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**FORMALIZED DESCRIPTION OF FLIGHT DISPATCHERS'
ACTIVITIES WITH SLOT MESSAGES**

The article is devoted to the analysis of the flight dispatchers' complex activities while working with messages on the organization of air traffic flows. Based on expert information, typical operation situations in the airline have been identified, the probabilities of their occurrence have been determined. The decomposition scheme and algorithms of flight dispatchers' activity while working with the messages concerning slots have been made. The description of flight dispatchers' activity with messages on the organization of air traffic flows using the decomposition procedure and flowcharts of algorithms has been analysed and worked out.

Flight dispatchers process a lot of different information, while performing many professional tasks: obtaining information, encoding and decoding data and disseminating processed information as air traffic flows messages; interaction with the Aeronautical Information Service and others and it can often occur in a time and deficit mode. The training factor while dealing with professional duties is important to reduce and avoid errors, so it is necessary to analyze this complex activity of compiling, transmitting and disseminating information on the organization of air traffic flows and systematize it. Such systematization will be the basis for the creation of algorithms and models of flight dispatchers' activity concerning messages on the organization of air traffic flows.

Decomposition schemes and algorithmic descriptions have been developed and they characterize the field of air traffic flows organization in terms of the airline specialists' activities at two main levels of planning: pre-tactical and operational. The decomposition has been analyzed at some levels such as airline specialists dealing with the organization of air traffic flows according to the planning stage, typical operation situations, type of work with the message (receipt and analysis; formation of the relevant message). These developments can be used in conducting training lessons with cadets during their professional training. Further areas of work are considered to be methodical work with the obtained research results in order to implement them in the training of future flight dispatchers.

Key words: *flight dispatchers, slot, algorithm, decomposition, typical operation situations.*

Problem statement. Receipt and dissemination of messages concerning air traffic services in the organization of air traffic flows at airports of civil aviation of Ukraine is carried out by pre-flight information service units (briefing offices) of the Air Navigation Information Service of UkSATSE, as well as relevant airline units. Flight dispatchers process a large amount of information, often in a time and deficit mode, while performing many professional tasks: obtaining information, encoding and decoding data and disseminating processed information as air traffic flows messages; interaction with the Aeronautical Information Service and others. It has been found that the reception or compilation, transmission and dissemination of messages on the organization of air traffic flows is a priority of the flight dispatcher in pre-flight information services. Unfortunately, the training program for future flight dispatchers does not devote enough time to this issue. It has been found that working with messages on the organization of air traffic flows, especially slotting, causes some difficulties for cadets in understanding and sequence of work with them. That is, the training factor in the performance of professional duties is important to reduce errors, so it is necessary to analyze this complex activity of compiling, transmitting and disseminating information on the organization of air traffic flows and systematize it. Such systematized information will be the basis for the creation of algorithms and models of flight dispatchers' activity concerning messages on the organization of air traffic flows.

Analysis of recent research and publications. Flight dispatchers' activity can be attributed to the operator, so the study considers the position of the operators of complex control systems psychology (Bodrov V.A, Ilyin E.P, Kotyk M.A, Malkhazov O.R, Mileryan E.A, Ponomarenko V.A.); methods of description and analysis of the operator activity (Kotyk M.A, Trofimov Y.L, Sergeev S.F, Zarakovsky G.M). The works of Anfilatov V.S, Ladanyuk A.P, Yemelyanov O.A., etc. are devoted to the principles of system analysis, including decomposition. The provisions of the expert survey (Beshelev S.D, Gurvich F.G, Orlov A.I, Postnikov V.M, Yadov V.A, etc.) are important for the study. Kharchenko V.P, Shmeleva T.F, Sikirda Yu.V. developed graphoanalytical models of flight situation development and decision-making by a human operator in expected and unexpected conditions of aircraft operation using decomposition procedures. Flight dispatchers' activity in the adaptive simulation system have been analyzed and detailed (Surkov K.Yu., Surkova K.V, Palyony A.S.). The regulatory framework of flight dispatchers with messages on the organization of air traffic flows (Aviation Rules of Ukraine. Rules of Organization of Air Traffic Flows; Rules for Providing Messages on Air Traffic Services; Regulations on Pre-flight Information Services at Civil Aviation Airfields of Ukraine; Quick Guide to Using the IATA SSIM Format in the Slot Allocation / Schedule Authorization Processes; Worldwide Scheduling Guidelines (International Air Transport Association); ATFCM User Manual (Air Traffic Flow and Capacity Management).

The purpose of the article is: a description of flight dispatchers' activity with messages on the organization of air traffic flows using the decomposition procedure and flowcharts of algorithms.

Delivery of main material. The aviation specialist, in this case the flight dispatcher must perform the following functions [1]:

- to conduct a multi-stage verification of the aeronautical information reliability;
- to pay attention to the nature of changes in aeronautical information and its timely entry into the aeronautical database and ensure the process of operational processing;
- to receive and prepare messages on the organization of air traffic flows and disseminate them among air traffic services, airport services and airspace users;
- to prepare pre-flight information bulletins, make changes to documents, ensure the maintenance of control copies, which are registered in the department;
- to keep records of aeronautical information documents, amendments, additions and changes;
- to provide pre-flight instruction to aircraft crews;
- to adhere to ICAO Standards and Recommended Practices and current legislation during the preparation of air navigation information and the implementation of air navigation information services.

According to the regulations [2], air traffic flows messages include: messages sent by NMOC to ATS units and operators, Slot Assignment Messages (SAM), Slot Review Messages (SRM), Slot Cancellation Messages (SLC), Slot Enhancement Proposal Messages (SIP), Flight Suspension (FLS) Messages on Direct Slot Enhancement Request (RFI) Messages on Slot Enhancement Proposal (SRJ) Rejection Messages, etc.).

Airport slot is a permission issued by the airport coordinator for the use of all airport infrastructure necessary for the provision of air services for the carriage of passengers (cargo) at the specified time and date [2].

ATFM (Air Traffic Flow Management) slot (ATFM Departure Slot (STOT)) is estimated time for the take-off of the aircraft, which is part of the air traffic controllers' clearance for departure [2].

Permissible deviation from the ATFM slot (Slot Tolerance Window (STW)) is the period of time from 5 minutes before STOT and 10 minutes after STOT, which can be used by the ATS control body, outside of which the aircraft cannot take off. ATFM Slot Deterioration – STOT change later due to ATFM Slot Review Message. ATFM Slot Improvement – change of STOT to an earlier time due to ATFM Slot Review Message [2].

One of the most common methods is the method of algorithmic description of the operator's activity [7]. It can be effective when studying different types of the operator's activities. The method of algorithmic description of control processes is based on the provision that any control is carried out by processing information, carried out according to the relevant rules – algorithms.

The operator's activity can be most clearly recorded in the form of block and logic diagrams of algorithms [8]. In the block diagram of the algorithm, the operator's activity is denoted by rectangles, and the logical conditions – by rhombus. Inside each rectangle and rhombus, the contents of this algorithm term are written. If the logical conditions are met, the control is carried out by the arrow number 1 (yes). If this condition is not met – on the arrow with the number 0 (no). The advantages of this form of modelling are clarity, content, completeness, consistency and completeness of the description of the operator's activity.

Algorithms for the the flight dispatcher's activity with reports on the organization of air traffic flows have been developed. The developed algorithms are logical algorithms, i.e. the decision of the set operation tasks is reduced to logical flight dispatcher's activity.

In fig. 1 the example of the flight dispatcher's activity algorithm with messages on the organization of air traffic flows during the operation situation "Change of a slot more than 5 minutes" at a pre-tactical stage is given.

Dealing with messages on the organization of air traffic flows is a complex process. It is advisable to use system analysis procedures, such as decomposition and aggregation, when analyzing the flight dispatcher's activity.

A complex process is divided into less complex parts, which can then be combined into one whole, which makes it possible to explain the whole through its parts in the form of the structure of the whole. Decomposition is considered as the dissolution of the whole into parts: tasks – subtasks; systems – on subsystems. This makes it possible to simplify the overall problem or process, reduce the dimension of the problem and use simpler models [3].

Decomposition is carried out functionally (by function), component (by type of elements), structural (by type of relationship between elements). The depth of decomposition is determined by the purpose of the system study, i.e. the number of levels of the goal tree/function tree [4].

An important point in the analysis of complex processes is to determine the levels or signs of decomposition on which the detailing and simplification of a complex whole. Characteristic aspects of the researched process should act as such signs. The following items are selected as levels of decomposition of flight dispatchers in the adaptive simulation system: training mode; stage/result of training; evaluation criteria according to which typical errors were made; separate educational activities [5].

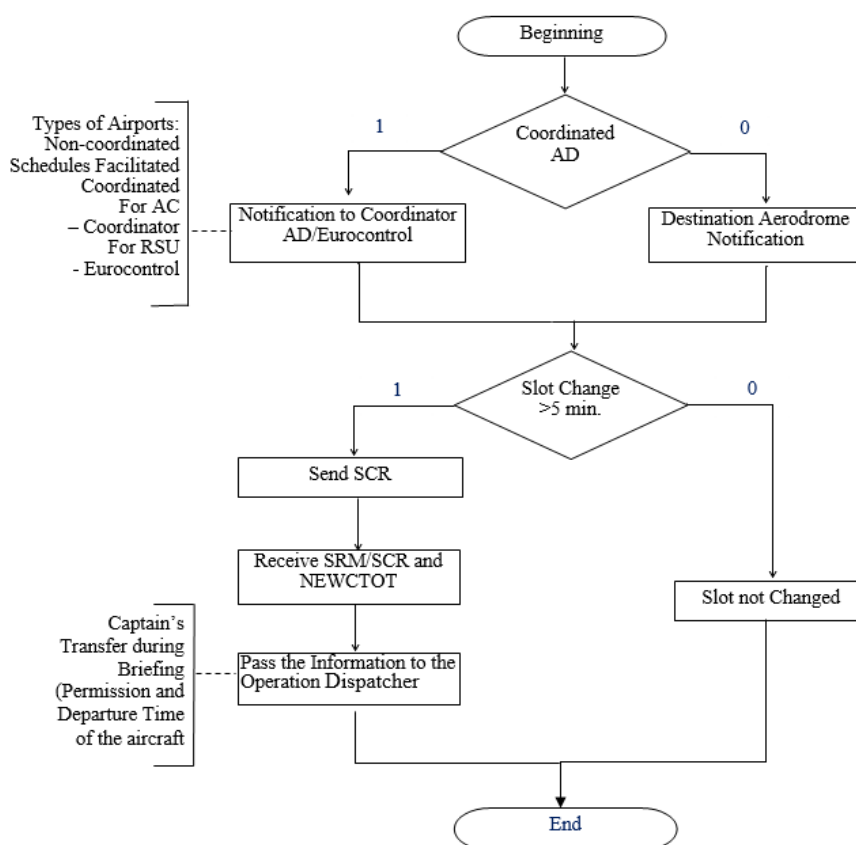


Fig.1 Algorithm of flight dispatchers' activities with messages on the organization of air traffic flows during the operation situation "Change of a slot more than 5 minutes" at a pre-tactical stage

The situations in the airline that can occur when working with reports on the organization of air traffic flows have been analyzed, in addition, a survey of experts to determine the likelihood of such situations has been conducted, the experts were specialists of the airline who deal with the situations on slots (request, change, improvement, cancellation, etc.). Typical operation situations have been identified with the help of experts, and the probability of their occurrence has been determined. Work with messages takes place in two stages: pre-tactical (input information analysis: flight performance with date, slot schedule, departure and destination airport, loading) and tactical planning (input information analysis: actual situation: with aircraft registration number, flight number, station (airport where the relevant situation occurred, such as delay or low visibility), a brief description of the event / situation, the estimated time when the aircraft will be able to perform (resume) the flight or the time of the next message with more detailed information).

Figure 2 shows the decomposition scheme of flight dispatchers' activity with messages on the organization of air traffic flows (slots) at the operational (tactical) stage of flight planning [6].

The decomposition was carried out at the levels of: airline specialists dealing with messages on the organization of air traffic flows, typical operation situations, the type of work with the message. Thus, the airline can work with messages, for example, in the schedule department and flight management, i.e. pre-tactical and operational planning. For example, this is the activity of forming and providing the airline's flights with the necessary slots when performing flights to / from the airports of Ukraine; when performing flights to / from foreign countries.

During operational planning there are typical production situations with the corresponding probability: the slot is missed – 7%; the aircraft is ready for departure at least 15 minutes before the EOCT – 47 %; low visibility (capacity reduction) – 25 %; re-routing in FPL – 6 %; flight delay – 10 %; the flight receives the status: suspended – 3 %; flight resumed, flight confirmation – 2 %.

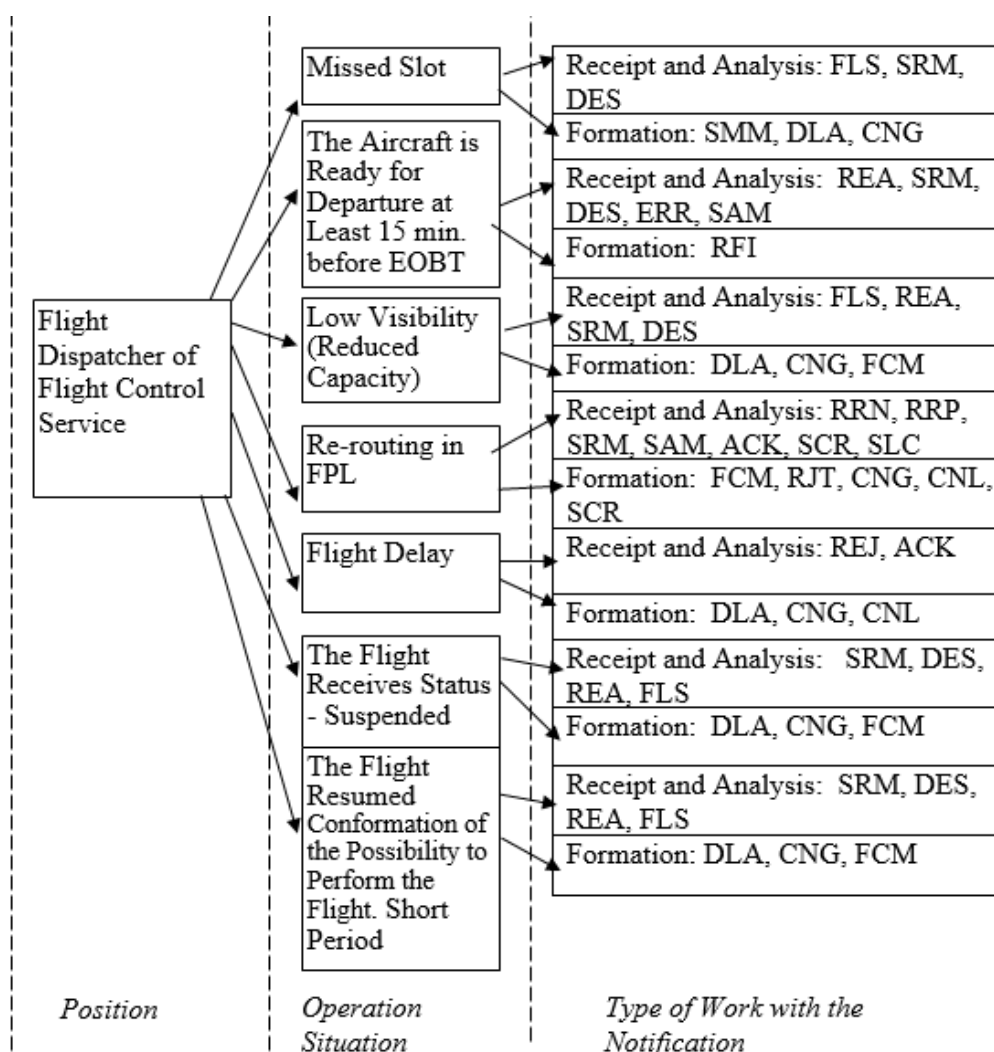


Fig.2 Decomposition of flight dispatchers' activity with messages on the organization of air traffic flows (slot)

In the event of typical operation situations, relevant situation messages are received and analyzed. For example, in the Slot Missed Situation, the flight dispatcher receives and analyzes FLS (Suspension Message), SRM (Slot Review Message ATFM), DES (Notice of Termination of Temporary Suspension of Flight); after the analysis, SMM messages (Message about the Inability to Perform the Assigned ATFM Slot), DLA (Aircraft Delay Message), CNG (Change Message) are generated in response.

The decomposition scheme of the activity of air traffic controllers with messages on the organization of air traffic flows (slots) at the pre-tactical stage provides a structure in accordance with certain typical situations: slot request; change the slot for more than 5 minutes; request to improve the slot; slot cancellation; obtaining a NOTAM on the closure of the airport for a short period.

Conclusions and prospects of further research. Developed decomposition schemes and algorithmic descriptions characterize the field of air traffic flows organization in terms of the activities of airline specialists at two levels of planning: pre-tactical and operational. The decomposition was carried out at the following levels: airline specialists dealing with the organization of air traffic flows according to the planning stage, typical operation situations, type of work with the message (receipt and analysis; formation of the relevant message). These developments can be used in conducting training sessions with cadets during professional training. Further areas of work are considered to be methodical work with the obtained research results in order to implement them in the training of future flight dispatchers.

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ФОРМАЛІЗОВАНИЙ ОПИС ДІЯЛЬНОСТІ ДИСПЕТЧЕРІВ ІЗ ЗАБЕЗПЕЧЕННЯ ПОЛЬОТІВ З ПОВІДОМЛЕННЯМИ ЩОДО СЛОТІВ

Анотація. Стаття присвячена аналізу складної діяльності диспетчерів із забезпечення польотів при роботі з повідомленнями щодо організації потоків повітряного руху. На основі експертної інформації виявлено типові виробничі ситуації в авіакомпанії, визначено ймовірності їх появи. Побудована декомпозиційна схема та алгоритми діяльності диспетчерів із забезпечення польотів при роботі з повідомленнями, що стосуються слотів.

Ключові слова: диспетчер із забезпечення польотів, слот, алгоритм, декомпозиція, типові виробничі ситуації.

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