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

DEPARTMENT OF AVIONICS

APPROVED
Head of department
_____S.V. Pavlova
‘___’_____2022

# GRADUATION WORK

**(EXPLANATORY NOTES)**

FOR THE DEGREE OF BACHELOR
SPECIALTY 173 ‘AVIONICS’

**Theme:** “UIA aircraft maintenance quality management system”

Done by: _____ K.A. Rukhkian
(signature)

Supervisor: _____ L.M. Sytnyansky
(signature)

Standard controller: _____ V.V. Levkivskyi
(signature)

Kyiv 2022

NATIONAL AVIATION UNIVERSITY

Faculty of Air Navigation, Electronics and Telecommunications

Department of avionics

Specialty 173 ‘Avionics’

APPROVED

Head of department

_____S.V. Pavlova

‘___’ _____2022

**TASK for execution graduation work**

K.A.Rukhkian

1. Theme: ‘UIA aircraft maintenance quality management system’, approved by order №352/ст of the Rector of the National Aviation University of 04 April 2022.
2. Duration of which is from 16.05.2022 to 16.06.2022.
3. Input data of the final work: The concept of quality management system, information about UIA, basic concepts, types and methods of maintenance. Ways to develop and improve the quality management system today.
4. Content of explanatory notes: List of conditional terms and abbreviations; Introduction; Chapter 1: QUALITY MANAGEMENT SYSTEM AS A TOOL OF IMPROVEMENT; Chapter 2 MAINTENANCE; Chapter 3: METHODS OF IMPROVING THE MAINTENANCE QUALITY MANAGEMENT SYSTEM;
5. The list of mandatory graphic material: figures, charts, graphs.

6. Planned schedule

| № | Task | Duration | Signature of supervisor |
|---|---|---|---|
| 1. | Validate the rationale of graduation work theme | 16.05-21.05 | |
| 2. | Carry out a literature review | 22.05-26.05 | |
| 3. | Develop the first chapter of diploma | 27.05-01.06 | |
| 4. | Develop the second chapter of diploma | 02.06-05.06 | |
| 5. | Develop the third chapter of diploma | 06.06-08.06 | |
| 6. | Tested for anti-plagiarism and obtaining a review of the diploma | 09.06-16.06 | |

7. Date of assignment: '____'_____ 2022

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

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

# ABSTRACT

The explanatory notes to the graduate work “UIA aircraft maintenance quality management system” contained _ pages, _ drawings, _ tables, _ flow-charts, _ reference books.

**Keywords:** AIRCRAFT, UIA, MAINTENANCE, QUALITY MANAGEMENT SYSTEM, IMPROVEMENT, MORPHOLOGICAL ANALYSIS, FUNCTIONAL COST ANALYSIS.

**Purpose of the work:** research of the essence of the quality management system of maintenance, search for solutions to improve it on the example of UIA aircraft, as well as its ability to adapt to emergencies.

**Object of research:** the process of managing the quality of maintenance system.

**Subject of research:** quality management system.

**Research methods:** conducting research aimed at studying scientific approaches to understanding the essence of the quality management system of maintenance and its improvement.

**CONTENTS**

# LIST OF ABBREVIATIONS

QMS - Quality Management System

SMS - Safety Management System

ISO - International Organization for Standardization

UIA - Ukraine International Airlines

IOSA - IATA Security Audit Program

DSATU - State Department of Aviation Transport of Ukraine

TOR - Technical operation by resource

TOC - Technical operation by condition

TOT - Technical operation by time

FCA - Functional-cost analysis

# INTRODUCTION

**Theme of the diploma project:** UIA aircraft maintenance quality management system.

**Actuality of theme.** As we can see, UIA has the highest quality standards for the maintenance of its aircraft, as well as its management system. But even such an exemplary company may face some difficulties due to external circumstances, such as the coronavirus or the Russian invasion of Ukraine, so UIA was forced to suspend its work, which led to the fact that the entire fleet of aircraft was transferred to storage for a long time . And we must not forget that progress itself does not stand still, and therefore, like all other systems, the quality management system must always be improved.

**Purpose of the work:** research of the essence of the quality management system of maintenance, search for solutions to improve it on the example of UIA aircraft, as well as its ability to adapt to emergencies.

**Object of research:** the process of managing the quality of maintenance system.

**Subject of research:** quality management system.

**Research methods:** conducting research aimed at studying scientific approaches to understanding the essence of the quality management system of maintenance and its improvement.

# CHAPTER 1
# QUALITY MANAGEMENT SYSTEM AS A TOOL OF IMPROVEMENT

## 1.1. Quality management system

A Quality Management System (QMS) is a means of ensuring that an organization is meeting requirements and continuously improving its processes. In aviation, QMS is focused on safety. QMS established a quality policy, objectives, QMS process documents and measures that focus on safety.

The aviation QMS is the foundation for the aviation SMS (Safety Management System). The QMS has already established many of the processes that the SMS requires, such as management review, analysis of data, corrective action, and internal audit. Some improvements to QMS processes are needed to fully meet SMS requirements. Examples include establishing processes to better identify new hazards and establishing processes to measure the effectiveness of safety risk controls. These improvements will be developed during the SMS implementation effort over the next several years.

Safety management and quality management are highly complementary and work closely together to achieve the overall safety goals of aviation.

## 1.2. Certification and ISO standards

ISO is an abbreviation derived from the English name of the International Organization for Standardization.

The International Organization for Standardization develops standards that ensure that products and services are safe, reliable and high quality, and production processes are built on the use of the most efficient resources with minimal impact on the environment. ISO standards are designed for a variety of areas, including quality management, environmental safety, energy management, and more.

Most ISO standards are used in many countries around the world, including Ukraine. The Ukrainian national version of the standards is called ДСТУ ISO.

All ISO standards have their own labeling, which indicates the scope of its application. The figures to the colon in the name of the standard indicate what a certain standard refers to (quality, ecology, etc.), and the numbers after it - for the year in which the standard was approved.

ISO 9001: 2015. One of the most popular standards developed by the International Organization for Standardization. It is accepted in more than 170 countries.

ISO 9001 is a quality management system, the certification of which ensures that the company can produce products at a stable level of quality and constantly improve it. In Ukraine, the analogue of this standard is DSTU ISO 9001: 2015. Working on the principles of ISO 9001 means that the company controls the quality of production and minimizes the risk of obtaining products of inadequate quality and turns the work of improving quality into the foundation of the production process.

The application of ISO 9001 approaches in the enterprise management system helps to solve many internal and external issues:

• improve its overall effectiveness and provide a solid basis for sustainable development initiatives;

• improve the quality of products and services, thereby increasing the satisfaction of its customers;

• become competitive in domestic and foreign markets;

• sell products at world prices;

• establish cooperation with foreign partners (in particular, to obtain investments);

• gain an advantage over competitors when participating in tenders;

• ensure transparency and ease of management of the organization;

• introduce a mechanism for continuous improvement of the management system and increase the efficiency of employees at all levels.

The internal results of the organization from the implementation of the quality management system directly depend on the efforts it makes to improve its activities. External benefits the organization receives by certifying its quality management system in an independent competent certification body.

The basis of standards for quality management systems is formed by seven principles:

• customer orientation;

• leadership;

• staff involvement;

• process approach;

• improvement;

• making decisions based on factual data;

• relationship management.

One of the key principles of building a quality management system in accordance with the requirements of ISO 9001 is a process approach: the organization consists of a number of interdependent processes that function as a holistic system. The output of one process is the input for the next. Therefore, the process approach consists in the systematic activity of defining processes, their sequence and interaction, management of processes and relationships between them.

In accordance with the requirements of ISO 9001 to create a quality management system, the organization must:

• identify the processes required for the quality management system and their application within the organization;

• determine the necessary inputs of these processes and the expected outputs from them;

• determine the sequence and interaction of these processes;

• identify and apply the criteria and methods (including monitoring, measurement and relevant performance indicators) needed to ensure the effectiveness of the functioning and control of these processes;

• identify the resources needed for these processes and ensure their availability;

• appoint persons with responsibility and authority for these processes;

• consider risks and opportunities;

• evaluate these processes and implement any changes necessary to ensure that these processes achieve their intended results;

• improve quality management processes and system.

The requirements of the ISO 9001 standard are general in nature and do not provide for the uniformity of the structure of quality management systems or the uniformity of documentation, because they apply to the activities of any organization, regardless of the type of service provided.

The text of ISO 9001 does not contain requirements for other management systems (environmental management, safety and health, financial management), but allows the organization to integrate its quality management system with the relevant requirements of the overall management system.

### 1.3. IATA Security Audit Program (IOSA) at UIA

Ukraine International Airlines is the flagship airline and the largest air carrier in Ukraine. According to Boeing statistics, UIA is the only airline in Ukraine that provides full maintenance of its own fleet.

Ukraine International Airlines is an IOSA-registered carrier that has successfully passed the IATA Security Audit (IOSA).

UIA has become the 51st registered IOSA carrier with more than 250 IATA members, joining companies such as KLM, Lufthansa, Austrian Airlines, TAP and SAS in the IOSA registry.

UIA has a license to provide services for the carriage of passengers and cargo by air. (Fig. 1.1)

Серія АГ

ЛІЦЕНЗІЯ

№ 505921

ДЕРЖАВНА АВІАЦІЙНА СЛУЖБА УКРАЇНИ

Вид господарської діяльності: **Надання послуг з перевезення пасажирів, вантажу повітряним транспортом**

Найменування юридичної особи: **Приватне акціонерне товариство «Авіакомпанія «Міжнародні авіалінії України»**

Ідентифікаційний код юридичної особи: **14348681**

Місцезнаходження юридичної особи: **01034, м. Київ, вул. Лисенка, 4**

Рішення про видачу ліцензії: **від 20.06.2012 № 1.13 - 06489**

Додаток № 1 на 5 арк.
Додаток № 2 на 3 арк.
Додаток № 3 на 6 арк.

Строк дії ліцензії: **з 27.06.2012р.**

Дата видачі ліцензії: **27.06.2012**

Відповідно до статті 17 Закону України «Про ліцензування певних видів господарської діяльності», ліцензіат повинен протягом 10 робочих днів подати до Державіаслужби України в письмовій формі повідомлення про всі зміни даних в документах, що додавалися до заяви про видачу/переоформлення ліцензії разом з документами, що підтверджують такі зміни.

**Голова Державіаслужби України** **А.А. Колісник**

Fig.1.1. License for the provision of services for the carriage of passengers, cargo by air

The IATA Security Audit Program (IOSA) is a world-renowned and recognized airline's operational management and control assessment system. IOSA is guided by globally recognized principles of quality auditing and is designed to conduct audits in a standardized and consistent manner.

The audit program consists of eight items:

• Corporate organization and management

• Operational activity

• Operational Control / Air Traffic Management

• Aircraft technical support and maintenance

• Crew work

• Ground handling of aircraft

• Cargo transportation

• Operational security

The IOSA certificate (Fig. 1.2) is recognized by the US Federal Aviation Administration (FAA) as the audit requirements for the US code-sharing program for foreign companies.

UIA has successfully passed a number of code-sharing audits in the process of concluding code-sharing agreements with leading European airlines such as KLM, TAP, Austrian Airlines, Swiss International Air Lines, Finnair and Iberia.

**СЕРТИФІКАТ ЕКСПЛУАТАНТА**
***AIR OPERATOR CERTIFICATE***

| **Типи експлуатації** *Types of operation* | Комерційна експлуатація повітряного транспорту (CAT) *Commercial air transport* | ☒ Пасажири *Passengers* | ☒ Вантаж *Cargo* |
|---|---|---|---|

☐ Інше *Other*

**УКРАЇНА**
***UKRAINE***
ДЕРЖАВНА АВІАЦІЙНА СЛУЖБА УКРАЇНИ
*STATE AVIATION ADMINISTRATION OF UKRAINE*

CE №: **UA 021**
*AOC №: UA 021*

**Приватне акціонерне товариство "Авіакомпанія "Міжнародні авіалінії України"**
***Private Stock Company "UKRAINE INTERNATIONAL AIRLINES"***

Комерційне найменування: МАУ
*DBA: UIA*

Адреса експлуатанта: вул. Лисенка, 4, м. Київ, Україна, 01030
*Operator address: 4, Lysenko str., Kyiv, 01030, Ukraine*

Телефон: +38 (044) 581-56-56
*Telephone:*

Факс: +38 (044) 230-88-66
*Fax:*

E-mail: uia@flyuia.com

**Операційні точки зв'язку**
***Operational points of contact***

Контактна інформація, що дає змогу негайно зв'язатися з оперативним керівництвом, наведена в Керівництві з експлуатації частина А, розділ 11.
*Contact details, at which operational management can be contacted without undue delay, are listed in Operations Manual Part A, chapter 11.*

Цей сертифікат засвідчує, що Приватному акціонерному товариству "Авіакомпанія "Міжнародні авіалінії України" надано право здійснювати комерційну повітряну експлуатацію, як це визначено в експлуатаційних специфікаціях, що додаються, відповідно до керівництва з експлуатації та Авіаційних правил України «Технічні вимоги та адміністративні процедури щодо льотної експлуатації в цивільній авіації», затверджених наказом Державної авіаційної служби України від 05 липня 2018 року № 682, зареєстрованим в Міністерстві юстиції України 27 вересня 2018 року за № 1109/32561.
*This certificate certifies that Private Stock Company "UKRAINE INTERNATIONAL AIRLINES" is authorized to perform commercial air operations, as defined in the attached operations specifications, in accordance with the Operations Manual and the Aviation Ruls of Ukraine "Technical requirements and administrative procedures related to air operations in civil aviation" approved by the order of the State Aviation Administration of Ukraine dated 05th of July 2018 No 682, registered in the Ministry of Justice of Ukraine dated 27th of September 2018, No 1109/32561.*

Дата видачі: **08.10.2021**
*Date of issue: 08.10.2021*

Прізвище та підпис:
*Name and signature:*
**Олександр БІЛЬЧУК**
*Oleksandr BILCHUK*
Посада: **Голова**
*Title: Chairman*

АО № 000676

Fig.1.2. IOSA certificate

UIA has a fleet of 25 airliners of various modifications (Fig. 1.3): 1 wide-body long-haul aircraft Boeing 777-200ER, 1 long-haul wide-body aircraft Boeing 767-300ER, 16 medium-haul Boeing-737 New generation, 5 medium-haul Embraer 195.


Fig.1.3 .UIA Fleet

# CHAPTER 2
# MAINTENANCE

## 2.1. System of technical operation of aircraft

The system of technical operation of aircraft (Fig. 2.1) is designed to maintain and restore the airworthiness and serviceability of aircraft and prepare them for flight. The State Department of Aviation Transport of Ukraine (DSATU), operators, maintenance and repair companies, aviation engineering and aviation service organize, provide and carry out technical operation of aircraft.

Maintenance and repair organizations and enterprises can be both independent enterprises and structural subdivisions of the operator. The objects of operation in the system of technical operation are aircraft that are registered in the State Register of Ukraine and for which a Certificate of Airworthiness has been issued in accordance with the Aviation Rules of Ukraine. The operator in whose name the Aircraft Certificate of Airworthiness is issued is responsible for maintaining the airworthiness of the aircraft.

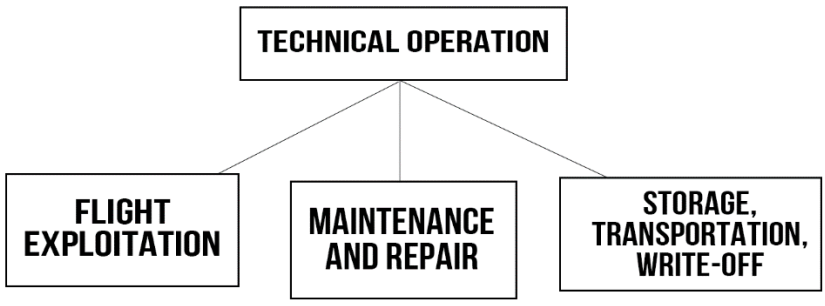


Fig.2.1. Structure of technical operation.

The main requirement for the process of technical operation in general is that with limited labor costs to ensure the highest probability that at the right time the aircraft will be operational and perform the task.

Maintenance and repair system (Fig. 2.2) is a set of interconnected parts - components: maintenance facility, production and technical base, maintenance tools, engineering staff, programs and operational and technical documentation for maintenance.

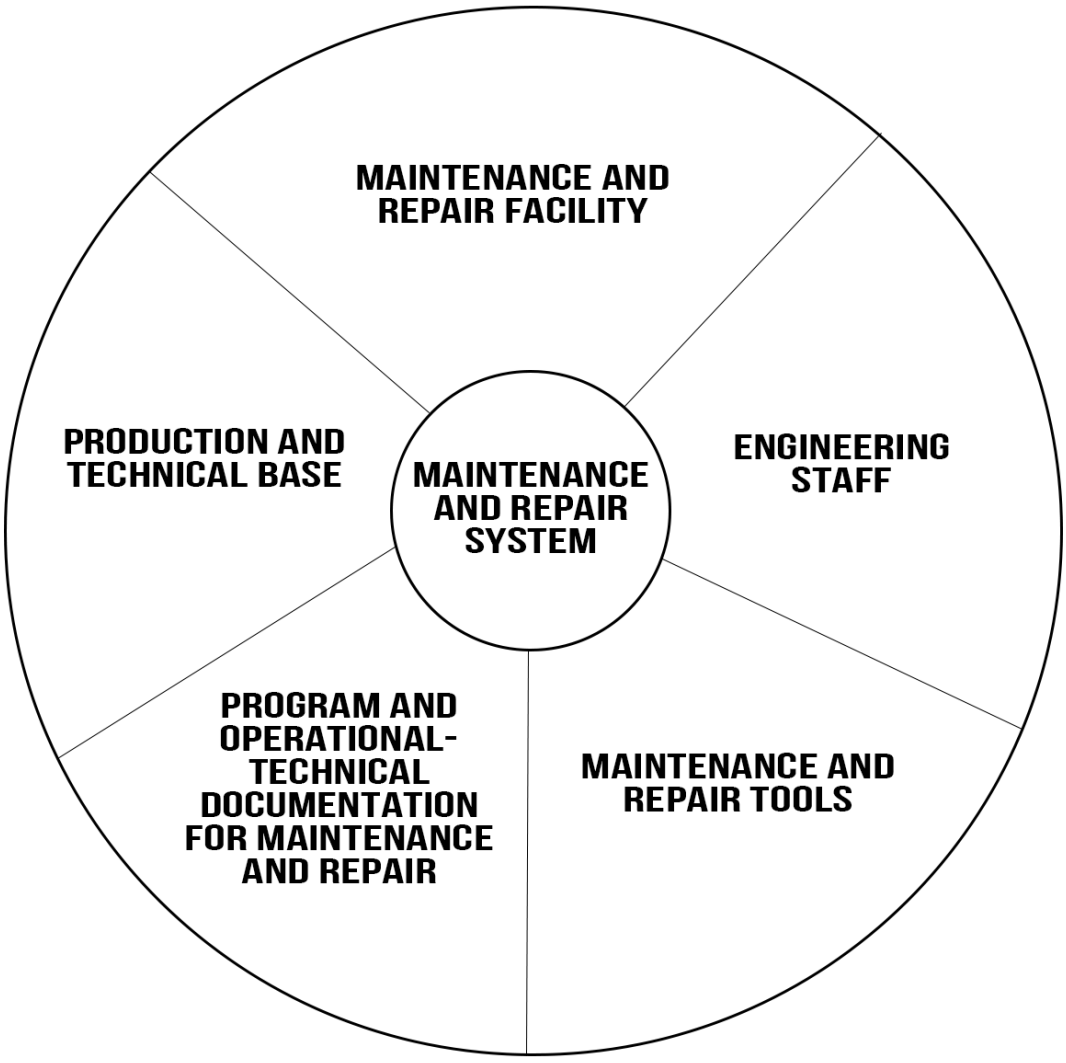


Fig.2.2. Structure of the maintenance and repair system

## 2.2. Operator maintenance and repair program

### *2.2.1. General requirements for the Program*

The maintenance and repair program is a comprehensive document that establishes the procedure for the implementation of works and activities for maintenance and repair, maintenance and restoration of airworthiness of the fleet and is the standard of the enterprise. The program regulates the organization, methods of operation, strategies and methods of maintenance and repair, responsibilities and relationships of the operator's units, maintenance and repair companies and other organizations that provide operators with maintenance and repair of fleet under contracts.

The operator's maintenance and repair program includes:

- description of the organizational structure of the aviation engineering service of the operator and its functions;

- operating conditions of the operator's fleet;

- characteristics of the fleet of aircraft as an object of technical operation;

- plan of maintenance and repair of aircraft, which regulates: the rules of appointment and implementation of types and forms of maintenance and repair; strategies and methods; composition and frequency of maintenance and repair work, as well as resource capabilities and limitations of aircraft, aircraft engines and components;

- list of minimum allowable equipment with which departure is allowed;

- description of the structure of information support for maintenance and repair of aircraft, which includes regulatory and technical documentation, dissemination of changes and additions to it, accounting for the development of resources of aircraft, aircraft engines and components, accounting for repairs and airworthiness directives;

- description of the system of contractual relations for maintenance and repair, as well as logistics;

- description of the system of collection, processing and analysis of data on failures and malfunctions of aircraft, aircraft engines and components, cases of airworthiness violations, operational obstacles;

- the content of the exchange of information with the ДДАТУ and the manufacturer. The aviation engineering service of the operator in accordance with the АПУ, general and standard regulatory and technical documentation develops this program.

### *2.2.2. General requirements for the management of maintenance and repair of enterprises*

Management of maintenance and repair is a standard that regulates the procedure for maintenance and repair work at the enterprise. This normative and technical document contains:

- description of the organizational structure of the enterprise;

- division of duties and responsibilities of aviation personnel who perform and control maintenance and repair;

- procedure for maintenance, inspection and one-time inspections, airworthiness directives, improvements and repairs;

- enterprise standards governing maintenance and repair, quality management and reliability;

- the procedure for issuing an order card for maintenance and repair work, preservation and restoration of airworthiness, as well as certification of the aircraft's suitability for flight in the order card;

- the order of transfer of unfinished works on maintenance and repair;

- the procedure for incoming control of aircraft, aircraft engines and components, as well as measures to ensure the installation of aircraft components that meet the technical requirements of the manufacturer.

## 2.3. Types and forms of maintenance of aircraft

Maintenance works differ in volume, complexity, time required, frequency, location, purpose. In civil aviation, two types of maintenance are used: main and special. The main ones are operational and periodic maintenance, and the special ones are seasonal, individual and storage maintenance. (Fig. 2.3)

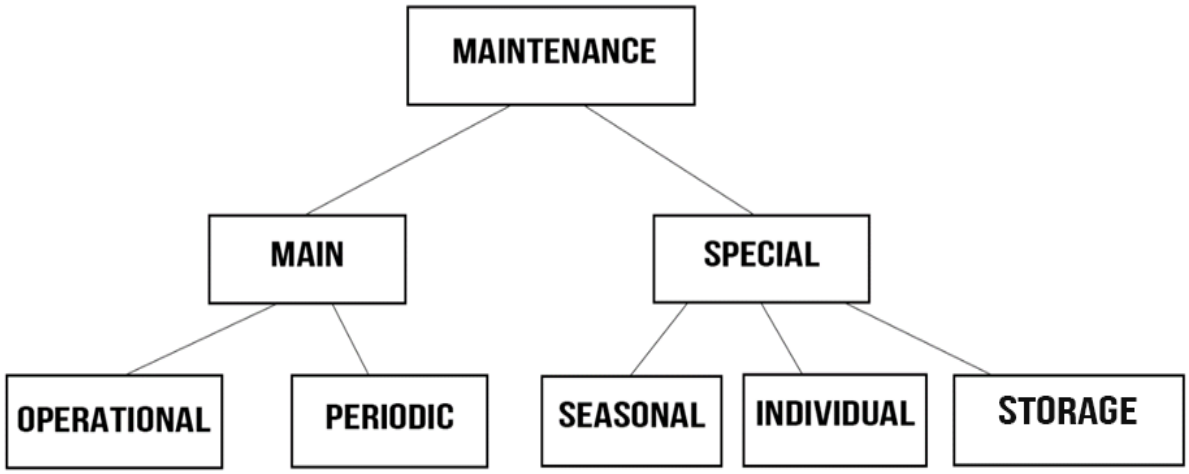


Fig.2.3. Scheme of types of maintenance

### *2.3.1. Operational maintenance*

The main purpose of operational maintenance is to prepare the aircraft for flight, and in case of defects - to find and eliminate them. This type of maintenance is

characterized by relatively low complexity of work performed after before departure, as well as after the arrival of the aircraft.

The main forms of operational maintenance: meeting the aircraft, providing its parking, inspection and maintenance, ensuring departure.

The meeting is performed immediately after the landing of the aircraft, they include: receiving from the crew information about the status of the aircraft and its onboard systems, their behavior in flight with verification of the logbook, external inspection of the aircraft, connection to the ground network nutrition.

Aircraft parking is performed during the parking of the transfer of the aircraft from the crew to the Aviation Engineering Service, if the duration of the parking until the next departure exceeds five hours. In addition to the work performed from the meeting of the aircraft, accept it from the crew, set all switches, control levers and rheostats in the "off" position, turn off the ground source of electricity, at low temperatures (- 25 C and below) removed from the board and transfer rechargeable batteries to a warm room, cover the air pressure receivers and install plugs on them, install protective plugs on air intakes and more.

Inspection and maintenance work takes several forms.

For certain types of aircraft maintenance regulations provide for the implementation of forms: A1 (or A - transit), A2 (or A - basic), B (basic).

Work on Form A1 is performed at each transit and destination airport immediately after landing and meeting work; after a test flight; before departure after periodic maintenance; during regular refueling of the aircraft during training flights; before departure, if the aircraft has not flown after any form of maintenance for more than 12 ... 24 hours (depending on the type of aircraft).

The purpose of the A2 form is the same as the A1 form, but to a lesser extent, which is determined by the maintenance regulations.

There is such a relationship between the complexity (in people * h) of forms A2 and A1

$$T(A2) = T(A1) + \Delta T(A2) \quad (2.1.)$$

where: T (A2); T (A1) - labor intensity (volumes) of work on forms A2 and A1, respectively; ΔT (A2) - additional complexity of work on the A2 form.

After performing the work on the A2 form, the aircraft is ready for flight within 12 hours. Form B inspection and maintenance work is performed at the base airport in 5-15 flight days (depending on the type of aircraft), and the number of days may be increased if the aircraft has not flown every day. For example, on the Tu-154 aircraft, Form B work is performed every 10 +/- 2 days, this period may be extended, but should not exceed 15 days. Form B work is also performed in cases where the duration between the previous flight and the next flight is from 16 to 30 days. Form B includes all work performed on Form A2, as well as additional work provided by the maintenance regulations:

$$T(B) = T(A2) + \Delta T(B) \quad (2.2.)$$

where: T (B) and T (A2) - the complexity of work on forms B and A2, respectively; ΔT (B) - additional complexity of work on the form B.

Departure maintenance work is performed immediately before the departure of the aircraft (regardless of which forms of inspection and maintenance A1, A2 or B were performed), as well as again - after the delay of departure for more than 1 hour. These works include: connection of aerodrome power sources to the on-board power supply of the aircraft, uncovering (if necessary), removal of snow and ice from the surface of the aircraft, installation of batteries, check the alarm position of door locks, hatches and latches, air conditioning in the cockpit and aircraft cabins, disconnection of aerodrome

power supplies, etc. After a downpour, dust storm, snowfall, as well as after removing ice and snow from the surface of the aircraft, check the performance of aneroid-membrane devices from full and static pressure receivers.

After boarding the passengers and loading the aircraft, the aircraft is handed over to the crew for a receipt in the aircraft logbook and picture book for operational maintenance. Then disconnect the ground cable, remove the pads from under the wheels, tow the plane to the starting point of the aircraft engines, inspect it along the established route to make sure that the doors and hatches are securely closed, all caps and covers are removed. The ground power supply is connected, the intercom is connected to the cockpit to control the launch of aircraft engines on the ground, and after their start, the ground power supply and intercom are disconnected.

In the new regulations of maintenance of some aircraft operational maintenance provides for the performance of work in the following forms: A - work on the meeting; B, C, D - inspection and maintenance work; E, F - work to ensure departure; G - work to ensure parking (on some aircraft, form E - to ensure departure, form F - to provide parking, form G - no). Form A work is performed immediately after each landing. Inspection and maintenance works are performed in the following forms:

B - before the flight, if you do not need to perform a more complex form of maintenance; before departure after periodic maintenance; in the process of training flights during refueling of the aircraft;

C - once a day after the flight when performing 1 ... 5 maintenance on Form B (mainly at the base airport and depending on the conditions and specifics of the aircraft operation); after special maintenance; when preparing the aircraft for flight in case of downtime for 1 ... 15 days; at the end of each flight day during training flights;

D - at the base airport during training flights after 50 +/- 10 landings; once during the period M (in days) of regular operation of the aircraft (when performing at least one flight per day), if the time of the flight does not require the next periodic maintenance.

Period

$$M = N + K \quad (2.3.)$$

where N - set for this type of aircraft frequency of form D (in days); K - tolerance to change the frequency of execution of the form.

The time M to perform form D may be increased by the number of non-flight days, but shall not exceed 1.5 N days.

Departure work is performed in the following forms:

E - immediately before departure, if the duration of the aircraft does not exceed 2 hours (regardless of the form of inspection and maintenance);

F - immediately before departure, if the duration of parking the aircraft exceeds 2 hours.

Work to ensure departure in the form of G is performed when transferring the aircraft to the aviation base, if the duration of its parking exceeds 2 hours, as well as when moving the aircraft to another parking lot. In those maintenance regulations in which there is no form G, form F is performed when transferring the aircraft to the aviation base for maintenance or storage, if the duration of parking exceeds 2 hours.

Thus, the preparation of the aircraft for flight is provided by performing a set of operational forms of maintenance.

The parallel inclusion of forms B, C, D and E, F means that in each case only one of the parallel forms is performed. For example, for a particular case, operational maintenance can be formed from forms A-B-D. The volume of work performed on Form B exceeds the volume of work on Form B and includes works performed on Form B:

$$T(C) = T(B) + \Delta T(C) \quad (2.4.)$$

where: T (C) and T (B) - labor intensity (volumes) of work on forms C and B, respectively; ΔT (C) - additional complexity of work on the form C.

### *2.3.2. Periodic maintenance*

The main purpose of periodic maintenance is to conduct in-depth inspection of technical condition, detection and troubleshooting of systems, units, components and parts of the aircraft, preventive measures to prevent the possibility of malfunctions and failures.

Periodic maintenance is performed at the base airports due to the values of operating time (flight hours, number of landings) or time intervals (calendar service life) established by the operational documentation. Works on periodic maintenance are reduced to the form. Periodicity and the list of works of each form are established by regulations of maintenance, and technology of performance of operations, means of diagnostics (control), the tool, devices and materials, and also volume of works - technological instructions.

Countdown of operating time and calendar service life is conducted from the beginning of operation or from the last repair of the aircraft. Admission to work (service life), which is used in the previous service, is not taken into account in the future.

Periodic maintenance in calendar terms is performed on aircraft whose flight time in hours for the corresponding calendar period is less than necessary to perform periodic maintenance.

On aircraft with an average flight duration less than the norm for them, periodic maintenance is performed according to the number of landings.

Maintenance of the aircraft in calendar terms does not preclude the implementation of the following forms of raid (number of landings). Forms of periodic maintenance, in contrast to the forms of operational maintenance, are much more time-consuming and clear periodicity. The number of forms of periodic maintenance and the frequency of their

implementation depend on the type of aircraft, the conditions and experience of its operation, the level of development of aircraft and its means of maintenance.

Each form of periodic maintenance consists of separate blocks of work: preliminary, survey, standard and final.

Preliminary work is acceptance of the aircraft, preparation of the necessary equipment, tools, materials and equipment for maintenance, study of the task for maintenance, work with regulations and technological instructions.

Inspection works include defecation of the aircraft and its onboard equipment for each system, as well as control inspections of components, units and systems. Dismantling of units and assemblies, control of their condition in laboratories, performance of adjustment works and current repairs, installation of units and blocks on board, check of serviceability of onboard systems and their conformity to norms of technical parameters, etc. make the following block - standard works.

Final works are cleaning of the workplace, closing of hatches, compartments, shields, control of tools and devices, preparation of documentation, transfer of aircraft to the operational maintenance shop to prepare for flight or perform work to ensure its parking.

### *2.3.3. Seasonal maintenance*

The operating conditions of aircraft are largely determined by the seasons. This is especially true of the so-called transition periods: spring-summer and autumn-winter.

The spring-summer period is characterized by the following seasonal features:

- sharp temperature drops at the beginning and end of the season;

- a large amount of rainfall;

- a large number of areas of storm activity;

- the presence of dust storms and storm winds;

- high ambient temperature;

- a sharp increase in flight intensity.

The autumn-winter period of the year is characterized by difficult, unstable and dangerous weather conditions and phenomena: rising humidity, heavy rainfall, icing, low temperatures and their sharp differences, poor weather visibility and more.

All this greatly complicates the work of aircraft and aviation engineering services. People, aircraft and maintenance facilities must be properly prepared for operation in such conditions.

In early spring, when taxiing the plane on wet snow and water on the cart, the chassis riser and the fuselage gets freezing water. Freezing of limit switches leads to their failure. Freezing of the antennas results in poor communication. During this period, failures are possible due to the ingress of moisture, condensate into the electromechanisms with subsequent freezing and, as a consequence - jamming of the gearboxes. Elimination of such defects by heating is prohibited, because after it the failure of the electromechanism may occur in flight.

During this period, failures of the switching equipment may also occur due to the formation of ice on the contacts of relays, switches or switches.

In summer, a large amount of precipitation is possible, so it is necessary to monitor the tightness of the fuselage, timely closing of hatches and windows. Measures should be taken to prevent moisture from entering aeronautical and electronic equipment, consoles and switchgear, as moisture is the main source of failure of on-board equipment systems.

When it gets into the on-board equipment, moisture damages the elements of the products, promotes corrosion and, combining its effects with the action of electric current, destroys the insulation board.

The ingress of moisture on the power lines causes a decrease in insulation resistance, resulting in defects in systems where the wires are designed for low current, for example: autopilot, fuel gauge. The ingress of moisture into the high-frequency cables that

connect the output of the radio transmitters to the antenna leads to a decrease in output power, to the failure of the output stages of the radio equipment.

Penetrating into the conductive elements, moisture leads to short circuits, malfunctions in the control and start systems of aircraft engines, to increase the transient resistance of closed contacts of switching equipment. Penetrating into the pores of dielectrics, water and salts formed by it (when combined with various substances) create electrically conductive electrical circuits, dramatically increase the conductivity of materials.

In addition, moisture causes corrosion of metal parts. At high temperatures and high humidity, mold is formed, which destroys organic materials.

During periods of heavy rainfall, the number of failures of full and static pressure systems also increases. To prevent failures of aneroid membrane devices, it is necessary to monitor the serviceability of the plugs and their timely installation on the pressure receiver.

In the spring-summer period - the rainy season - aircraft very often fail fuel meters due to moisture in the plug sockets of sensors through the hatches, as well as sockets in the planes. The fuel gauge almost always overestimates the readings.

The peculiarities of aircraft operation in spring and summer are the same as for the autumn-winter period, which is characterized by unstable weather conditions, sharp temperature changes and high humidity, which contributes to the formation of condensate.

In the autumn-winter period, heaters are often used during intensive maintenance of the aircraft. Violation of the rules of operation of heaters, especially - overestimation of the air temperature coming from the heaters, disables the products of aviation and electronic equipment, cause melting of vinyl chloride insulation of power lines and high-frequency feeders. During the operation of the heaters it is not allowed to exceed the temperature of the supplied air, more than 60 ... 80 C.

### *2.3.4. Individual maintenance*

Individual maintenance is performed after significant deviations from the conditions of normal operation of aircraft: rough landing, landing on the runway, rolling the aircraft out of the runway, flying in a turbulent atmosphere, the aircraft enters the storm zone, lightning strikes the aircraft, air ships in a dust storm, excess loads, etc.

The purpose of individual maintenance is to monitor the condition of aircraft and eliminate faults that have arisen due to special flight conditions. The list of works for each specific case is determined by the maintenance regulations and the list of additional works appointed by the chief engineer of the aviation technical base.

### *2.3.5. Maintenance of aircraft during storage*

Storage maintenance is performed on aircraft that do not fly for a long time.

This type of maintenance reduces the harmful effects of external factors and promotes proper storage of aircraft in these conditions. At the same time maintenance work on the aircraft is performed every 10 days. With increasing storage time, the harmful effects of atmospheric factors increase, and hence the volume of work increases; they are performed every 10 days, 30 + 3 days, 90 + 9 days of storage; the volume of work on preparation of the aircraft for flight after storage also increases. The list of works is determined by the maintenance regulations.

A large number of different units, devices and systems are constantly stored in the warehouses of aviation technical bases and airlines. They are systematically serviced in accordance with special storage instructions.

### *2.3.6. Other types of maintenance*

The following types of aircraft maintenance are also used (Fig. 2.4):

Basic maintenance - maintenance performed at the airport of permanent base of the aircraft before or after the flight.

Transit MOT - maintenance performed at the intermediate airport, as well as at the final airport before the return flight.

Scheduled maintenance - maintenance, which is performed for the previous purpose, in the previously agreed time.

Unplanned maintenance - maintenance that is performed without prior appointment, at random times.

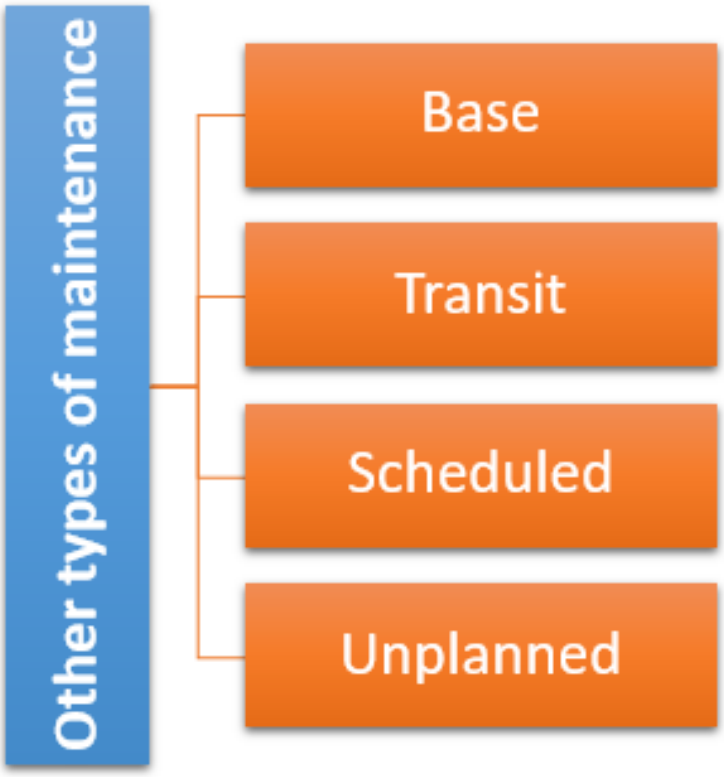


Fig.2.4. Other types of maintenance

## 2.4. Methods of technical operation and strategies for maintenance and repair of aircraft

The method of technical operation is the principle (rule) of determining the limit state of aircraft, after which its use for its intended purpose ceases.

Depending on the type of limit state, there are methods of technical operation of aircraft - by resource (TOR) and condition (TOC).

The TOR method involves the operation of aircraft (its object) before the development of its assigned resource (between two periodic maintenance, overhaul, assigned), after which it is subject to maintenance, restoration by repair or write-off.

Maintenance strategy is a principle (rule) of appointment of terms and volumes of maintenance of an aircraft product.

There are maintenance strategies by operating time (TOT) and by condition (TOC).

In the TOT strategy, the list and frequency of maintenance operations are determined by the product's service life from the beginning of operation or after overhaul.

In the TOC strategy, the list and frequency of maintenance operations are determined by the actual technical condition of the product at the time of maintenance. The results of forecasting and preliminary control of the technical condition of the product are also used.

## 2.5. Maintenance methods

The method of maintenance is a system of rules for managing the technical condition of aircraft products in the process of organizing and conducting maintenance.

In civil aviation, maintenance methods are classified according to a number of criteria.

Depending on the time spent on periodic maintenance, the maintenance method can be one-time or step-by-step.

If the classification is based on the specialization of engineering and technical staff, the method of maintenance can be subsystem and zone.

Depending on the organization of the sequence of maintenance work on a group of aircraft, there are parallel, sequential and flow methods of maintenance.

Depending on the cooperation and specialization of aviation bases in relation to the organization and conduct of maintenance of aircraft use different versions of the cooperative method of maintenance.

Consider these methods of maintenance in a concise form.

The one-time method involves the performance of the entire scope of work of this form of periodic maintenance during one maintenance. Normally, an aircraft is not used for flights until the full amount of maintenance has been performed according to the specified form of periodic maintenance. It is expedient to use this method at small loading of the operational enterprises by performance of air transportations and works, and also at round-the-clock work of shop of periodic maintenance.

A step-by-step method aimed at improving the use of aircraft and their on-board equipment, as well as creating a uniform loading of the periodic maintenance shop with large volumes of flight work of operating enterprises. In this method, the set of operations of each form of periodic maintenance is divided into approximately equal parts, which are performed in separate stages while maintaining the established periodicity of work (operations).

The subsystem method involves the performance of maintenance work on certain assigned to the crew (performers) functional systems of aircraft. Such systems include electrical equipment, instrumentation, oxygen equipment, on-board automatic control

systems, etc. Each of the crews receives operational information for the maintenance of the relevant on-board systems.

The parallel method involves the maintenance of all aircraft simultaneously. This method requires a large staff (for each aircraft - a complete set). Specialists are insufficiently and unevenly loaded, so this method is practically not used in civil aviation.

The sequential method involves the transfer of a group of specialists sequentially from one aircraft to another, if the work on the previous aircraft is completed.

In the flow method, specialists, having started work, perform it continuously, moving from one aircraft to another. The flow method is used in the operational and periodic maintenance of a large number of aircraft, as well as in the performance of repairs at civil aviation plants.

To increase the efficiency of the use of production assets of civil aviation enterprises use different options for cooperative methods of maintenance of aircraft.

In the flow method, specialists, having started work, perform it continuously, moving from one aircraft to another. The flow method is used in the operational and periodic maintenance of a large number of aircraft, as well as in the performance of repairs at civil aviation plants.

To increase the efficiency of the use of production assets of civil aviation enterprises use different options for cooperative methods of maintenance of aircraft.

## 2.6. Aircraft maintenance management methods.

During the operation of the aircraft, its components and units are constantly exposed to operational factors, changing its technical condition.

The internal mechanism of failure is a temporary process of changing the structure and properties of the product caused by loads, temperature and other factors.

The variety and stochastic nature of the impact of operational factors on the objects of aircraft lead to the fact that with the same operating time or duration of operation, the objects have different actual conditions. In this regard, the operating time or calendar service life does not unambiguously characterize the technical condition of the object during operation.

It is known from the theory of reliability that a faulty condition characterized by non-compliance of any parameter with the requirements of regulatory and technical documentation, in which its further operation is unacceptable or impractical, is called the limit.

According to the criteria of the limit state, which establish the limits of use for its intended purpose, the following methods of operation are identified:

• to resource depletion,

• to failure,

• to the limit state.

To identify the limit states of products in the maintenance system for each method of operation are scheduled maintenance work (Table 2.1):

• method of operation for resource production - work to control the operation,

• method of full operation (feasibility study) - work to control the efficiency with the determination of the level of reliability,

• method to pre-failure state - work to control the value of the determining parameter of the state.

The set of rules for the maintenance and restoration of product reliability is defined as a strategy to restore the technical condition of the product.

| Maintenance strategy | Operation strategy |
|---|---|
| By operating time | to resource depletion (service life) |
| As with the level of reliability control | To failure |
| As with parameter control | To the limit state |

Table 2.1. Maintenance and operation strategies.

## 2.7. Rules of maintenance

General rules

At aircraft maintenance it is necessary:

- use only the operating modes established by the operating documentation when checking the functioning of systems and equipment;

- timely, high quality and in full to perform work during maintenance during storage;

- comply with operational restrictions set by regulatory and technical documents for aircraft, engines and components;

- use during maintenance only serviceable means of control and ground maintenance, devices and marked tools provided by the operating documentation, which have passed metrological inspections;

- use fuels and lubricants, special liquids, gases, consumables provided for this type of aircraft;

- adhere to the rules of control, which would prevent unauthorized opening, unscrewing and falling out of individual parts of aircraft;

- protect aircraft from mechanical damage during start-up and testing of engines, disassembly and assembly work, towing and loading (unloading), from collisions with obstacles, from the driving effects of the environment in extreme weather conditions;

- keep in good condition and ready for use as intended sets of emergency rescue equipment;

- to prevent changes in the position of the aircraft in the parking lot and the power outage from the moment the inertial system is turned on until it is put into operation.

At the end of the work on the aircraft, the contractors must carefully check whether there are any parts, tools and other items left on the job site (in compartments, hatches, air intakes, cabins).

Aviation personnel must control the use of ground handling equipment of general use, prevent the maintenance of special vehicles that are not equipped with grounding and fire extinguishing equipment, take prompt measures to eliminate possible emergencies related to abnormal operation of ground handling equipment.

When parking the aircraft for more than two hours, as well as in rain, snow, blizzard, dust storm, regardless of the duration of parking, air intakes, full and static pressure receivers and other aircraft systems install protective devices provided by the operating documentation. In order to prevent the departure of an aircraft with unprotected safety devices, they must be painted red and have red soft pennants. On aircraft where the installation of protective devices is painted red (orange), safety devices are made black. Protective devices, which are removed from the aircraft during the flight and maintenance, are stored in places that would prevent their damage and exposure to adverse weather conditions.

Products from one aircraft to another may be moved only when necessary, and the procedure established by the operating documentation must be followed.

Installation of new types of components on the aircraft, performance of modifications, as well as changes in the design of aircraft are carried out in accordance with the bulletins of the aircraft developer (manufacturer), which are put into effect ДДАТУ and agreed with the owner (operator) of the aircraft.

Installation of additional (non-standard) equipment on the aircraft is performed according to the documentation agreed with the aircraft developer and ДДАТУ. The procedure for operation of additional equipment installed on the aircraft is determined by the operating documentation for this equipment and is carried out by specialists of the customer organization.

Maintenance of glider elements, power plant and aviation equipment, which are part of one functional system of the aircraft, is entrusted to the relevant specialists of the aviation engineering service. The order of maintenance of such systems (components) by specialists, their duties and responsibilities for the technical condition of the system and its elements are determined by the operating documentation.

When performing dismantling and installation work it is necessary to ensure:

- exclusion of the possibility of water, dust, dirt, small parts and other objects in open cavities and sockets, products and pipelines of glider systems, engines, aviation and electronic equipment;

- storage of small parts that are dismantled in specially designed boxes (bags);

- reliable fastening, flanging, metallization, tightness of connections;

- checking the efficiency and correct operation of the installed products, as well as the systems from which they are mounted;

- installation of disposable parts on aircraft (gaskets, cotter pins, etc.);

- maintaining the established color of painting and marking of parts, pipelines, hoses, cylinders of glider systems and aircraft engines in accordance with the requirements of state and industry standards;

- quality control of work performed by officials specified in the operating documentation.

# CHAPTER 3

# METHODS OF IMPROVING THE MAINTENANCE QUALITY MANAGEMENT SYSTEM

This topic provides the following methods (Table 3.1.)

Table 3.1

Table of methods

| **The basis of management improvement methods** | **Survey methods (data collection)** | **Methods of analysis** | **Methods of improvement** |
|---|---|---|---|
| Analysis and synthesis,<br>Induction and deduction,<br>The relationship of part and whole,<br>Establishing causal relationships,<br>Consideration of phenomena in motion | Self-examination,<br>Interviews,<br>Active monitoring of the working day,<br>Questionnaire,<br>Study of documents | Decomposition,<br>Sequential substitution,<br>Comparisons,<br>Dynamic,<br>Structuring<br>Normative,<br>Parametric,<br>Experiential, | System,<br>Analytical and calculation,<br>Analogies<br>Expert-analytical,<br>Block,<br>Morphological,<br>Functional cost analysis |

### 3.1. Basis of management improvement methods

1) A combination of analysis and synthesis. In the analysis, each element of maintenance is divided into parts that are partially studied. To see the stable connections between the elements (or their parts) and the causes of various phenomena, it is necessary to combine them into a single whole - to synthesize.

With the help of abstraction can be called an isolated manifestation of one factor. The study of the influence of individual factors and the definition of the component of their combined impact allow us to proceed to the analysis of specific situations.

2) Deduction - the process of deriving a conclusion that is guaranteed to follow, if the initial assumptions are true, then the conclusion based on them is valid. The conclusion should be based solely on the previously presented evidence and should not contain new information about the subject under investigation.

3) Induction is a process of judgment, which concludes that in the current state of knowledge is certainly true, but does not guarantee it. The inductive conclusion can be refuted or generalized in the presence of additional facts.

4) The relationship of part and whole. The connection of elements in addition to a simple mechanical sum, also has many new and distinctive properties, characteristics and features.

5) The need to establish causal and investigative phenomena. Determining the cause and effect should be carried out in each case, because closely intertwined with each other, they can change places.

6) The need to consider phenomena in motion, development, change. Systems analysis is a methodological tool for a rational approach to solving problems of management improvement. This approach focuses on the disclosure of the object of study as a whole and its constituent elements.

### 3.2. Methods of analysis

1) The method of decomposition allows you to separate complex phenomena simpler. After division it is necessary to reproduce the object as a whole.

2) The method of sequential substitution allows to study the impact on the analyzed object of each factor that affects it separately.

3) The method of comparison is to compare the studied object with the planned level, the advanced object, the normative indicator.

4) The dynamic method involves the location of data in the time series and the exclusion of random deviations.

5) The method of structuring goals involves setting goals in terms of their compliance with the system, as well as their placement in a hierarchical system.

6) Normative method involves the application of a system of standards that determine the composition and content of functions, number of employees, type of organizational structure of the enterprise, criteria for building the structure of management, division and competence of managers, specialists and technical executors.

7) The parametric method is to establish functional relationships between the parameters of the elements of the production system and control system to determine the degree of their compliance.

8) The experimental method is based on the experience of the previous period in this field and the experience of other similar structures.

### 3.3. Methods of improvement

1) Analytical and calculation method of improving management in that allows you to creatively combine a set of methods from specific conditions of the enterprise.

2) The method of analogies is the use of organizational forms that have proven themselves in functioning systems with similar technical and economic and organizational characteristics in relation to this structure.

3) Expert-analytical method of improving management is based on the involvement to assess the quality of work of highly qualified management specialists, management staff of the same enterprise.

4) The block method accelerates the process of improving management and increases its efficiency, because it combines typical block solutions with original organizational solutions in a single management system.

5) The method of morphological analysis is a means of obtaining various combinations of options for organizational solutions proposed for the implementation of individual management functions.

6) The method of functional-cost analysis allows you to choose the option of performing a management function, which requires the lowest cost of its implementation. It makes it possible to identify redundant or duplicative links of management, functions that for one reason or another are not performed, to determine the degree of centralization and decentralization of management.

The greatest effect and quality of the management system of any object is achieved when a system of methods is used in the complex.

### 3.4. Morphological method

The method of morphological analysis is a means of obtaining various combinations of organizational solutions proposed for the implementation of individual management functions. If you write in a column all the functions, and then in front of each indicate all sorts of options for its implementation, we obtain a morphological matrix. The essence of this method is to break a complex problem into small subtasks that are easier to solve separately. It is assumed that the solution of a complex problem consists of solutions of its subtasks.

When conducting morphological analysis, it is important to determine its purpose. If the purpose of morphological research was formulated as an improvement of the existing quality management system, the structure of this purpose can be represented as follows: (Fig. 3.1)

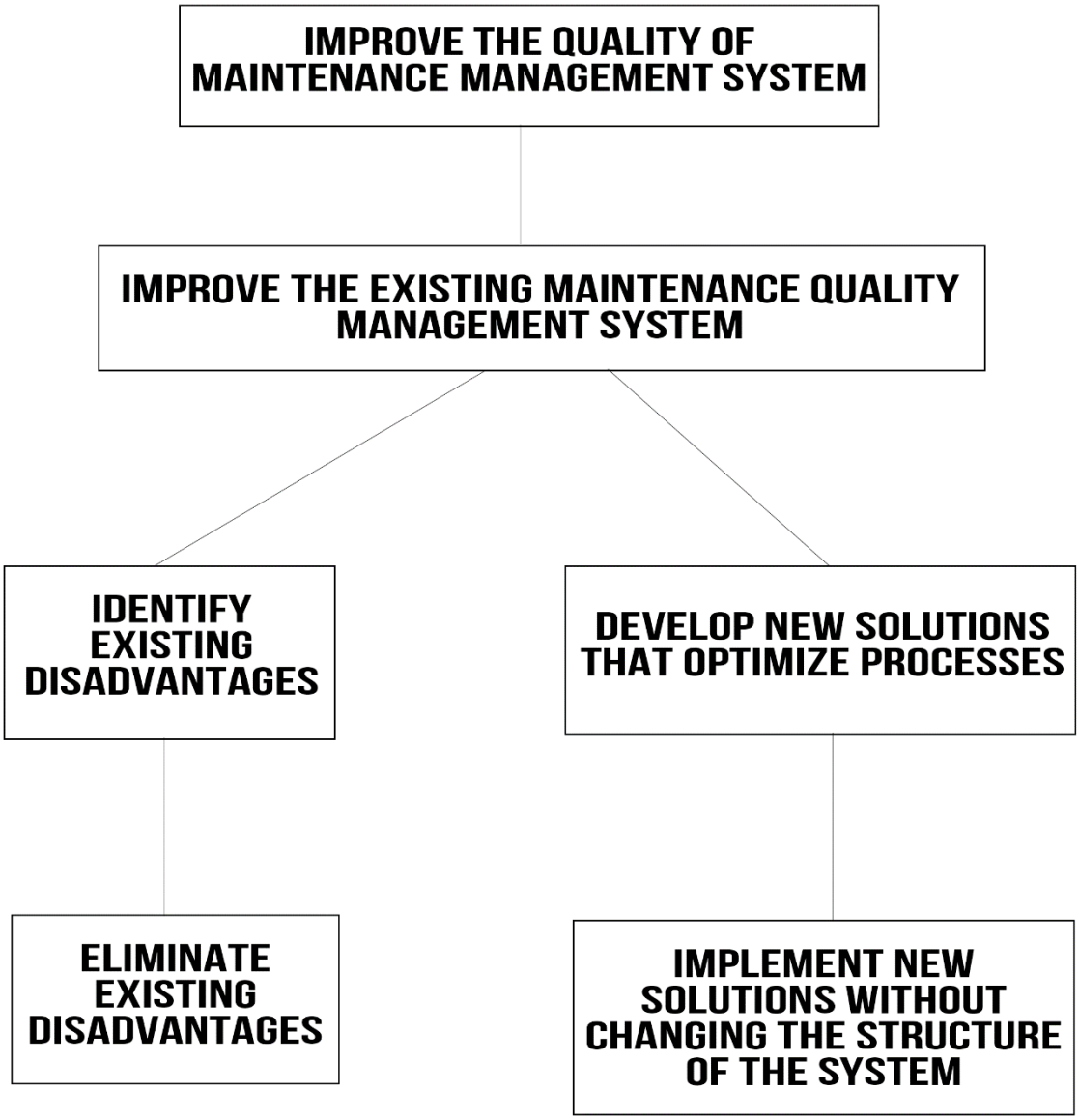


Fig.3.1. Structure of the original purpose

And if the purpose is to develop a new quality management system, the structure of the search of purpose will look like this: (Fig. 3.2)

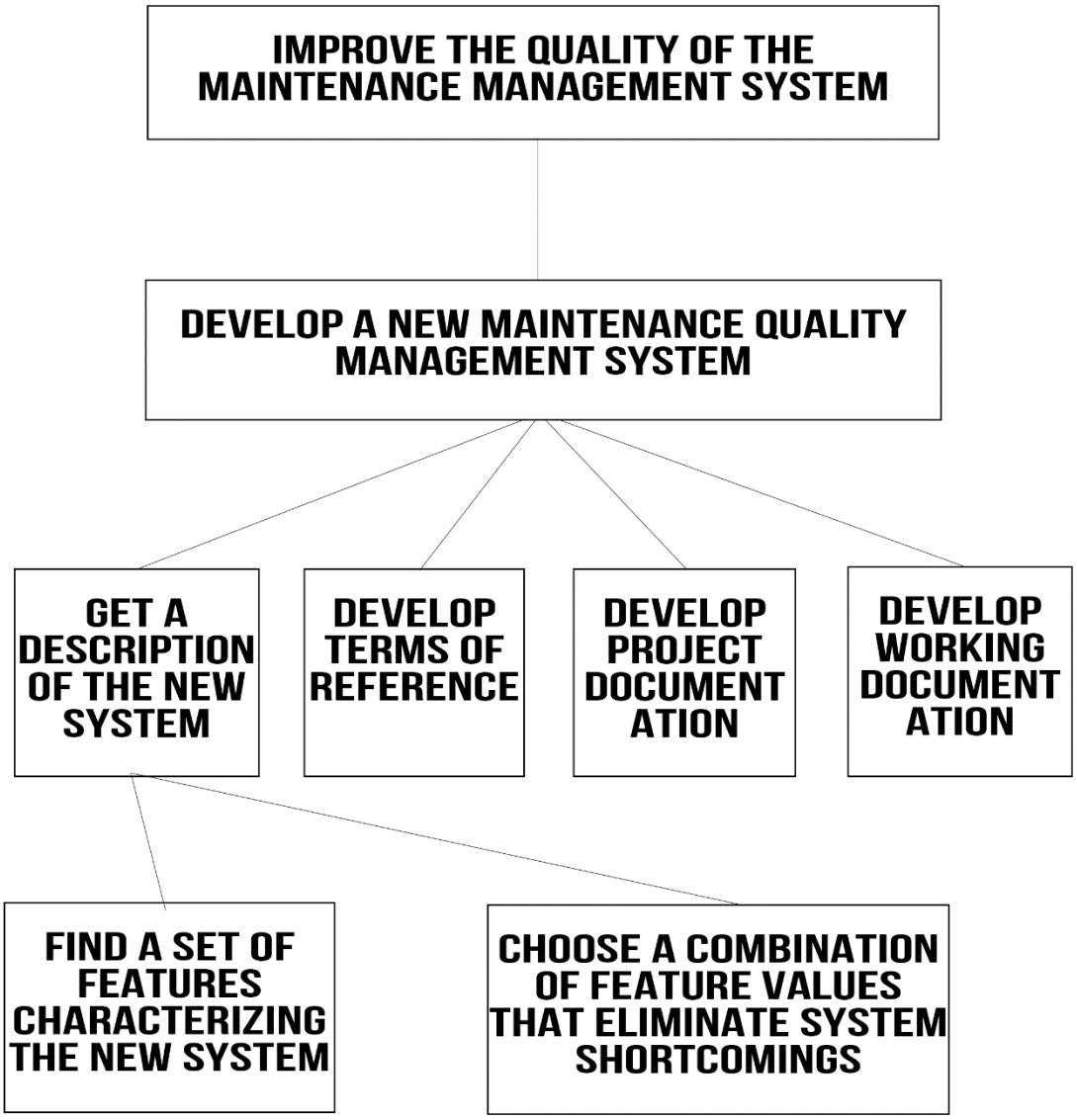


Fig.3.2. Search purpose structure

Morphological analysis can be performed in two ways: deductive and inductive.

The deductive method primarily involves the construction of the archetype and that given the original general concept - the formulation of the main function of the object, by successive multilevel division of the function components of its subfunctions, get a tree of

functions. On the basis of this tree the block diagram of the generalized type of the given object or system is constructed.

It is necessary to begin with definition of the main function. To obtain the formulation of the main function, you need to find the terms that define the type of object.

The formulation of the main function is the basis for building a generalized functional model of the object by decomposing it into subfunctions.

The inductive way of constructing a generalized functional model involves moving from the private to the general. Private in this case will be descriptions of existing technical facilities that solve similar problems. Information about them must be converted into appropriate block diagrams, combining or dividing individual nodes into blocks that perform a single subfunction.

The inductive method of model construction should be used if you have several well-described prototypes with ready-made functional structures. The deductive method in this case can be used to self-test and refine the model. If these data are not available or their acquisition is time consuming, it is better to use as the main method - deductive, and inductive to use for self-testing.

### 3.5. Functional cost analysis

Functional-cost analysis (FCA) is one of the methods of improving management and allows you to improve the management system with minimal maintenance costs.

FCA can be used to address issues of improving the organizational structure of the management staff, improving the quality of justification processes, making and implementing management decisions, information and technical support of the quality management system of maintenance.

FCA quality management system - a method of technical and economic study of functions, aimed at finding ways to reduce management costs in order to improve the efficiency of maintenance.

FCA is based on the following principles of systematic and functional approach, the principle of compliance with the degree of importance of cost functions and the level of quality of their implementation, the principle of collective creativity.

The systems approach requires an analysis of the field of maintenance management as a holistic system consisting of subsystems and elements. This approach involves the study of the relationships within the interacting management and service units, as well as the external relationships with the higher-level management system and related systems.

The functional approach allows to present the management system as a set of functions performed. The research includes management functions that provide justification, adoption and implementation of management decisions to achieve results - obtaining quality maintenance of aircraft, with a minimum level of socially necessary costs for management and processes. When studying functions, specialists completely abstract from a specific management system, its organizational structure and consider only the functions and the best ways to perform them. The main task is not to improve the management system or organizational structure, but to find the best ways to perform management functions. This gives the freedom to find fundamentally new solutions that are not related to the old organizational structure, or to simplify it as much as possible so that the quality of performance is not reduced.

The principle of compliance of the degree of significance of cost functions and the level of quality of implementation is that they determine the importance of each function of the management system against other functions, the actual costs of their implementation and quality of execution. Then there is a comparison of the significance of functions with the cost of their implementation and the level of quality of their implementation. This technique allows you to give an economic assessment of the existing and proposed management system.

The principle of collective creativity to find and develop the most effective options for improving management is that the FVA uses a different combination of intuitive, deductive, inductive and other ways of thinking. At the same time, a wide range of specialists of different profiles and different levels of management are involved in solving problems.

Functional cost analysis is carried out by:

- development of management systems for aging enterprises;

- development of management bodies of existing enterprises or structures;

- organization of the management system of production units or structures in their creation and development;

- improving the forms of management of enterprises or structures during their reconstruction or technical re-equipment;

- Improving the management system of enterprises due to the occurrence of any production situations.

The purpose of the FCA maintenance quality management system is:

- reduction of costs for the implementation of management functions to maintain or improve quality;

- increase the efficiency of the management staff to achieve optimization of performance.

The main tasks of functional-cost analysis:

- achieving the best ratio between the efficiency of the quality management service and the cost of its maintenance;

- reducing the cost of services and improving their quality

- Increasing the productivity of the management staff and working production units;

- economic use of material, labor and financial resources;

- elimination of "bottlenecks" and imbalances in management and work processes;

- improving the use of production assets;

- Reduction or elimination of defectives.

The experience of using FCA in improving the management system of a number of enterprises and associations of electrical and electronic industry, mechanical engineering for light and food industries, chemical and petroleum engineering, energy repair, etc., allowed to develop terms and definitions of FCA.

The object of FCA is a management system (industry, association, enterprise, production), its subsystems and its components (elements).

Basic terms and definitions of FCA:

Classification of FVA functions - their grouping on various grounds.

Decomposition of the management function - the division of functions into components of their management procedures, and procedures - on operations.

Management procedure is a part of management functions, which provides the content and sequence of management tasks, characterizes the executor, place of execution, technical means used, time spent on each operation, the necessary information for its implementation.

Operogram - a graphical representation of the procedure.

A management operation is a part of a management procedure performed by a manager, specialist or executor with or without the use of technical means to develop, justify or make management decisions.

Functional connections of management - connections of functional divisions of the enterprise (association) in the course of activity. There are horizontal and vertical connections.

Horizontal connections are made between units that are at the same level of management.

Vertical connections are formed between the links of different levels of management.

External management functions are aimed at implementing the object's ties with related and higher organizations.

Internal management functions arise between the management units of the object as one level and different links.

Functional unit - an integral part of the management staff, determines the function in order to maintain a continuous service process.

The main management function is the function for which the control object is created.

The primary management function is a function that is necessary for the implementation of the main management function.

The auxiliary function contributes to the basic management function.

Useful function reflects the essence of the object, its purpose, determines its efficiency and aims to ensure the efficient functioning of production.

Useless function - an extra link that does not reflect the essence of the object, does not affect its efficiency, leads to increased costs for the maintenance of the management staff.

Harmful management function negatively affects the activities of the object, increases management costs, reduces production efficiency.

An uncharacteristic function does not reflect the essence of the object, its purpose, to be transferred to another object - the carrier of the function.

Duplicate management function - an unnecessary function, in fact and purpose belongs to one of the objects that perform it, leads to an increase in the cost of maintaining the management staff.

Holder of the management function - a separate functional unit, its last parts, an official or a group of specialists involved in the implementation of management tasks.

Scheme of organizational structure of management (structural-elementary model of the object) - a set of specialized functional units, components, interconnected in the process of making, justifying and making management decisions. Displays the subordination of management media. Depicted graphically as diagrams.

Functional model of the object - a description of the object under study in the language of its functions, which reflects their relationship and interaction.

Functional-structural model of the object - a conditional image of the studied object, obtained by combining the scheme of organizational management structure and functional model.

Functionally necessary costs - the minimum cost of implementing tasks or a set of management functions with the required quality of their implementation.

Excess costs are part of the costs associated with the implementation of useful management functions in a way that is not optimal in terms of functionally necessary costs, as well as the cost of implementing useless and harmful management functions.

Costs for the implementation of management functions - the cost of maintaining the function carrier, as well as costs associated with the implementation process.

The quality of the management function depends on the quality of construction of the object and the quality of the process of implementation of the management function. The quality of construction of the object is determined by its reliability and adaptability, and the quality of the process of implementation of the function is characterized by the quality of decisions made by the object, and the result of their implementation - increasing system efficiency.

Analysis of costs for the implementation of management functions - determining the costs for the content of the bearer of the function, the costs for its implementation and comparing them on the level of significance with a special chart.

Diagram of the significance of functions and the cost of their implementation - a combined diagram to assess the relevance of the importance of management functions and the cost of their implementation (Fig. 3.3). In the upper part of the diagram of the management function is the degree of their importance, and in the lower part are the costs of their implementation.

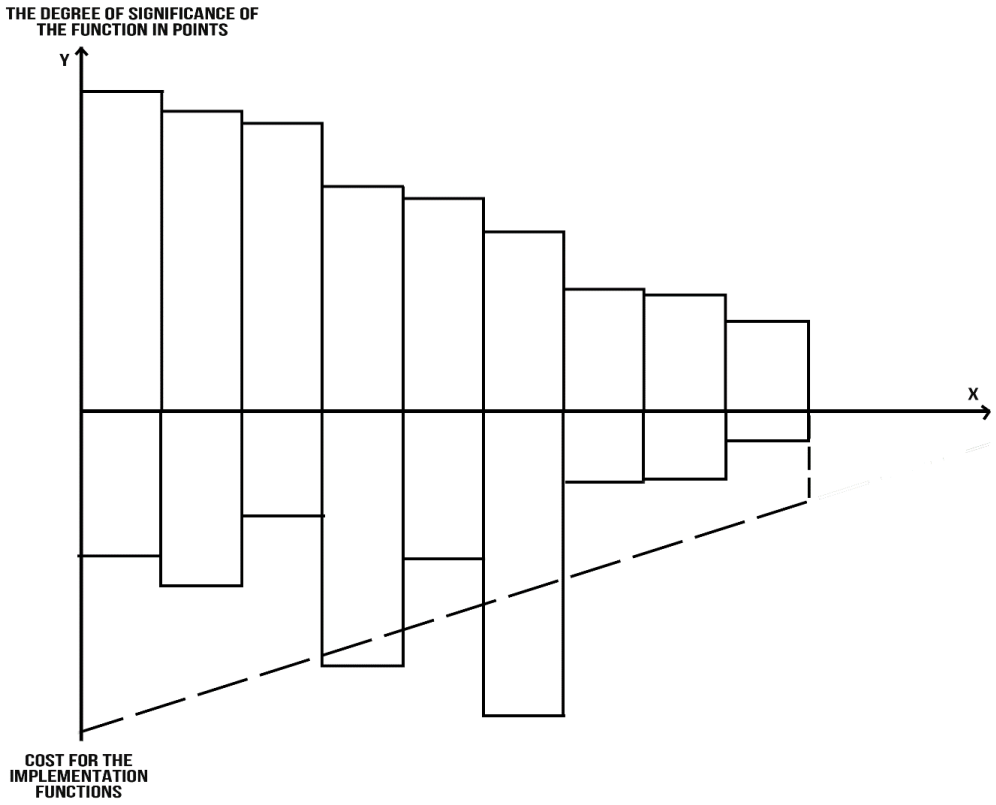


Fig.3.3. Diagram of the significance of functions and the cost of their implementation

Quality analysis of management functions - determining the level of quality of functions and comparing it with the degree of significance of tasks and their costs for implementation using special diagrams.

Diagram of the significance of functions and the level of their quality - a combined diagram to assess the compliance of the significance of management functions and the level of quality of functions. At the top of the diagram, management functions are arranged according to their level of significance, and at the bottom - an assessment of the level of their quality.

Functional-cost diagram - a graphical representation of management functions. The analyzed functions are located between two dotted vertical lines, the main functions are placed on a horizontal line in the center of the chart, and the auxiliary - either above or below the main functions. There are special rules for charting. Such diagrams reveal useless, harmful, uncharacteristic, duplicate functions.

The best option is a solution that allows you to increase the efficiency of service and its management system with minimal costs for the implementation of management functions.

FCA enterprise management system includes the following stages: preparatory, informational, analytical, creative, research, recommendation, implementation.

At the preparatory stage, a research working group is formed, a comprehensive survey of the state of production and management of the enterprise is conducted, the FCA object is selected, specific tasks of analysis are determined, a work plan and an order for FCA are drawn up.

At the information stage, the collection, systematization and study of information characterizing the enterprise management system or its individual subsystems, as well as data on similar systems, best practices for improving management.

The analytical stage is the most time consuming. At this stage, the formulation, analysis and classification of functions, their decomposition, analysis of functional interactions between departments of the management staff, the cost of performing and the level of quality of functions. It also determines the degree of significance of functions and the reasons for their inconsistency with the level of costs and quality of implementation of functions. Unnecessary, harmful, uncharacteristic and duplicate functions are revealed.

Tasks for finding ideas and ways to improve the enterprise management system are formulated.

At the creative stage, ideas and ways of performing management functions are put forward, formulations of options for the implementation of functions are formulated on their basis, preliminary assessment and selection of the most expedient and real ones are performed.

At the research stage, a detailed description of the selected option, their comparative organizational and economic evaluation and selection of the most rational of them for implementation. At this stage, general and detailed designs of the management system with all the necessary justifications are being developed. The project can cover the entire management system of the enterprise, the management of the shop, site or a separate subsystem, unit. The complexity and duration of project development depends on the nature of the object.

At the recommendation stage, the analysis and approval of the project of the enterprise management system developed with the use of FCA is carried out, and a decision is made on the procedure for its implementation. A plan-schedule for the application of FCA recommendations is drawn up and approved.

At the stage of implementation of FCA results, socio-psychological, professional, material and technical preparation for implementation is carried out. Here the system of material stimulation of project implementation is developed and the estimation of actual economic efficiency from its realization is given.

FCA can be used not only to improve the maintenance quality management system, the management system of a number of enterprises, but also to solve the technical problems of specific facilities.

# CONCLUSIONS

In the diploma work, one of the country's leading airlines, UIA, was presented, which, due to the difficult situation in the country, was forced to suspend operation and transfer its entire fleet to storage. The quality management system, ISO standards, technical operation of aircraft, maintenance, its rules, types and methods were also considered.

The third part presented methods for improving the maintenance quality management system. The most effective of them were considered in detail: morphological and functional cost methods.

The method of morphological analysis is based on the selection of different combinations of options in organizational decisions, which are required for the implementation of other management functions.

When conducting a morphological analysis of the maintenance quality management system, its purpose is determined.

If the goal of morphological analysis was set as an improvement of the existing quality management system, then it is necessary to identify and subsequently eliminate the existing shortcomings of the system, as well as develop and implement new solutions that optimize the processes existing in the system.

And if the goal is to develop a new maintenance quality management system, then you need to develop terms of reference, design and working documentation, get a description of the new system and then find a lot of features that characterize the new system, and also choose a combination of feature values that eliminate deficiencies.

Functional cost analysis allows you to evaluate the selected options and apply those that most effectively solve this problem.

Functional-cost analysis (FCA) is one of the methods of improving management and allows you to improve the management system with minimal maintenance costs.

FCA can be used not only to improve the maintenance quality management system, the management system of a number of enterprises, but also to solve the technical problems of specific facilities.

## REFERENCES


1. Ch-376 Fundamentals of aircraft maintenance: textbook. allowance / N.V. Chekryzhev. - Samara: Publishing House of SSAU, 2015. - 84 p.
2. Functional and cost analysis of new opportunities in the conditions of self-financing / Kibanov A. - M. Knowledge, 1990. - 64 p.
3. A. Popov Morphological analysis of technical objects. – Lyubertsy 1987
4. https://www.flyuia.com/ua/ua/about/standarts
5. https://www.aviationfile.com/what-is-iso9001-quality-management-system-qms-in-aviation/
6. https://www.faa.gov/about/initiatives/sms/explained/quality_and_safety_management
7. https://onmedu.edu.ua/shho-take-standart-iso-9001/