EXPERIENCE ON EDUCATION MODEL OF PILOTS FOR SPECIFIC OPERATOR IN THE TECHNICAL SCIENCES

The chapter deals with the experience on optimization of processes in the education of military pilots in the conditions of introducing new aeronautical supersonic technology into air traffic in the context of increasing the performance of pilots and air traffic safety. It analyses and evaluates the theoretical and practical part of the training of military pilots at the Faculty of Aeronautics in the past and compares it with existing educational processes abroad. It proposes variants of pilot training for the needs of the Air Force of the Armed Forces of the Slovak Republic in the pilot – expert in piloting a tactical aircraft specialization in which the direction and strategy of pilot training for the needs of the Air Force of the Armed Forces of the Slovak Republic will be determined.

Experiences in this area are presented in informing the public about the results of the project Model of training of professional personnel for the needs of the Air Force of the Armed Forces of the Slovak Republic MOPODPER (2021).

The proposed part of the feasibility study includes defined aviation education models of professionals for the needs of the Air Force of the Armed Forces of the Slovak Republic. In this chapter we discuss the model of aviation education of military pilots in the pilot – expert in piloting a tactical aircraft specialization. We are inspired by the work of Model of training of professional personnel for the needs of the Air Force of the Armed Forces of the Slovak Republic, regulations of the Minister of Defence of the Slovak Republic (2016), the study programs "Pilot" I. degree of the Technical University of Košice (2020), the Long-term plan for defense development with emphasis on the construction and development of the Armed Forces of the Slovak Republic (2017), requirements for professional competence of personnel for the maintenance of military aircraft (2017), respected airdrome development processes (Korecki et al., 2018, p. 99), and logistic processes to ensure the flight safety (Pomazalova et al., 2010, p. 453).

The theoretical preparation was carried out in the period 1973–1990 within the study program Fighter Pilot in the form of full-time 4-year study, in the period 1990–2004 within the study program Fighter Pilot in the form of full-time 5-year study and in the period 2004–2020 within the study program Professional Pilot in the form of full-time 3-year bachelor's study.

Continuation of theoretical preparation in the next period from the academic year 2020–2021 is planned within the study program Pilot in the form of full-time 3-year bachelor's study. We respect the experience in human performance as on physiological indices of workload in a simulated flight task (Veltman et al., 1996, p. 323), on monitoring mental workload in driving simulators using physiological measures (Brookhuis et al., 2010, p. 898), or on heart rate measures of flight test and evaluation (Bonner et al., 2002, p. 63), on stressors and stress coping strategies among civil pilots (Jeeva et al., 2008, p. 60), on human factors and analysis of aviation education content of military pilots (Rozenberg et al., 2019, p. 139), or praxeological problems in aviation education of military pilots (Jevčák et al., 2020, p. 119).

The analysis and evaluation of pilot training abroad are available to readers from the experiences of NATO, the Czech Republic, Canada, Poland, the Federal Republic of Germany, and the United States of America. In these foreign experiences, we find inspiration and confrontation with the experience of 60 years of aviation education in Košice. as the last system changes in the training of pilots for a military air operator were made in 2016 (a specific air operator respecting not only civil aviation standards but also NATO, and national standards and requirements. The main motive of our work and historical data analysis is to provide a research tool for the objective historical and content analysis of pilot training system for the following prognoses.

To process the majority of the study focusing on the issue of pilots´ aviation education for the Armed Forces of the Slovak Republic, we used an analytical-synthetic method based on critical thinking, shaped by conceptual tools of situational management of complex systems, i.e. situation management methodology.

In the analytical solution of the research objectives, we performed an analysis of the current state of education and training of pilots for the Air Force of the Armed Forces of the Slovak Republic with emphasis on:

- the current system of higher military education in the Slovak Republic and abroad,
- main problems of the current system of preparation and training of military pilots in the Slovak Republic.

Based on the analysis of the current state of solving the issue of aviation education in the Slovak Republic and abroad, a study of flight training procedures and pilot training, we synthetically created alternative systems of aviation education for pilots – experts in piloting tactical aircraft for the Slovak Air Force in 2030.

Past and present experience: Faculty of Aeronautics of Technical University of Kosice

The Air Force of the Armed Forces of the Slovak Republic ensures the continuous fulfilment of tasks related to ensuring the security of the Slovak Republic. Their specific activities include a number of tasks they perform in peacetime, and the nature and scope of the tasks performed are not different from the tasks they would perform during military operations. For this reason, great emphasis is placed on the level of theoretical readiness and practical skills of professional staff, regardless of the level of security of the country. The professional personnel of the Air Force include specialists of various military professions which can be divided into three basic groups, namely:

- aviation specialists,
- air defence specialists,
- other specialists.

In the past, there were specific educational institutions for each of these groups, which trained specialists according to individual military professions. The specialists were trained within the network of military vocational schools or military universities. The gradual transformation of military educational institutions, leading to their gradual demise, led not only to the degradation of military vocational education, but in later years, mainly to the lack of professionally trained specialists. Substitute programs gradually have supplemented the decrease of professional staff, the level of professional training, but especially the number of graduates has not satisfied the needs of the Air Force of the Armed Forces of the Slovak Republic. Therefore, there is a need to assess the current training opportunities for professional aviation personnel and to propose solutions that should help eliminate the current shortage of trained personnel in the shortest possible time and thus help prevent the recurrence of the current shortage in the long term.

In the past, for more than 60 years of aviation education in Košice, the flight training of pilots and aviation technical staff was provided by the Military Aviation Academy of Gen. M. R. Stefanik in Kosice. As an accredited university education institution, it focused primarily on the training of military students and, since 1991, civilian students.

On 1 September 2004, the Act No. 455/2004 Coll. on the establishment of the Academy of the Armed Forces of Gen. M. R. Stefanik, on the merger of the Air Force Academy in Kosice with the Technical University in Kosice, on the establishment of the Marshal Andrey Hadik National Defence Academy and on the amendment and supplementation of some laws. Under Section 2 of this Act, the Military Aviation Academy, M. R. Stefanik merged with the Technical University in Kosice.

With effect from 1 September 2004, the Institute of Aeronautics of the Technical University in Kosice was established as a separate research and pedagogical workplace which was incorporated into the structure of the Rectorate of the Technical University of Kosice. As a result of the transformation process of the Air Force Academy of Gen. M. R. Stefanik in Kosice another faculty of the Technical University was established on 1 February 2005.

The Faculty of Aeronautics of the Technical University in Kosice continues to provide university education, develops scientific knowledge and conducts scientific research activities in three fields of engineering studies and two fields of doctoral study (table 4.1.1). Based on changed conditions within the transforming military education system of the Slovak Republic and requirements of school and aviation legislation, new study programs of university education were elaborated (table 4.1.2). The programs respect the requirements of the Higher Education Act, the Accreditation Commission, and the current Aviation Legislation.

Table 4.1.1

Engineering and doctoral studies at FA TUKE Košice (former fields, 2003)

Name of study/scientific field	Name of study specialization	Degree of study	Length of study
Air Traffic Control	1. A combat aircraft pilot 2. Control, operation and automation in aviation 3. Air traffic control	Ing.	5 years
Aircraft Engineering	1. Operation, maintenance and repair of aircraft and LM 2. Airport technical equipment and operation	Ing.	5 years
Air Electrical Engineering	1. Radiotechnical equipment of air traffic 2. Aircraft instruments and electrical systems 3. Air weapon systems 4. Radio and radiotechnical systems of aircraft	Ing.	5 years
Operational and combat use of aviation and air defence	Field of science	PhD.	3/5 years
Air Armament and Technology	Field of science	PhD.	3/5 years

Table 4.1.2

Selected study programs of FA TUKE Kosice – accredited for Pilots (2021)

Field of study	Study program		
	1.degree Bachelor´s	2. degree Master´s	3. degree Doctoral
Transport	Air Transport Management External/Daily	Air Transport Management External/Daily	Air Transport Management External/Daily
	Air Traffic Controller Daily		
	Pilot (Civil and Military Pilot) Daily	X	X

Academic discussion on our experience

Aviation education of pilots of the Air Force of the Armed Forces of the Slovak Republic responds to the current requirements when the Slovak Republic, as a member of NATO, harmonizes and unifies aviation technology with other member states of this defence community. The Slovak Republic has recently substantially modernized its aircraft by purchasing fourteen Lockheed Martin F-16 Fighting Falcon Block 70/72 supersonic fighters. The purchase of state-of-the-art aircraft must go hand in hand with flight education of pilots who will use them (table 4.1.3, 4.1.4).

Table 4.1.3

Training C models in the pilot – expert in piloting a tactical aircraft specialization

Preparation model	2020 – Model C - USA	2026 – Model C - SR
1	2	3
Entry age	19	19
Regrutation	After high school graduation	After high school graduation
Required education for the position	2nd degree of university	2nd degree of university
Requirements for pilot experience before training	no	no

Continuation of table 4.1.3

1	2	3
Duration of preparation	5 years of military study of the Faculty of Aeronautics with training plus 2 years of training in the USA	5 years of military study of the Faculty of Aeronautics with training plus 2 years of training in the SR
Practical flight training	LA 140^{h} ATE 120^{h} F-16 150^{h}	LA 140^{h} ATE 120^{h} F-16 150^{h}
Age of reaching the 3rd class pilot training	26	26

Note: Jevčák et al., 2020, p. 120.

Table 4.1.4

The draft of an initial training flight program (SEP 50 hours)

Training type	**Length of training (hrs.)**
Basic piloting technique BPT	10
Circuits	10
Advanced piloting technique APT	10
Emergency procedures	5
Navigation flights	5
Night VFR	5
IFR	5

Note: Jevčák et al., 2020, p. 120.

We have developed models of pilot training for the needs of the Air Force of the Armed.

Forces of the Slovak Republic in the pilot – expert in piloting tactical aircraft specialization. The design part of alternative systems of pilot education in the form of alternatively processed models of pilot training will provide an effective tool for decision-making processes within which the direction and strategy of pilot training for the needs of the Air Force of the Armed Forces of the Slovak Republic will be determined. The training of pilots for the Air Force of the Armed Forces of the Slovak Republic can be implemented within the set of the following basic alternative solutions (table 4.1.5).

Table 4.1.5

Model of preparation for the pilot – expert for piloting a tactical aircraft specialization

Name of a model	Conditions for the implementation of the proposed model	Solution proposal
1	2	3
Model A (2020)	Recruitment of civilian students for the "pilot" study program after graduation from the 2nd level of university plus flight training in the USA	non - system solution
Model B (2020)	Recruitment of civilian students after completing the 1st degree of the study	non - system solution
	program Professional Pilot at the Faculty of Aeronautics TUKE and continuing studies at the 2nd level of university, at the Faculty of Aeronautics of the Technical University in Kosice plus flight training in the USA	
Model C (2020) USA	5 years of completed studies at the 2nd level of university at the Faculty of Aeronautics of the Technical University in Kosice connected with flight training plus flight training in the USA	recommended solution by 2026
Model C (2020) SR	5 years of completed studies at the 2nd level of university at the Faculty of Aeronautics of the Technical University in Kosice connected with flight training plus flight training in the Slovak Republic	recommended solution by 2026
Model D (2020) USA	3 years of completed studies at the 1st level of university at the Faculty of Aeronautics of the Technical University in Kosice connected with flight training plus flight training in the USA	alternative solution
Model D (2020) SR	3 years of completed studies at the 1st level of university at the Faculty of Aeronautics of the Technical University in Kosice connected with flight training plus flight training in the Slovak Republic	alternative solution
Model E (2020) USA	Graduated from the secondary school with high school graduation plus flight training in the USA	alternative solution
Model E (2020) SR	Graduated from the secondary school with high school graduation plus flight training in Slovakia	alternative solution

Note: Jevčák et al., 2020, p. 120.

The prerequisite for the model of preparation for the pilots – expert in piloting a tactical aircraft specialization is the preparation of flying personnel for the Lockheed Martin F-16 Fighting Falcon Block 70/72 aircraft. Models of preparation A–E are alternatively solved with the possibility of training in the USA and subsequently in the Slovak Republic. Alternatively, the achieved education is also solved, namely the 2nd level of university, the 1st level of university, or university education is completed with a university diploma.

The flight training proposal of the pilot – expert in piloting a tactical aircraft specialization is divided into three stages of practical flight training. The first flight training on light aircraft is 140 flight hours divided into two stages: initial / selective training of 40 hours and continuing training of 90 hours. The second stage of flight training is the transition from a light aircraft with a piston engine, to a type with a jet engine. Continuing and combat training on a subsonic combat training aircraft represents 120 flight hours. The last stage of flight training is combat training on F-16 aircraft in the range of 150 hours (table 4.1.6, 4.1.7).

Table 4.1.6

The draft of flight program of continuing and combat training/combat subsonic aircraft 120 hours

Training type	Length of training (hrs.)
Basic piloting technique BPT	5
Circuits	10
Advanced piloting technique APT	15
Flight in small heights	5
Take offs and landings in pairs	10
APT in pairs	10
Flight in clouds in pairs	5
Navigation flights	10
Night VFR	10
IFR	10
Night IFR	5
Shooting at air targets	5
Air combat against each other	10
Shooting at ground targets	5
Bombardment	5

Note: Jevčák et al., 2020, p. 121

Table 4.1.7

The draft of a continuing training flighjt program (SEP 90 hours)

Training type	Length of training (hrs.)
Basic piloting technique BPT	5
Circuits	10
Advanced piloting technique APT	10
Flights in small heights	10
Take offs and landings in pairs	10
APT in pairs	10
Flights in clouds in pairs	5
Navigation flights	15
Night VFR	5
IFR	5
Night IFR	5

Note: Jevčák et al., 2020, p. 121.

Introductory / selective training LA (Light Aircraft)

Introductory training for a pilot – student provides mastering the take-off and landing of an aircraft, an introduction to a simple and advanced technique of piloting a small piston aircraft. It continues with navigation flights and emergency procedures and completing instrument training.

When using a light aircraft with a piston engine the cost of a flight hour of training is minimized and at the same time the pilot gets direct contact with the technique of piloting the aircraft, the so-called "Hand piloting". This type of aircraft piloting forms the basis for the technique of piloting any other type of aircraft in the future career of the pilot. It is decided about the capabilities of the student – pilot for the given profession and the continuation of the flight training, or some possibility to transfer a student to another study program after the end of (or during) the introductory training. Introductory training does not apply to variants A and B where a pilot´s valid PPL license is assumed.

The design of continuing training (SEP) is based on assumption that the pilot has mastered spatial orientation without problems, has no problems with the vestibular system, is not afraid of flying, has a correct estimate of distances, etc., and is ready to continue in further flight training. The continuing training includes other elements of advanced piloting techniques, low altitude flights and group flying in a pair of aircraft. Subsequently, the pilot completes flights in the continuing training of IFR and at night. In continuing training, the cost per a flight hour is again a

decisive factor in the choice of an aircraft. At this stage of training, it is desirable to fly as many exercises as possible which can be applied without additional costs for structurally more complex and costly types. The duration of the training is one year.

Continuing and Combat Training ATE (Aircraft Turbine Engine)

The next step in the career training of a tactical aircraft pilot should be the transition from a light aircraft with a piston engine to a jet engine type. Ideally, a training / combat subsonic aircraft with a jet engine appears. More powerful training / combat subsonic aircraft can also be equipped with more powerful instrumentation which provides the possibility of IFR training day / night. Continuing and combat training includes almost identical exercises as the continuing training (SEP) with adaptation to the aircraft type. The combat training is the top which includes shooting at air targets, air combat against one another, shooting at ground targets and bombing. The duration of the training is one year.

Combat training F-16

Training on the F-16 will initially take place in the United States as part of combat training. In the next period, after the training of Slovak pilots – instructors, combat training can continue in the territory of the Slovak Republic in the presence of the Mobile Team of Instructors from the USA. The design of the flight program of combat training contains all the necessary exercises that guarantee the full operational deployment of combat pilots after its successful completion. The duration of the training is two years.

Total training time for individual training models listed in tab. 4.1.4–4.1.8 was calculated based on the relations:

- **Model C, USA:** 3y. (Bc. Study) + 2y. (Ing. Study) ((LA + ATE)) + 2y. (F-16 in the USA) = 7 years
- **Model C, SR:** 3y. (Bc. Study) + 2y. (Ing. Study) ((LA + ATE)) + 2y. (F-16 in SR) = 7 years

The age for combat use depends on the starting age and the method of training given in tables 4.1.5–4.1.7. The pilot of a tactical aircraft should have flown at least 410 hours at the time of completion of training for combat deployment in the Air Force of the Armed Forces of the Slovak Republic.

The Ministry of Defense of the Slovak Republic has an increasing problem in obtaining quality and qualified young people for the position of professional soldiers in the Armed Forces of the Slovak Republic, which currently lacks thousands of professional soldiers. The reason is the declining interest of young people in joining the army, the declining quality

of those interested in the service of a professional soldier, the declining occupancy rate of professional soldiers and the increasing number of professional soldiers leaving the reserve.

The problems of personnel management and ensuring the required quality of soldiers and their numbers in all positions of the Air Force of the Armed Forces of the Slovak Republic are reaching a critical limit and it is necessary to significantly change this situation. The above statements become even more critical in the context of the introduction of new aircraft into the armament of the Armed Forces of the Slovak Republic, and in connection with the requirement for age limits for positions such as a pilot of supersonic aircraft, is desirable to review the current state of education and training and take effective measures to bring about change in this area. The quality of the educational process also significantly affects the future performance of pilots because pilots will use the skills and habits, acquired during initial / selective, continuing and combat training, throughout their career (see draft, table 4.1.8).

Table 4.1.8

The draft of a flight programe of combat training (combat supersonic aircraft F-16 150 hours)

Training type	Length of training (hrs.)
VFR flight (BPT, APT)	20
Groups (BPT, APT)	10
IFR flights (BPT, APT)	10
Night (BPT, APT)	15
Small heights (BPT, APT)	10
A-A combat training	40
A-G combat training	20
Reconnaissance flights	10
In- flight refuelling	5
Procedures of NATINADS (NATO Integrated Air Defence System)	10

The current performance of a pilot during a particular flight is conditioned not only by the quality of refresher training in recent months and in addition to the effects of the last days and hours before the flight and immediate effects during the flight. In the context of the above, both education of pilots and their current performance are an important factor for the level of air traffic safety.

The design part of the feasibility study in the form of alternatively elaborated models of training of professional personnel for the needs of the

Air Force of the Armed Forces of the Slovak Republic will provide an effective tool for decision-making processes.

The possible shortcomings and pitfalls of research are in national source limits (human, technological, financial). Comparing it with foreign studies of a similar type is necessary to understand the Central European environment for Armed Forces' transformation and development with the strong support of our aliens.

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