Psycho-emotional and intellectual components of air traffic controllers' professional activity

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Abstract. The paper reveals the special features of the professional activity of air traffic controllers. The scientific and theoretical substantiation of the peculiarities of this activity has been made through the definition of its goals, requirements and structural elements. It has been substantiated that this professional activity should include the psycho-emotional and intellectual components affecting the development of professional abilities, skills and the personality of air traffic controllers in general. The psycho-emotional component involves individual characteristics of air traffic controllers, their emotions and situational psychological readiness. The intellectual component of the air traffic controllers' professional activity embraces reasoning, decision-making and professional communicative competence, which plays a key role in the development of the aviation specialist. A thorough study of these components in the training process of future air traffic controllers can contribute to improving the efficiency of their professional activity, which affects flight safety and therefore becomes relevant and significant.

1. Introduction

The aviation industry in Ukraine is developing in the context of new reforms and requires qualified and competent air traffic controllers able to ensure the effective performance of the air traffic management system. The profession of an air traffic controller is a highly demanding job, the main feature of which is continuous air traffic control within the area of their responsibility to ensure safe, regular and orderly aircraft movement. In performing these tasks, air traffic controllers use radio equipment, means of radio communication with aircraft crews, as well as telecommunication with related sectors and other specialists. Such work requires a high level of responsibility and stress resistance as well as complexity of the performed work which includes fast and clear delivery of commands and instant attention switch [1]. They must have a shared understanding of what is expected of them in terms of performance as their task is to control aircraft in a limited range of time, identify risky separations between the aircraft and resolve potential conflict situations [2]. In the process of performing the tasks, the air traffic controller has to prioritise different tasks, manage their cognitive resources and evaluate and control their performance [3]. They must be able to assume future cognitive activity in the rapidly changing situation and identify potential conflicts between aircraft due to verbal communication. So, the professional activity of the air traffic controller includes the following psychological processes: predicting, planning, information perception and processing, decision-making and control of results.

The air traffic controllers' level of professional development determines the efficiency of the entire human-machine system. From the point of view of a systematic approach, the professional activity of any specialist should be considered in the context of a holistic life activity in the unity of the activity and personal components as a qualitative characteristic of the subject of activity, which indicates a high professional qualification and competence of any specialist and allows them to work at a high level of productivity and to constantly develop their professional skills and abilities.

New requirements to the professional training of air traffic controllers are caused by increased intensity of air traffic and automation of air traffic control processes. According to the qualification characteristics of professions in Ukraine, the requirements to air traffic controllers include complete or basic higher education; the certificate of an air traffic controller; work experience in the field of air traffic services not less than 3 years; and English proficiency. W Aiguo [4], H Emery [5], A Kukovec [6] emphasize the significance of professional communication in English of future air traffic controllers, which is confirmed by the requirements of the International Civil Aviation Organization (ICAO).

The analysis of the studies and ICAO documents has shown that, the peculiarities of aviation professions are the works connected with danger to life, extreme activity, high "cost" of decisions making, complexity of specialist's actions, high pace of activity, monotony of work at long-awaited signals, comparison of different actions in accordance with the objectives in one activity, processing of large volumes of information, complex dynamics of changes in functional states.

According to O Husar and O Myronets, the profession of an air traffic controller is one of the youngest professions in the world and the role that these specialists play in ensuring the efficiency of air traffic control is crucial [7]. They are the specialists who give *t*he permission to start the engines and allow the aircraft of various airlines take off, and thanks to their activity air transport is not only the most efficient, but also remains the safest transport. Working within a limited time, high responsibility for every decision that has been made, and limited information available make it necessary not only to display a high level of an air traffic controller' proficiency, but also a spectrum of individual psychological qualities [8] .

The peculiarity of the professional activity requires the availability of special professionally important qualities:

- attentiveness;
- fast attention switch;
- good visual and auditory memory;
- resistance to stress and fatigue;
- ability to take adequate decisions in extreme conditions;
- ability to operate in the imagination with objects in three-dimensional space;
- ability to plan actions;
- ability to quickly perform mathematical operations [9]

The professional activity of air traffic controllers is the type of activity where a mistake cannot be made. The success of an air traffic controllers' professional activity must be understood as the ability of the specialist to combine theoretical knowledge and practical skills with work experience and use them effectively while performing their professional duties. Thus, the assimilation of ready-made knowledge becomes not a goal, but one of the auxiliary means in the training of future air traffic controllers.

The **purpose** of the paper is to provide a scientific and theoretical basis for the specifics of the professional activity of air traffic controllers by defining the requirements to it and its objectives and structural components.

The tasks needed to implement the purpose are as follows:

1) to analyse the requirements to professional activity of air traffic controllers and identify the required abilities and specific features;

2) to identify the special features of the professional activity of these aviation specialists and leading approaches at the technical university;

3) to identify the structural components of the professional activity of air traffic controllers and prove the importance of English proficiency to improve their professional skills.

2. Methods

While researching the psycho-emotional and intellectual components of air traffic controllers, the following methods were used: a systematic and comparative analysis of psychological and pedagogical studies on the research issues; an analysis of the requirements to air traffic controllers and their correlation to existing state, systematization and generalization of data, etc.

The system method was used to investigate the ergatic system of connections, its components and their relationship with the external environment. It shows that these relationships and interactions lead to new properties of the system, which are not present in its components. In the context of our study, the main object of the ergatic system is the human and the psycho-physiological capabilities of the human operator, who receives and transforms information about the condition of aircraft equipment and ensures its proper operation and flight safety in general. On this basis, the study of psychological properties is an integral part of forming specialists in the operation and maintenance of modern multifunctional air transport equipment.

3. Results

The air traffic controllers' professional activity is based on the structure and functions of the air traffic control system. This system is designed to ensure the safe and efficient movement of air traffic and is a complex ergatic system in which the air traffic controller plays a central role. Traditionally, the air traffic management structure consists of four subsystems: a subsystem of direct air traffic control, a subsystem of air traffic planning and support, a subsystem of air traffic management organization and a subsystem in the form of a control and coordination body. The most flexible and adaptable element in this system is a human, an air traffic controller. Using all their capabilities, they are able to compensate the lack of information, imperfect and functionally limited equipment, primitive working conditions and sometimes even incorrect tasks. However, a human's ability to adapt is also limited. If requirements to a specialist do not correspond to their abilities and do not affect their emotions, this will result in reducing the performance and lead to errors.

The arising emotions affect the brain systems which regulate the behaviour and the processes of perception, extracting information from memory and the autonomic functions of the body. The most obvious state of emotional tension is displayed in the form of vegetative shifts (heart rate, blood pressure rise, hormone emission), the volume of which exceeds the body's needs. This is due to the need to mobilize resources in the situation of uncertainty: it is better to spend too much energy than to be left without enough oxygen and energy sources in the midst of stressful activities. Emotions in the latter case provide an invaluable service to the body, mobilizing all forces for a task of an uncertain nature. But the emergence of emotional tension is accompanied by the transition to other forms of behaviour compared to the calm state, the principles of evaluating and responding to external signals. The physiological essence of the transition can be defined as a return from specialized reactions to a dominant response, an important feature of which is the ability to give to the same response to a wide variety of external stimuli [10]. The above-mentioned characteristics of the emotional state lead to the conclusion that there is a danger of emotional tension; therefore it is extremely important to prevent the air traffic controllers from this state. The emotional tension in an emergency situation can reveal either in impulsive actions as a result of a sharp increase in excitability (wrong selection of buttons, switches on the dashboard, error in recognizing aircraft call signs) or in slowing down and even failing to perform certain actions as a demonstration of deep stopping reactions (being at a loss). Thus, emotional tension, depending on its intensity, may be conducive to a complex task or may contribute to the commission of wrong actions [1]. A distinctive feature of the future air traffic controllers' professional training is that they control the air traffic based on information. The sources of information for them include a variety of visual displays as well as radiotelephony communications. In the automated control systems, information about aircraft is presented on the radar screen, where,

together with the radar mark a form is represented by three lines with no more than 8 characters on each of them. The lines carry information about the type of aircraft, its number, height, speed and fuel balance. The processing of all incoming information is necessary for decision-making and is a complex process, the main components of which are mnemonic and intellectual processes.Thus, we can say that the air traffic controllers' professional activity is highly intellectual and sets special requirements for their professional communication.

A demonstration of the air traffic controllers' professional communication at the workplace is radio exchange. The radio exchange of civil aviation is an act of speech interaction, the exchange of professional information between the aircraft crew and ground control services and/or other aircraft is carried out via high-quality communication channels. The content of such communication is defined by the real circumstances in the air traffic control (ATC) zone, expressed in graphic and audio-visual form on the screens of instruments and consoles. Thus, radio exchange involves two parties: participants of the radio exchange, which is performed by the pilot on the aircraft and the air traffic controllers on the ground. The communication between the participants of the radio exchange is determined by the established rules. Radio exchange is based on the principles of brevity and conciseness, completeness and pithiness, clarity and unambiguousness [11].

The communication between the air traffic controller and the pilot is high-stakes interaction, miscommunication must be avoided so as to minimise the probability of an incident or accident occurring [12]. Therefore, the procedure of this communication is clearly defined by the legislation of Ukraine (Rules of radiotelephony communication and phraseology of radio exchange in the airspace of Ukraine) and normative documents of the ICAO. The ICAO has established new requirements to professional communication skills of modern aviation specialists, which include a high level of English proficiency and the development of professional skills. The inability to apply foreign language knowledge, skills and abilities formed for standard operating conditions in extreme situations leads to a decrease in the level of flight safety [13].

During the training of air traffic controllers, the problem of preparing for radio exchange in English in non-standard situations is vital. The ICAO has requirements for the use of ordinary speech: clarity, accuracy and correctness are the goals of professional communication. The components of professional communication are also subordinate to these goals. According to the ICAO documents, the quality characteristics of professional communication aimed at better understanding are specificity, accuracy and direct meaning [14].

In March 2008, the ICAO introduced the requirements for language training for aviation personnel. Since then, aviation staff are required to have an aviation English proficiency mark in their individual licenses, which complies with the ICAO requirements, i.e. which is not lower than the fourth (operational) level of the ICAO language proficiency rating scale. English proficiency by aviation industry specialists is a complex interaction of knowledge, skills and competencies, and it requires much more than memorising the appropriate vocabulary by heart. English proficiency must meet the needs of the aviation professional field as well. There are two types of needs: objective needs (targeted use of the language in real communication situations) and subjective needs (degree of personal confidence, attitude and style to learn, experiences and expectations).

The ICAO objectives and standards for language training of air traffic controllers determine their readiness for successful professional and verbal functioning, characterized by the acquisition of knowledge and development of skills of radio exchange in standard and non-standard situations. Professional language training for aviation specialists is directly related to ensuring the necessary level of flight safety. Thus, the communication activity in the performance of a typical professional task of radio exchange has a number of specific features and characteristics that are related to both linguistic and extra-linguistic factors of the flow of this process.

Taking into account the high psycho-emotional and intellectual orientation of the professional activity of air traffic controllers, it should be noted that not only the availability of relevant professional knowledge, skills and experience are the requirements of the profession, but also the totality of personal qualities and individual psychological characteristics that would contribute to the

formation of psychological readiness for activities in conditions of increased risk and responsibility. However, psychological readiness is a necessary but not sufficient condition for the high professional reliability of air traffic controllers [15].

Situational psychological readiness is a dynamic holistic state of personality that is characterised by an internal commitment to a particular activity and behaviour, and is achieved by mobilising internal resources for its consistent, targeted implementation. Situational psychological readiness begins with a goal setting based on the needs and motives (or awareness of the objectives) of the specialist. This is followed by the development of an implementation strategy, models and future action plans. The specialist then translates the readiness into substantive actions by applying certain means of action, comparing the progress and intermediate results with the target, and making amendments. The most important component, however, is the emotional attitude or involvement of the specialist, i.e. the mobilisation of internal resources in accordance with the requirements of the professional environment.

Situational psychological readiness also plays a special role in the professional activity of air traffic controllers. Situational psychological readiness contributes to full involvement in work despite its current state (degree of complexity / intensity / monotony) and helps air traffic controllers understand their physical and psycho-emotional state. Despite the fact that there are several approaches to determining the structure of situational psychological readiness, the following structural components can be identified taking into account the special features of air traffic controllers' professional activities: motivational, emotional and volitional, ooperational and somatic reflexive.

The *motivational component* is the need to successfully complete the task and strive for both major and minor achievements; the ability of specialists to encourage themselves to work (especially during periods of prolonged monotony).

Emotional and volitional component involves the sense of responsibility for activity; belief in one's own strength and success; skills for self-regulation and managing one's own emotional state; ability to self-mobilise; ability to concentrate and detach from external stimuli; ability to overcome fear and doubt; and enthusiasm for work.

Operational component includes mobilization and updating of relevant professional knowledge, skills and abilities; adaptation to the requirements and conditions of the current situation; understanding of the means to achieve the set goals.

Somatic reflexive component is the ability to self-reflection; attention to health and tracking the body feelings; knowledge from methods of improving health.

The main role of situational psychological readiness in the activities of air traffic controllers is to update and mobilise intellectual and internal resources, as well as to form resistance to stress factors, which often lead to the reduction in the air traffic controllers' performance. Summing up, it should be noted that the role of situational psychological readiness in the activity of air traffic controllers is determined by the following characteristics:

- the emotional state of mind at work;
- the definition and awareness of the action plan in accordance with the set goals and objectives, with their step-by-step implementation;
- the ability to manage their emotional state;
- the ability to understand and highlight elements of a professional situation, to monitor its current state and make a forecast of its further development.

4. Discussion

Since the professional activity of aviation specialists takes place in non-standard situations, it often causes them to experience crisis conditions, which are manifested in professional destruction, stressful situations and inability to adapt to new working conditions [16]. Therefore, they have to be trained to cope with these difficulties even during the period of study. In a variety of modern approaches to professional training of air traffic controllers, it is appropriate to apply a system approach to determine the main features and specifics of the functioning of air traffic controllers in the "man-machine"

system. An essential feature of a purposeful system of interaction between people and technology is the simultaneous achievement of positive results on the part of both people and technology. Purposefulness is determined by the fact that a person enters the system. A dynamic system is characterised by the complexity and variety of elements (a person, staff, automatic equipment, devices, machines, complexes of machines). Within this system, a person monitors all events at the same time, and under conditions deviating from the norm, switches the control to a manual mode. The human technology system may belong to the class of a self-organising system, i.e. a system that is capable of reducing uncertainty after leaving a stable state due to various influences. Adaptive systems adapt to the changes that result from failures and unpredictability. The level of adaptability of a system depends on the flexibility and plasticity of behaviour on the part of an individual and his predictive abilities [17].

Communication is an integral part of the ergatic system between the pilot and the air traffic controller. It usually takes place in the context of standardized take-off, flight and landing procedures using standard radio exchange phraseology, which, according to Henry Emery, is the core of air communication [5]. However, phraseology is not exhaustive and there are non-standard situations in which its use cannot fill the communication gap. In such cases, an adequate level of general English, i.e. plain English proficiency, is needed to go beyond the radio exchange phraseology in the conditions that require it [6]. It is formed as part of the English language course based on general English skills acquired at secondary school. However, when studying general English at aviation universities, the focus is more on the subject and speech functions typical for standard and non-standard conditions of aviation communication, for example, the development of listening and speaking skills, the development and perception of forms of orders and requests for information on health, human behaviour and geographical features [14].

Every three years, air traffic controllers take an exam in aviation English and get the international certificate which allows them to perform their professional activity. The state rules for issuing certificates to aviation personnel determine that the air traffic controller must have the operational level 4 of proficiency in English according to the ICAO rating scale [18]. Thus, aviation safety depends on effective communication between flight crew members and air traffic controllers and a lot of attention is paid to the issue of safety by the ICAO, world aviation organisations and researchers investigating this issue. In addition to general English and standard phraseology, air traffic controllers in the mono aspect must also understand and navigate their own professional field, including its technical and practical features, as their profession has its own specific characteristics and represents a technical world with its own language, lexical units and concepts that are not understood by most ordinary people. In this case, it is possible to talk about mastering professional English in order to understand specialised vocabulary and expressions concerning onboard equipment and aircraft parts, meteorological conditions, etc. Such knowledge, skills and abilities are acquired as part of the professional English course at aviation universities with the study of radio exchange phraseology.

Thus, the English communication competence of air traffic controllers to perform the professional radio exchange functions on international air flights implies mastering general English, professional aviation English and standard radiotelephony phraseology. Therefore, the preparation for radio exchange includes the courses of both aviation English and general English, which, due to the gradual and systematic learning of English, ensure that the air traffic controllers' foreign-language competence is formed in order to conduct professional communication. It should be emphasised that an important criterion for the effectiveness of the training of future air traffic controllers is the formation of communication skills, which makes it advisable to use a communication approach. This approach focuses on the organisation of the learning process and real speech communication, and is implemented through the modelling of basic patterns (e.g. the active nature of verbal communication is embodied in the communicative behaviour of the teacher as a participant in the process of communication and learning and in the communicatively motivated, active behaviour of the student as a subject/object of communication and learning; the communication process, which should be modeled on a limited but precisely defined range of discussion problems; communication situations,

which are modeled as the most typical variants of students' relationships with each other; language tools, which ensure the process of communication and learning in appropriate situations [13].

The problem of applying a competent approach to the professional training of specialists at aviation universities institutions directs us to discover the essence of the concept. The concept of competency-based approach means the orientation of the educational process towards the formation and development of key (social and personal) and professional competencies of an individual. It should be noted that the competence approach in determining the conditions and principles of training specialists at university is effective, and is consistent with the implementation of integrative processes in national education in accordance with European educational standards. In particular, we define the competence approach to the professional training of future air traffic controllers as a set of relevant knowledge, skills and abilities required for aviation specialists to perform their professional functions in the workplace. We believe that the professional competence of the future air traffic controllers is the professional knowledge and communication skills acquired during training at aviation university and the ability to apply them while performing air traffic control tasks, taking into account the requirements for professional qualifications.

Conclusions

Based on the analysis of the professional activities of aviation specialists, the expediency of organizing the training of future air traffic controllers with a systematic, competent and communicative approach has been disclosed. Applying a systematic approach to training future air traffic controllers makes it possible to achieve the goal for the development of future specialist in the ergatic human-machine system. The use of competency approach contributes to the development of future air traffic controllers relevant competences during training at university. The communicative approach creates opportunities for organizing the learning process based on real verbal communication and provides appropriate motivation based on the use of professionally oriented problem situations through the involvement of students in simulated air traffic control activities. Based on the analysis of the professional training of air traffic controllers, it has been established that in development of psycho-emotional component the following significant elements are important: the individual characteristics of the air traffic controller, their emotions and situational psychological readiness to perform professional activities. The intellectual component of the professional activity of future air traffic controllers is embodied by reasoning, decision-making and professional communicative competence. The combination of all these elements of the professional activity of air traffic controllers is an important task of the state policy of Ukraine in the aviation industry. In the context of our research, the key points of the professional training of air traffic controllers are the following: in the process of training in accordance with the communicative approach, future air traffic controllers acquire communicative competence – the ability to use the language correctly and appropriately depending on the professional communication situation, especially when conducting radio exchange in non-standard situations. We believe that the successful fulfilment of the state social order for air traffic controllers with professional competence largely depends on their level of training and the development of their professional qualities. In our future research we intend to work on the substantiation of the pedagogical conditions for the development of professional competence of future air traffic controllers in the process of ESP learning.

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