Year	≥12 Event/Year
Operational Reliability	Reliability report (B737)	Average rate	≥99%	98.7% - 99%	≤98.7%
	Reliability report (B767)	Average rate	>99	98.7% - 99%	≤98.7%
MEL usage	Reliability report, FML, CLB record (B737)	Number of event in 1000 flight cycle	≤0.01 Event/FC	0.012-0.031 Event/FC	≥0.032 Event/FC
	Reliability report, FML, CLB record (B767)	Number of event in 1000 flight cycle	≤0.027 Event/FC	0.03-0.047 Event/FC	≥0.048 Event/FC
Repeated discrepancy	Reliability report, repeated discrepancy report (B737)	Number of event in 1000 flight cycle	≤0.003 Event/FC	0.003-0.01 Event/FC	≥0.01 Event/FC
	Reliability report, repeated discrepancy report (B767)	Number of event in 1000 flight cycle	≤0.003 Event/FC	0.003-0.01 Event/FC	≥0.01 Event/FC
In-flight Shutdown IFSD	Reliability report, Incident report, captain report	Number of event in 1000 flight cycle	≤0.001 Event/FC	0.001-0.003 Event/FC	≥0.003 Event/FC
Unscheduled Engine removal	Reliability report, FML, CLB record	Number of event in 100 flight cycle	≤0.01 Event/FC	0.01-0.03 Event/FC	≥0.03 Event/FC

CONCLUSION

Targets are the level that any airline must adhere to. Each airline has its own target indicators, the more serious and developed the airline is, the tougher its targets.

5 MAINTENANCE ORGANIZATION STAFF OPTIMIZATION

5.1 Maintenance organization characteristic and description

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 [9]:

- aircraft safety – airworthiness at its heart;
- keep aircraft in service – availability, which is of key importance to an operator i.e. the aircraft can meet its schedule;
- 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 [9]:

- scheduled or preventive work to anticipate and prevent failures;
- unscheduled work – Repair maintenance and On-condition maintenance.

Typical Maintenace Organization Scheme is illustrated on Fig. 5.1:

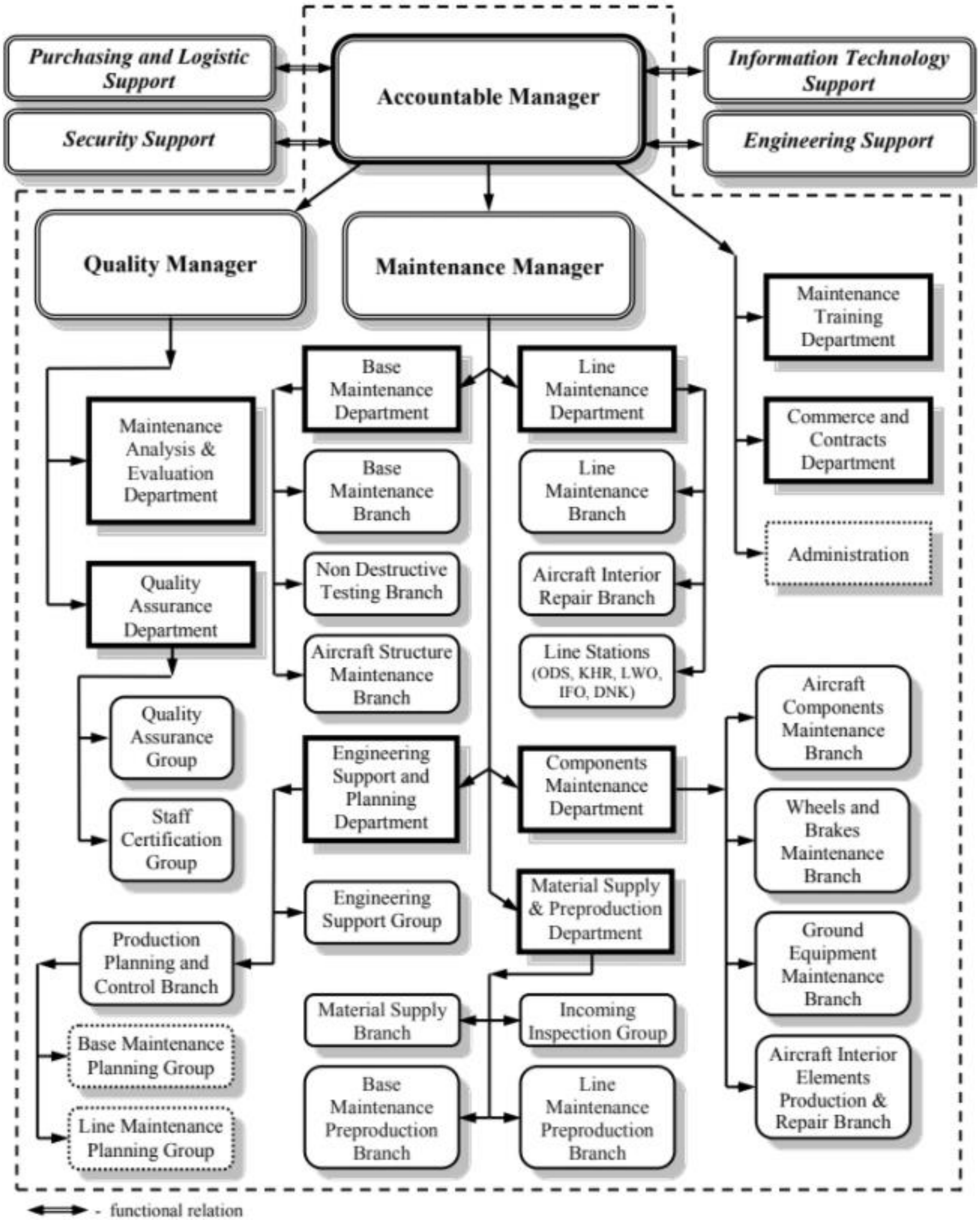

Fig. 5.1 – Typical Maintenace Organization Scheme

5.2 Line 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. According to EASA Part 145, line maintenance should be understood as "any maintenance that is carried out before flight to ensure that the aircraft is fit for the intended flight." This may include [9]:

- trouble shooting;
- defect rectification;
- component replacement, up to and including engines and propellers, with use of external test equipment if required;
- scheduled maintenance and/or checks including visual inspections that will detect obvious failures but do not require extensive in depth inspection. It may also include internal structure, systems and powerplant items which are visible through quick opening access panels/doors;
- minor repairs and modifications which do not require extensive disassembly and can be accomplished by simple means.

5.3 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 maintenance organization (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. The different activities may include:

- C and D Checks (block checks see Maintenance Programme) which will check for deterioration of the airframe, engines and systems, e.g. corrosion, fatigue;
- removal of defects – implementation of Service Bulletins (SB) and Airworthiness Directives (AD), although this can also be done during Line maintenance;

- technology upgrade – fitting of Terrain Avoidance and Warning System (TAWS), Airborne Collision Avoidance System (ACAS) etc;
- cabin reconfiguration, painting etc.

5.4 Certifying/Support staff lists

The «Certifying/Support Staff Lists» identify all maintenance organization certifying and support staff, which hold the following Part-66 Aircraft Maintenance Licenses or its international analogies:

Part-66 Licenses:

- category A;
- category B1;
- category B2;
- category C.

The certifying staff responsible for the release of an aircraft or components after maintenance, and support staff confirms

with his signature performance of works is responsible for the fact that all work specified in release to service document or work card executed correctly, completely and technical documentation is executed properly.

If the works have been performed by the qualified staff (who has the rights to sign the production documentation), such qualified staff, in the first stage, is responsible for the completeness and correctness of such works.

«Certifying/Support Staff Lists» and «Certifying Pilots List» have the following information:

- name;
- skill (maintenance organization category);
- license and expiry date of it;
- Maintenance Organization Company Authorisation number and expiry date of it;

- scope of Maintenance Organization Company Authorisation and limitations.

5.5 Mechanic qualification

The following qualifications exist for aircraft maintenance:

- Unskilled Worker (UW);
- Qualified Mechanic (QM).

Qualified personnel holding the maintenance organization qualifications «QM», «QMI» and «QSM» are responsible for the correct and entire performance of their relevant maintenance task(s) and signing of it in production documentation.

Qualified Mechanics (QM, QSM) work under the supervision of an appropriate Certifying/Support staff. This means that:

- the mechanic is assigned to a specific Certifying/Support staff at any time;
- prior to commencing the work, the mechanic shall ask, and the Certifying/Support staff shall instruct:

a) which task(s) the mechanic shall perform;

b) which special instructions, (pre)cautions and/or warnings apply if any;

c) at what stage(s) the mechanic shall stop the work for inspection by the AME before proceeding;

- the mechanic shall report to the Certifying/Support staff:

a) any question or uncertainty he may have regarding being able to properly completing the task(s);

b) any mistakes requiring rectification to reestablish required maintenance standards;

c) completion of the work;

d) details for work hand-over, as and if applicable.

5.6 Exchange of A, B and C categories part on Unskilled-Worker

The main idea of optimization of maintenance organization personnel is to reduce the number of workers with A, B and C licenses to reduce the costs of the maintenance organization. But at the same time, increase the number of workers with the Unskilled-Worker position, which, in principle, does not change the number of working hands in the maintenance organization, but at the same time reduces the number of worker-inspection personnel (A, B, C categories). As practice shows, workers with licenses A and B can often do the work as the QM worker does, which is a little incorrect in terms of airline costs. A good source of new Unskilled-Workers is National Aviation University graduates or 5th year students who already have a basic higher education and are still studying for a master's degree. These people also need work and want to build a career. In addition to their low wages compared to categories A, B and C, these are fresh heads with a lot of ambition and enthusiasm, which will be good for their work in the airline. New people must be trained surely, but through some time it start to work. Leave unchanged all three categories of QM mechanics. Leave unchanged all three categories of QM mechanics.

In the Table 5.1 illustrated the principle of selection new people into the job:

Table 5.1 – Job Selection Factors

Job selection factors	
Language	Intermediate or higher level
Education	Higher basic education
Personal quality	Responsible Disciplined Clever
Knowledge	High

And in the Table 5.2 I want to represent the difference between present staff in some maintenance organization and suggested one:

Table 5.2 – Exchange of Staff

Exchange of staff	
Aviation Fleet Company: Boeing 737 – 38 units Boeing 767 – 2 units Boeing 777 – 4 units	
Present staff: A category – 35 workers B1 category – 20 workers B2 category – 15 workers C category – 6 workers Unskilled-Worker – 40 workers Costs per year – 225 000 USD	Suggested staff: A category – 25 workers B1 category – 13 workers B2 category – 10 workers C category – 3 worker Unskilled-Worker – 60 workers Costs per year – 164 000 USD
Money safe is 61 000 USD per year	

CONCLUSION

Consists of periodic inspections of the technical condition of the aircraft, which must be carried out by maintenance organizations after the expiration of the established calendar time or the established taxation adopted by the airline that uses this aircraft.

There are the following types (forms) of maintenance: transit check, daily check, weekly check, A-check, B-check, C-check and D-check.

A-check and B-check are simple checks, while C and D-check are heavy maintenance. If the airline operates only daytime flights, then it would be advisable to carry out maintenance at night. Redistribution of work between nocturnal forms ideally can in principle exclude moderate forms (A-check).

6 LABOR PRECAUTION

6.1 Analysis of harmful and dangerous production factors

According to the theme of my diploma project "Improvement of airworthiness retaining system of Boeing family aircrafts based on threat identification and risks management at maintenance", the design of aircraft elements with the help of computer programs as the operational procedure is chosen to be analyzed.

The process of designing aircraft at this stage of development of information technologies is carried out with the use of computer technology, which is associated with harmful effects on the human body, which is in the immediate vicinity of a computer.

In the process of performing work, the engineer may be affected by the following hazardous and harmful production factors according to standard ГОСТ 12.0.003-74 "Occupational safety standards system.

Dangerous and harmful production effects. Classification".

These factors are:

the dangerous voltage level in an electrical circuit, the short circuit of which can occur through the human body increased level of electromagnetic radiation;

an increased level of static electricity;

increased noise level;

irrational organization of the workplace;

insufficient illumination of the working area.

Dangerous and harmful production factors are subdivided by the nature of action into the following

- groups:
- physical;
- chemical;
- psychophysiological.

6.1.1 Dangerous and harmful production factors

Dangerous and harmful production factors are subdivided by the nature of action into the following groups:

- factors generated by the physical properties and characteristics of the state of material objects of the production environment;
- factors generated by the chemical and physicochemical properties of substances and materials used or located in the working area;
- factors generated by the biological properties of microorganisms located in biological objects and (or) polluting material objects of the production environment;
- factors generated by behavioral reactions and defense mechanisms of living beings (bites, stings, release of poisonous or other protective substances, etc.);
- factors generated by the socio-economic, organizational and managerial conditions of employment (poor organization of work, low safety culture, etc.);
- factors generated by the mental and physiological properties and characteristics of the human body and the personality of the worker (poor health of the employee, finding the employee in a state of alcoholic, drug or toxic intoxication or abstinence, loss of concentration of attention by employees, etc.).

6.1.2 Physical hazards and harmful production factors

- the increased dustiness and gassiness of air of a working zone;
- increased or decreased temperature of surfaces of equipment, materials;
- increased or decreased air temperature of the working area;
- increased noise in the workplace;
- increased vibration level;

Factors which belong to physical harmful factor a dangerous:

- the voltage level in an electrical circuit;
- the short circuit of which can occur through the human body; increased level of electromagnetic radiation;

- an increased level of static electricity;
- reduced air ionization;
- increased noise level;
- irrational organization of the workplace;
- insufficient illumination of the working area.

6.1.3 Chemical hazardous and harmful production factors

Hazardous and harmful production factors that have the properties of a chemical effect on the body of a working person, called for short chemical substances, are physical objects (or their constituent components) of animate and inanimate nature, which are in a certain physical state and possess such chemical properties that when interactions with the human body within the framework of the biochemical processes of its functioning lead to damage to the integrity of body tissues and (or) disruption of its normal functioning.

Chemical substances can be:

- Solid;
- Pasty;
- Powdery;
- Liquid;
- Vaporous;
- Gaseous;
- Aerosol states;
- Including nanosized ones.

1. The degree of danger of chemicals is associated with the ways of their entry into the human body, which are subdivided into the following groups of penetration:

- through the respiratory system (inhalation);
- through the gastrointestinal tract (oral route);
- through the skin and mucous membranes (skin pathway);
- through open wounds;

- with penetrating wounds;
- with intramuscular, subcutaneous, intravenous injections.

2. By the nature of the resulting chemical effect on the human body, chemical substances are divided into:

- toxic (poisonous);
- annoying;
- sensitizing;
- carcinogenic;
- mutagenic;
- affecting reproductive function.

3. By composition, chemical substances are divided into:

- individual substances;
- mixtures.

4. According to the criterion of dangerous transformation, chemical substances are divided into:

- used in production activities without subsequent transformation of chemical properties;
- used in production activities for deliberate technologically determined chemical reactions that cause the emergence of new substances with different chemical properties;
- new chemical substances with different chemical properties that arise unintentionally during production and labor operations.

5. According to the criterion of hazardous and (or) harmful effects on the organism of the worker, chemical substances are divided into:

- directly acting on the body of the worker as dangerous and harmful production factors of the chemical nature of the action;

- indirectly acting on the body of the worker as dangerous and harmful production factors of the physical nature of the action, due to the properties of these chemicals to ignite, burn, smolder, explode, etc.

6.1.4 Psychophysiological hazardous and harmful production factors

Dangerous and harmful production factors that have the properties of psychophysiological effects on the human body are divided into:

- Physical overload associated with the severity of the labor process;
- Neuropsychic overload associated with the tension of the labor process.

Factors which belong to psychophysiological harmful factor:

- increased nervous stress;
- psycho-emotional stress;
- overwork.

6.2 Measures to reduce the impact of harmful and dangerous production factors

6.2.1 Ways to protect workers from harmful production factors

All means of protection can be divided into:

- Collective
- Individual.

Collective funds involve the simultaneous protection of a large number of workers. They are divided into several classes:

- To normalize the air environment. These include ventilation systems, air conditioners.
- To normalize lighting in workplaces: various lamps, lamps that are able to provide good lighting.
- To protect against harmful and dangerous factors.

If the enterprise has a high level of noise, then the walls are covered with materials that absorb sound, special covers are put on the working mechanisms, and earplugs are given to the workers.

To prevent injury to the equipment, all hazardous areas are fenced off from all directions. Lock buttons are installed on the doors and dampers, which will not allow opening it until the mechanism completely stops working.

Workers dealing with electricity must be provided with rubber gloves, boots or galoshes. The equipment is equipped with warning lights and safety signs.

If collective methods are not capable of providing high-quality protection, then each worker in hazardous production is given individual means. These include gowns, gloves, respirators, bandages, protective suits, etc.

6.2.2 Elimination of dangerous and harmful factors

At many enterprises, the production cycle is inextricably linked with the impact of harmful substances on humans. Management and management should make every effort to try to completely eliminate or reduce this impact.

If you approach some processes deliberately, it turns out that sometimes toxic substances can be replaced with safer ones. Many managers do not agree to this for mercantile reasons.

Thus, they save on the health of their subordinates. If replacement is not possible, then everything should be done to ensure that the employee is exposed to harmful and dangerous factors as little as possible.

In order to prevent negative impact, the following measures should be applied:

- Local air purification;
- Air spraying;
- Wearing workwear;
- Equipped recreation facilities;
- Exact adherence to working hours;

- The break is provided at regular intervals;
- Employees are granted longer paid leave.

If all measures are taken in a timely manner and used in a comprehensive manner, then it can be argued that the management is trying to provide its personnel with safe working conditions.

6.2.3 Noise and its impact on humans

At enterprises where machines and other equipment are located in the shops, as a rule, noise is not enough. A constantly operating technique produces loud sounds that can change in intensity.

If a person is forced to regularly be exposed to such exposure, then this will adversely affect his health. From a strong noise, the head begins to hurt, the pressure rises, and the hearing acuity decreases.

In the end, from such conditions, performance decreases, fatigue appears, attention decreases, and this can already lead to an accident.

Managers in such enterprises should take care of their employees to try to reduce the negative effects of noise on the body at least a little. For this enterprises eliminate these factors by the following way:

- Noise mufflers.
- Personal protective equipment such as headphones, ear plugs, helmets.
- Provide soundproofing of noisy places using protective covers, booth equipment.
- Decoration of premises with sound-absorbing materials.

6.2.4 Exposure to vibration and its elimination

Vibration is included in the list of harmful production factors. It can be classified into several categories:

- by transmission method: general and local.
- in its direction: vertical and horizontal.

- by exposure time: temporary and permanent.

As a result of the constant influence of this factor, not only the nervous system begins to suffer, but also the musculoskeletal and the analyzer system. Workers who are forced to work in such conditions often complain of headaches, dizziness, motion sickness.

If we add also the influence of related factors, such as humidity, high temperature, noise, then this only intensifies the harmful effects of vibration.

To protect against it, you can suggest the following measures:

- replacement of equipment with more technological ones.
- use of soft coatings on vibrating parts of devices or equipment.
- installation of units on a solid foundation.

6.2.5 Protecting workers from hazardous substances

Despite all the measures aimed at neutralizing the harmful effects of factors, it is impossible to achieve ideal working conditions. This does not allow to do the peculiarities of technological processes, products and raw materials for its manufacture.

Therefore, for managers, protection from harmful production factors is a top priority.

It is necessary to be guided by the following priorities:

- eliminate the hazard or reduce the risk of exposure.
- use safe working practices.
- combat the dangerous factor and its source.
- use personal protective equipment effectively.

It often happens that all the measures taken cannot ensure completely safe working conditions, in these cases it is simply impossible to do without the use of personal protective equipment.

Among them, the following categories can be distinguished, which are the most common in use:

- anti-vibration products can be: gloves, handhelds, gloves. Since such protection can reduce labor efficiency due to the inconvenience of work, additional breaks should be provided.
- headphones from noise. But they can reduce a person's ability to navigate in space, provoke headaches due to squeezing.
- respirators and gas masks. It is very difficult and inconvenient to work in them for a long time, so you should look for alternative means of protection.

It can be concluded that personal protective equipment, on the one hand, reduces the impact of harmful factors, but on the other hand, it can create a different hazard to the worker's health.

6.2.6 Safety meauses

They are aimed primarily at ensuring that harmful production factors do not exert their dangerous effects on humans.

For this purpose, safety training must be carried out at any enterprise without fail. The date and content are recorded in a special journal with the signature of all instructors and the person who conducted this instruction.

In total, there are several types of such work:

- induction training. It is carried out without fail with hired persons. Here, neither age, nor experience or position matters.
- primary. It is carried out already at its workplace, it is usually carried out by a foreman or the head of a given department or workshop.
- repeated. It is held for all employees without exception every six months.
- unscheduled.

Unscheduled instructions conduct if:

- the rules have changed.
- the technological process has changed.
- we have purchased new equipment.

- cases of violation of safety rules by employees were identified.
- after long breaks in work.

Quite often, you can find in practice a situation where employees are simply given to sign in safety logs without being instructed. This is simply unacceptable. Any accident in this situation will completely lie on the conscience of such negligent leaders who only work for show.

6.3 Occupational Safety Instruction

General safety requirements

A design engineer informs his manager about any situation, a threat to the life and health of workers, about all accidents at work, about the deterioration of his health, including the manifestation of signs of an acute illness. While on the territory and in the buildings of the organization, on construction sites and at workplaces, the design engineer must:

- timely and accurately comply with the internal labor regulations, orders of the immediate supervisor, provided that he is trained in the rules for the safe performance of this work;
- comply with the requirements of local regulations on labor protection, fire safety, industrial sanitation, regulating the procedure for organizing work at the facility;
- observe labor discipline, work and rest regime;
- take good care of the employer's property.

Safety Requirements before starting work:

- inspect the workplace and equipment;
- remove all unnecessary items;
- remove dust from the display screen of a personal computer;
- adjust the height and angle of the screen;
- adjust the seat height;
- check the health of the equipment;

- check approaches to the workplace, escape routes for compliance with labor protection requirements.

Check by visual inspection:

- absence of cracks and chips on the cases of sockets and switches as well as the absence of bare contacts;
- reliability of closing all current-carrying devices of the equipment;
- presence and reliability of grounding connections (absence of breaks, strength of contact between metal non-current-carrying parts of the equipment and the grounding wire);
- the integrity of the insulation of electrical wires and power cords of electrical appliances, the serviceability of safety devices;
- sufficiency of lighting of the workplace;
- absence of foreign objects around the equipment;
- condition of floors (absence of potholes, irregularities, etc.).

Safety Requirements during operation:

- use serviceable equipment, fixtures, lighting devices necessary for safe work, use them only for those works for which they are intended;
- monitor the equipment operation, periodically carry out its visual preventive inspection.

When working with a PC:

- the screen should be 5 degrees below eye level, and be located in a straight plane or tilted towards the operator (15 degrees);
- the distance from the eyes to the screen should be within 60-80 cm;
- the local light source in relation to the workplace should be located so as to exclude direct light from entering the eyes, and should provide uniform illumination on a surface of 40 x 40 cm, not create blinding glare on the keyboard and other parts of the console, as well as on the video terminal screen in direction of the eyes;

- to reduce visual and general fatigue, after each hour of working at the screen, you should use regulated breaks of 5 minutes, during which you take rest.

Safety Requirements after work:

- switch off the equipment during a power outage and leaving the workplace after work;
- inspect the workplace and equipment;
- remove all unnecessary items.
- check by visual inspection equipment on a lack of defects.

Safety Requirements at emergency situations:

- when eliminating an emergency, it is necessary to act in accordance with the approved emergency response plan;
- upon detection of malfunctions of equipment, instruments and apparatus, as well as in the event of other conditions that threaten the life and health of workers, the design engineer should stop work and report them to his immediate supervisor and the employee responsible for the implementation of production control.

When a fire source appears, you must:

- stop working;
- turn off electrical equipment;
- organize the evacuation of people;
- start extinguishing the fire immediately.

When electrical equipment catches fire, use only carbon dioxide or dry powder fire extinguishers. If it is impossible to carry out extinguishing on his own, the design engineer should, in accordance with the established procedure, call the fire brigade and inform the immediate supervisor about it. In the event of injury or deterioioration of health, the design engineer must stop work, notify the management and seek medical help.

CONCLUSION

Occupational safety and health ought to not be sidelined as a service delivery issue. Health specialist health and well-being is an imperative viewpoint of workers' inspiration and work fulfillment, which impact efficiency as well as maintenance. Health specialist safety also influences the quality of care; caring for the caregiver should be a need range of concern for the health system's execution. What is nice for worker health is sweet for quiet health.

7 ENVIRONMENTAL PROTECTION

7.1 Contribution of aviation to global climate change

The most common environmental impacts from operational changes are noise, air quality, fuel consumption and greenhouse gas emissions, although other impact areas may be considered at national or local level.

Some States have an established list of parameters to be used in a logical assessment, and it is useful to become familiar with them in order to ensure that all relevant required indicators are included in the research framework. The purpose of the proposed change will also help identify parameters to consider, especially if the proposal is aimed at solution of the existing environmental problem. Particular attention should be paid to identifying interdependencies of ecological and non-ecological nature to ensure that any trade-offs are adequately reflected in the study. This section provides an overview of the possible options to consider.

7.1.1 Air quality

The combustion of aviation fuel creates a variety of air pollutants in the form of gas and particulate emissions that can affect air quality and human health. Generally, when assessing air quality, the following general varieties are distinguished:

- NOx - nitrogen oxides, a mixture of nitrogen dioxide (NO2) and nitrogen oxide (NO);

- VOC - volatile organic compounds (including non-methane hydrocarbons (NMHC));
- CO is carbon monoxide;
- PM - particulate matter, with the most problematic being particles, aerodynamic
- the diameter of which is less than 10 µm (PM10) and 2.5 µm (PM2.5) 2;
- SOx - sulfur oxides.

These emissions can, in turn, be building blocks of wider environmental problems associated with ground-level ozone, photochemical smog, secondary aerosol particles and other chemical processes in the atmosphere with potential health effects.

Emission inventories should take into account additional types of emissions that can cause health and environmental problems, including so-called hazardous air pollutants (HAPs), known organic gases that, even at low concentrations, can have serious health effects. At the date of publication of this document, HAP research is at a relatively early stage, although some scientists have detected up to 15 known HAPs in aircraft engine exhaust. It should be noted, however, that for many of these substances the knowledge of emission factors is very limited.

7.1.2 Fuel consumption and greenhouse gase

Airplanes emit huge amounts of carbon dioxide and water vapor, nitrogen oxides and soot into the atmosphere. The environmental impact of these components depends on the flight altitude. Look at the Fig. 6.1 that illustrates emissions:

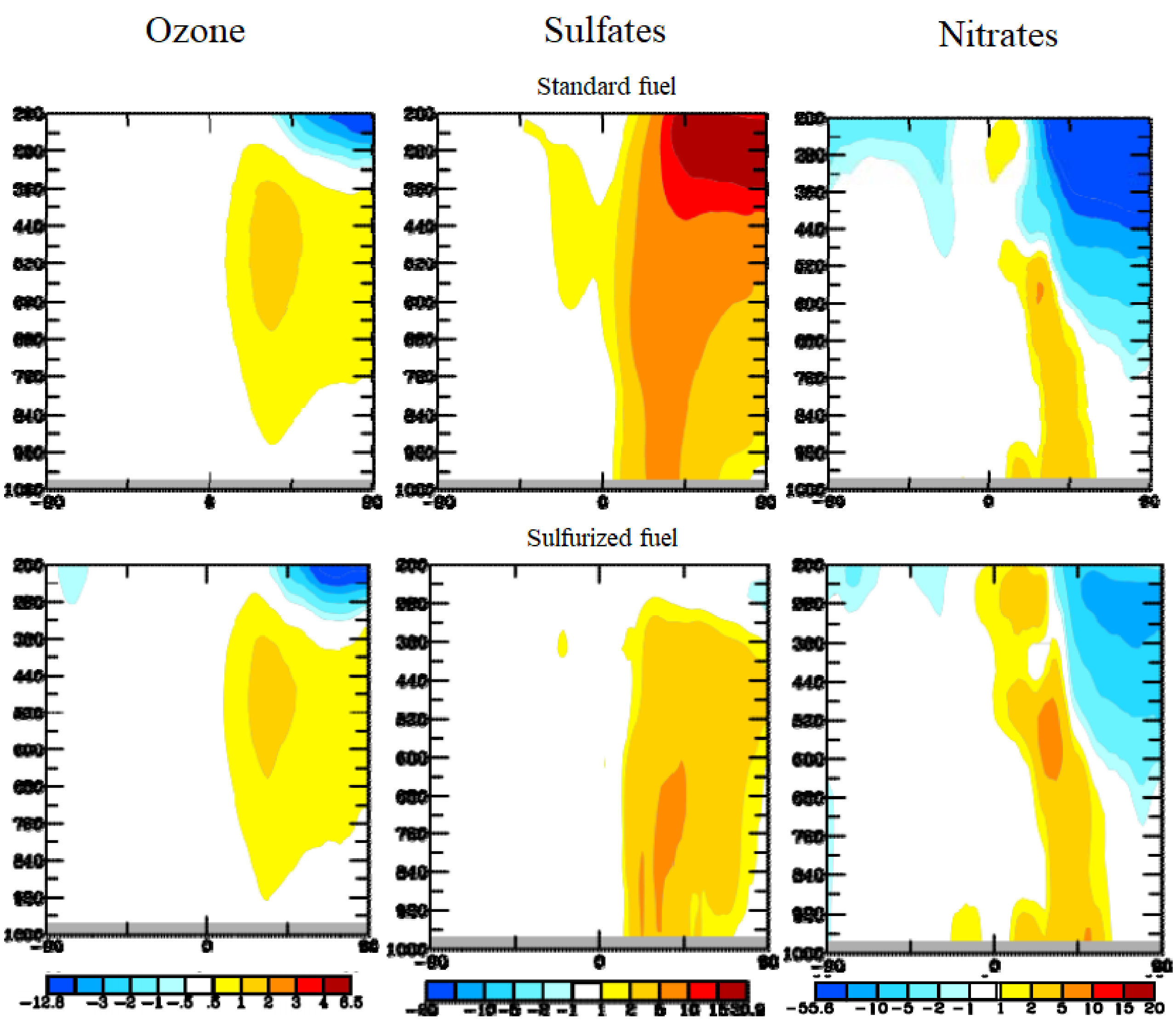

Fig. 6.1 – Airplane Emissions

The fact that airplanes pollute the environment with their exhaust gases is obvious and beyond doubt. Yes, in fact, any human economic activity damages nature and contributes to climate change. The only question is how great is the contribution of one kind or another to this general process.

So, according to Professor Ulrich Schumann, director of the Institute for Atmospheric Physics of the German Aerospace Center, aviation accounts for about 3 percent of the entire anthropogenic greenhouse effect. I must say that not all experts agree with this assessment. Which is quite natural, because this figure is very approximate, partly even speculative. After all, the exhaust gases of aircraft contain carbon dioxide, water vapor, nitrogen oxides, and fine soot. All these components have an ambiguous and sometimes multidirectional impact on the environment and the planet's climate.

7.1.3 Carbon dioxide is distributed evenly

The fact is that aviation fuel - kerosene - is a complex mixture of hydrocarbons. Carbon is 86 percent in it, hydrogen is 14 percent. When burned, carbon combines with oxygen in the air, so that each kilogram of aviation kerosene burns adds 3.15 kilograms of carbon dioxide to the atmosphere. "Since carbon dioxide is a very stable substance, it is evenly distributed around the entire globe," says Professor Schumann.

In addition, CO2 easily migrates in the vertical direction, so whether it was formed near the Earth's surface or at an altitude of 10-11 thousand meters, where most of the civil aviation corridors run, does not play any role. Therefore, it is easy to calculate that approximately 2.2 percent of all anthropogenic carbon dioxide is emitted into the atmosphere by aircraft. Road transport accounts for about 14 percent, other types of transport - sea, rail and others - produce 3.8 percent in total.

The duration of exposure to emissions varies significantly, from carbon dioxide, which persists in the atmosphere for a long time, to water vapor, which has a relatively short lifespan. Modern gas turbine engines emit practically no nitrogen oxides (N2O), and although moderate methane (CH4) emissions are possible when the engines operate at the least economical modes, no methane emissions were observed at other stages of the flight.

7.1.4 Influence of the condensation trail on the height

It is much more difficult to assess the role of water vapor emitted by aviation. That is, a quantitative assessment is not difficult: it is known that when one kilogram of kerosene is burned, 1.23 kilograms of water vapor are formed. But with a qualitative assessment, the situation is more complicated. When hot and humid exhaust gases enter a cold environment, the steam condenses, forming the smallest droplets of water, and at high altitudes, where the outside air temperature reaches 30-40-50 degrees below zero, the smallest ice floes. These droplets and ice floes are sometimes clearly visible from the ground - in the form of the so-called condensation trail, trailing behind the aircraft. How this wake affects the atmosphere depends on the flight altitude.

"The troposphere is the lower, very turbulent layer of the atmosphere, in which the weather is formed," explains Professor Schumann. layers that do not mix with each other ".

7.1.5 Water vapor in the stratosphere and troposphere

In the stratosphere, with its extremely low moisture content - less than 0.01 ppm - ice trails evaporate quickly. But in the troposphere, where air masses can be saturated to the limit with moisture, the behavior of the condensation trail depends on many weather factors, says Professor Schumann: "If the air humidity is high, ice crystals absorb additional water, grow, and condensation trails can form cirrus clouds. They contribute to further condensation of moisture from the air, as a result, the density and water content of the clouds increase. "

This development of events is observed in 10-20 percent of cases. “In other words, air transport really increases the cloudiness on our planet,” the scientist emphasizes. True, the question is pertinent here: is it good for the climate or bad? On the one hand, clouds reflect some of the shortwave solar radiation back into space. “To put it simply, the trails of condensation cast a shadow on the ground, and it's cooler in the shadow than in the sun,” explains Professor Schumann. On the other hand, ice crystals in such clouds absorb long-wave infrared radiation and then send some of this heat to the ground. There are two oppositely directed effects, and experts cannot say for sure which of them prevails, although most experts are inclined to believe that heating is still somewhat stronger than cooling.

7.1.6 Influence of soot

Another factor affecting the planet's environment and climate is soot in the form of fine dust. The diameter of soot particles in aircraft exhaust gases ranges from 5 to 100 nanometers. It is clear that this dust, having barely entered the atmosphere, contributes to the formation of a condensation trail, since a part of the water vapor emitted by the aircraft simultaneously with soot settles on it. And besides this, soot particles can stay in the air for weeks in suspension, contributing to the formation of clouds. However, dust particles of a different origin, both natural (volcanic dust, desert dust, dust from soil erosion) and anthropogenic (emissions from industrial enterprises), and, in addition, liquid droplets of different natures, participate in the same processes.

In such a situation, it is extremely difficult to assess the effect of soot in general, and even more so, soot emitted by aircraft. According to Professor Schumann, the German Aerospace Center is studying the environmental impact of, say, soot particles emitted into the atmosphere during large forest fires. However, the results have been highly controversial. Even the question of whether soot contributes to an increase or decrease in cloudiness, there is still no definitive and unambiguous answer.

7.1.7 Influence of ozone on different heights

A separate topic is the influence of aircraft exhaust gases on the concentration of ozone in the atmosphere. As you know, the combustion chamber of a modern aircraft engine can heat up to 2000 degrees. "At such temperatures, nitrogen in the air in a free state binds to oxygen, forming oxides NO and NO2," explains Professor Schumann, "however, these oxides have a multidirectional effect on atmospheric ozone: at high altitudes they decompose it, at low altitudes - form ".

Ozone decomposition prevails at altitudes over 16,000 meters, but ordinary civilian aircraft do not fly there. Their corridors are located below 12 thousand meters, and there nitrogen oxides cause active formation of ozone. Unfortunately, this so-called tropospheric ozone enhances the greenhouse effect - just like carbon dioxide or water vapor. In addition, high ozone levels in the air have a negative impact on health. And this ozone has nothing to do with the ozone layer in the stratosphere that protects our planet from hard ultraviolet radiation. In other words, the ozone hole over Antarctica cannot be patched up by aircraft exhaust.

7.2 Reducing the impact of aviation emissions and greenhouse gases on the global climate

Montreal, 6 March 2017. The ICAO Council, composed of representatives from 36 countries, has adopted a new Aircraft CO2 Emissions Standard that will help reduce the global climate impact of aviation greenhouse gas emissions.

The measures to control aircraft CO2 emissions, contained in the new Volume III of Annex 16, Environmental Protection, represent the world's first global industry standard for the certification of aircraft structures to regulate CO2 emissions.

This standard will be applied to new types of aircraft structures from 2020, and to types of aircraft structures in production - from 2023. In the future, without a significant modernization of the design, the production of currently manufactured aircraft, which by 2028 will not meet this standard, should be discontinued.

“International Civil Aviation has once again taken the lead in addressing the impact of aviation CO2 emissions on the global climate,” said ICAO Council President Dr Olumuywa Benard Aliu, “making air transport the first industry sector in the world to adopt the Design Certification Standard. on CO2 emissions ". "Along with our landmark agreement on a new carbon offset and reduction system for international aviation (CORSIA), reached last October at the 39th Assembly, these latest developments confirm the leadership and concrete action of our sector to ensure sustainable and environmentally sound responsible future of civil aviation around the world, "added President Aliu.

“Given our commitment to greener air transport, this historic achievement puts aviation in an even better position,” said ICAO Secretary General Dr. Fan Liu. "We appreciate the dedication of the ICAO Secretariat staff, the hundreds of experts on the Committee on Aviation Environmental Protection (CAEP) and the State Representatives on our Air Navigation Commission."

Up to 2050, civil aviation emissions into the Earth's atmosphere can be halved compared to 2012.

Scientists analyzed the effectiveness of various ways to reduce emissions for the main "workhorses" of the air fleet - Airbus 320 and Boeing 737. According to scientists, the environmental situation can be significantly improved only by increasing the cost of modernizing equipment. Of all the options, the cheapest is to simply pack passengers on airplanes tighter.

Cuts in emissions in half by 2050 can be achieved through the emergence of the next generation of the air fleet using lightweight carbon frames, aerodynamic fenders and open rotor engines. Simple upgrades to current-generation aircraft include wingtips, **biofuels** and electric transmissions for taxiing. According to scientists, a separate technology will not solve the problem of reducing emissions. Only a set of measures will reduce carbon dioxide emissions by 2% per year.

CONCLUSION

While aviation is a relatively “clean” mode of transport by comparison, its climate and environmental impacts may become noticeable over time due to the ever-increasing air traffic, leading to increased pollution in the upper troposphere. While estimates of such impacts are currently highly uncertain, the International Civil Aviation Organization is taking steps to reduce the negative environmental impacts of aviation. To this end, new standards are being developed that tighten the requirements for aircraft in operation for aircraft noise and emissions, and the list of aviation emissions for which aircraft engines are certified is being expanded. As the main instrument for regulating the negative impact of aviation on the atmosphere, the Committee ICAO for the Environment proposes a Global Market Action Mechanism. While not all ICAO members support this idea, there is a clear need to introduce new technologies in the aviation industry to reduce the environmental burden of air transport.

GENERAL CONCLUSION

The safety management system comprises of as it were four components, we are going briefly conversation approximately every component now as an diagram, and after that go into much more detail. The approach component characterizes best management goals and necessities. The policy gives basic methods and controls for the execution of an SMS, and maintenance and control methods are critical safety properties within the plan of automated systems and are also safety dangers. SRM management and safety components are the center useful SMS forms. These two components combine system safety and quality management into an interactive process. SRMs, as risks are distinguished, are analyzed to survey and control risks. Security is where they are observed to guarantee they proceed to work to decrease safety hazard. The Safety Assistance Component gives the forms fundamental to bolster a solid safety culture, such as communication and training. An organization's safety culture is portion of the environment that surrounds all safety management efforts. The structure of the tone forms and strategies for the SMS arrangement is overseen by management, but once set up, the most useful SMS forms are SRM and safety notification, and safety enhancement isn't restricted to a system like safety culture, it saturates all components of an SMS and organization. Labor assets. The company must guarantee that each maintenance organization has the vital staff to arrange, execute, administer, review and favor the maintenance work to be performed. The M&E organization has sufficient staff to arrange, execute, oversee, review, plan and control quality to guarantee the organization is steady in understanding with Part 145 approvals.

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