FLIGHT TRAINING DEVICES OF THE ‘SELEKCJA’ SYSTEM

Abstract
The article describes a comprehensive system of the ‘SELEKCJA’ system designed for the needs of flight training conducted at the Polish Air Force Academy. Selective training is the first stage of flight training aimed at preparing the candidates for the next stage that is a basic training. The selection in aviation is a continuous process which provides pilots to be verified on a daily basis. Flight training devices of the ‘SELEKCJA’ system used in flight training aim at improving the candidates’ selection process for the academy. After selective training in the aeroclub, training with the use of ‘SELEKCJA’ simulators is another verification tool. Computerized database of the system allows to track the progress of candidates to become pilots during their training on a military aircraft at the 4th School Aviation Wing. Additionally, the system contains all medical information on candidates while their stay at the academy.

Keywords: ‘SELEKCJA’ system, simulator, flight training devices, aeronautical training, air force, Polish Air Force Academy, aviation personnel.

Introduction
Based on the results of years of experience of a couple of airmen generations, it can be stated that flight training is specific, costly and long-lasting. It cannot be accelerated or reduced. Military aviation is a type of activity that requires versatility and aircraft piloting is a difficult and dangerous profession. The first step in education of military aviation applicants is recruitment and a selection of appropriate candidates for training in the air. The proper selection of candidates is associated with skills and experience of instructor staff and with a complex training system that has to be frequently adapted to changes occurring in aviation. Advanced aviation technology requires from military pilots a specific set of physical and mental features to fulfill sophisticated requirements of pilotage. New developments in military pilot training are supposed to select the best candidates precisely, prevent high turnover at further stages of training and manage the military pilots’ career properly.

The idea of a new concept of the Polish Air Force Academy cadets’ education and training which was implemented in 2012 is to ensure efficiency of a flight training process and adapt it to a new generation of equipment being at the disposal of the Polish Air Force Academy.

Armed Forces. The purchase of a modern training system is one of the stages in the process of transition of the training system into new aviation reality in Poland. Before the cadets start their practical training in the air with the use of a modern aircraft of advanced training in aviation Alma Mater, there is already the training system available which ensures preparation of candidates for military pilots for a transition into a school aircraft which will replace the worn-out TS-11 ISKRA.

In order to avoid mistakes at the pre-selection stage and to ensure an effective training of candidates for military aviation, a modern integrated system ‘SELEKJCJA’ was implemented since the academic year 2012/2013 at the Polish Air Force. Nevertheless, the system is a verification tool, additionally, it allows to track progress of the candidates during their training on military aircraft in the 4th School Aviation Wing. The aim of the article is to characterize the latest system of candidates’ selection for military aviation which was implemented in the Polish Air Force Academy in Dęblin in order to improve the process of candidates’ selection. It is worth emphasizing that the result of the research conducted in the Military Institute of Aviation Medicine and the Polish Air Force Academy is the system that is capable of candidates’ monitoring starting from recruitment to training in the Eaglets’ School and the 4th School Aviation Wing. Additionally, the system includes all medical information on candidates while they are at the academy.

The issue indicated in this article has been expressed as a query: What are the benefits of the implementation of the ‘SELEKJCJA’ system at the Polish Air Force Academy in terms of training of candidates for military pilots? The author was prompted to raise that issue due to the conviction that ‘SELEKJCJA’ system is a vital component of modern aviation training and it can contribute to better control of young pilots’ progress. It is also a tool for assessing the suitability of a candidate for a profession of a military pilot. Such qualities enable to save time and money during flight training and to choose an optimal professional career path.

The description of the structure and arrangement of individual elements, as well as the capabilities of the ‘SELEKJCJA’ system should allow to understand better the early stages of flight training, not only among professionals but also within wider groups of aviation enthusiasts.

‘Selekcja’ system – general information

The ‘SELEKJCJA’ system designed for the needs of flight training provided at the Polish Air Force Academy was created in the framework of the research and development conducted in the Polish Air Force Academy (PAFA) in Dęblin and the Military Institute of Aviation Medicine (WIML) in Warsaw. The system uses data from the WIML flight simulator laboratory, WIML overload tolerance laboratory and WIML overload tolerance laboratory.

---


3 On 27/02/2014 in Dęblin, the agreement was signed concerning supply for the Polish Armed Forces of AJT Master aircraft system which will replace the worn-out TS-11 Iskra and will provide possibility for training combat pilots of advanced training aircraft with flying characteristics and on-board equipment similar to the characteristics and equipment of highly maneuverable combat aircraft. This will fill the technological gap and will allow to conduct a comprehensive training of pilots designated for F-16 aircraft, see:http://mon.gov.pl/aktualnosci/artykul/najnowsze/2014-02-25-podpisanie-umowy-na-ajt/.

4 System - a coherent set of interdependent elements forming both theoretical structure and practical methods. Otherwise, a set of elements and relationships existing between them, creating a certain totality of a static or dynamic nature. For: Goźlińska E., Szlosek F., Hand dictionary of vocational training teacher, Biblioteka Pedagogiki Pracy, Radom 1997, p. 119.
aviation psychology department, and within training progress – from the Polish Air Force Academy in Dęblin.

Fig. 1. Selection system components

Source: Synthetic description of the results obtained in the form of an offer for companies, Annex 1 to the final report of research project No. 0014/R/T00/2009/08 entitled ‘Comprehensive system of assessment of suitability for the profession of a military pilot with the use of flight simulators’.

Based on the Polish Air Force Academy and WIML experience and technical equipment, individual components of a candidate selection system were developed and performed (see Fig. 1), namely:

– subsystem of psychological tests;
– flight training devices;
– subsystems of psycho-physiological parameter registration and analysis (mainly measurement of objective and subjective arousal of central nervous system, critical frequency of heart flicker, HRV, oculomotor characteristics, information processing speed and memory functions) under simulated and real flights with the use of combat training aircraft;
– subsystems of practical training in the air.

System used in ‘SELEKCJA’ is designed to collect and process data concerning candidates and cadets, enabling the assessment of suitability of candidates at the stage of recruitment to the academy and a continuous assessment of student-pilot progress during theoretical and practical training, and, as a consequence, an optimal selection of candidates for pilots to the appropriate aircraft. The system collects and stores data concerning PAFA trainee cadets.

---

5 See: Synthetic description of the results obtained in the form of an offer for companies, Annex 1 to the final report of research project No. 0014/R/T00/2009/08 entitled ‘Comprehensive system of assessment of suitability for the profession of a military pilot with the use of flight simulators’, p. 2.
6 Cf.: Final report on the implementation of a development project entitled ‘Comprehensive system of assessment of suitability for the profession of a military pilot with the use of flight simulators’, p. 5.
7 See: Final report on the implementation of a development project entitled ‘Comprehensive system of assessment of suitability for the profession of a military pilot with the use of flight simulators’, p. 58.
The arrangement of twenty-two working positions in three aviation institutions (see Fig. 2) involved in the training of candidates for military pilots is to ensure the most effective management of the ‘SELEKCJA’ system.

**Fig. 2. Locations of ‘SELEKCJA’ computerized system**

*Source: Synthetic description of the results obtained in the form of an offer for companies, Annex I to the final report of research project No. 0014/R/T00/2009/08 entitled ‘Comprehensive system of assessment of suitability for the profession of a military pilot with the use of flight simulators’.*

Software of individual working positions located in the Polish Air Force Academy allows to enter all data related to the use of simulators and practical flying, results of medical examinations and psychological tests. Access to the information is also provided to the PAFA’s commanding staff which makes it an invaluable tool supporting education process.

The working positions located in the Military Institute of Aviation Medicine allow to enter the data related to initial and recurrent examination results, as well as the data referring to psychological test results determining the suitability of the candidate for a pilot’s profession. Positions located in the 4th School Aviation Wing allow to analyze the conduct of practical flight training and to enter the data related to the results of completion of successive flights and to analyze flight already completed.

The ‘SELEKCJA’ system can be looked at through the prism of processes supporting both educational training and flight training (see Fig. 3). Information filtering allows for presentation of results of the conducted exercises. The results obtained enable a statistical analysis of completed flights and simulator exercises, a preliminary assessment of the results, as well as reports allowing to compare the

---

8 Rector - Commandant of the Polish Air Force Academy, Deputy Rector, Vice-Rector for students’ matters, Dean of the Aeronautics Faculty, Deputy Dean, Associate Dean have access to the information available in the system.

9 Aviation & Medical Military Commission, Psychological laboratory, Centrifuge has a working position with the possibility of entering data with the results of examinations conducted in the Military Institute of Aviation Medicine.

10 Three positions are located in the 41st School Air Base in Dęblin and in 42nd School Air Base in Radom and one post at the Chief of Training of the 4th School Aviation Wing.

11 Such processes, highlighted for the purpose of this system are: flight training management, “SELEKCJA” system administration and statements, print-outs and information filtering.
results of individual candidates with the results of other trainees. The information stored in the system that is located on working positions in the Polish Air Force Academy, in air bases of the 4th School Aviation Wing and in the Military Institute of Aviation Medicine enables an objective assessment of candidates for military pilots.

![Information related to cadets' education](image1)
![Information related to flight training](image2)

**Fig. 3. Types of data stored in ‘SELEKCJA’ system**

*Source: Synthetic description of the results obtained in the form of an offer for companies, Annex 1 to the final report of research project No. 0014/R/T00/2009/08 entitled ‘Comprehensive system of assessment of suitability for the profession of a military pilot with the use of flight simulators’.*

**Flight training device of the Polish Air Force Academy – ‘selekcioner’ simulator**

Flight simulator called ‘SELEKCJONER’ is used to verify skills of candidates for pilots of the Polish Air Force and to examine training progress and a further selection of PAFA’s students. The design of the simulator allows to perform studies of candidates and students on combat aircraft and combat helicopters equipped with the set of integrated on-board instruments, the so called ‘glass cockpit’, and equipped with the set of classic instruments. It is possible to conduct training in IFR conditions and training in combat tasks to a limited extent. Moreover, the simulator enables to perform psychological tests to evaluate the suitability of a person subject to the test in accordance with JAR-FCL requirements.¹²

![Image 1. The ‘SELEKCJONER’ simulator with a module to W-3PL Głuszec helicopter](image3)

*Source: author’s own material.*

¹² JAR-FCL 3 (Joint Aviation Requirements - Flight Crew Licensing 3 (MEDICAL). JAR-FCL3 provisions specify requirements related to civil aviation personnel, as well as the principles of psychological tests conducted among this group of persons. Despite the specifics of military aviation, it seems that they can be used as a reference while constructing the subsystem of psychological tests in the framework of ‘SELEKCJONER’ system, see: J. Ślusarski, *Subsystem of psychological tests with the use of ‘SELEKCJONER’ system simulator*, Dęblin 2012, pp. 2-4.
The simulator allows to conduct training in the following scope:
- taxi, take-off and landing procedures;
- aircraft/helicopter flying within specified performance range;
- VFR\textsuperscript{13} and IFR\textsuperscript{14} flying and landing;
- cross-country flights (VMC\textsuperscript{15} and IMC\textsuperscript{16});
- emergency procedures;
- radio correspondence.

Taking into consideration the results of the training allows the selection of candidates for military pilots.

Devices used in the system are in accordance with the requirements, modular structures which enable upgrading to new requirements and cooperation with other simulation devices\textsuperscript{17}.

The simulator consists of the following elements: combat aircraft cockpit built on the basis of F-16 cockpit, helicopter cockpit built on the basis of W-3PL cockpit, instructor’s working position with computers and monitors, visualization system and software\textsuperscript{18}.

**Combat aircraft cockpit built on the basis of F-16 cockpit**

For the purpose of the simulator, a simplified replica of F-16 cockpit was designed and constructed (see Img. 2). The cockpit is equipped with flight instruments displayed on LCD screens. Depending on the configuration (classic instrument panel or glass cockpit) the screens display instruments of a different shape and functionality. The displays are covered with masking panels with holes in places where the instruments are located. There are knobs and buttons on the masking panels. Most of them are operational, the remaining ones are dummies with shapes and colors similar to those in the actual aircraft. The cockpit can be provided with a central or side control stick. Stick replacement is very simple and can be made by simulator operating staff. Control stick and engine control lever are equipped with buttons, levers and knobs of HOTAS


\textsuperscript{17} Technical report on the completed development works entitled ‘Comprehensive system of assessment of suitability for the profession of a military pilot with the use of flight simulators’, Annex 2 to Final Report, Air Force Academy, Military Institute of Aviation Medicine Aerospace Industries Ltd., p. 6.

\textsuperscript{18} See: Final report on the implementation of a development project entitled ‘Comprehensive system of assessment of suitability for the profession of a military pilot with the use of flight simulators’, p. 50.
system. Functionality of HOTAS handles\textsuperscript{19} of central and side control stick is the same. The use of central control stick imposed a change in instrument panel geometry in relation to the actual aircraft. Nonetheless, it retains functionality necessary to conduct selective flights. Additionally, the cockpit is equipped with radio navigation instrument control panel which does not correspond to the system in use in a real aircraft but it allows to perform flights with the use of radio navigation aids. The cockpit is equipped with communication and sound amplification systems. The communication system is provided with earphones for communicating with an instructor. The sound amplification system contains loudspeakers allowing to simulate the sounds coming from a power unit, chassis, armament, etc.

![Image 2](image2.jpg)

**Img. 2. The ‘SELEKCJONER’ simulator with a module to F-16 aircraft**

*Source: author’s own material.*

The cockpit is equipped with its own PC for displaying instruments on LCD screens, simulating aircraft flight dynamics, simulating background sounds, communicating with the instructor’s position and generating voice commands to the psychological test system. Flight dynamics of the simulated aircraft allows to execute take-offs, climbing, maneuvers and landing. It has been adjusted to navigational characteristics of F-16 aircraft. The cockpit has been designed as a modular structure. It allows an easy replacement of cockpit components. Each desktop or a device such as a control stick, an engine control lever or pedals are connected via USB cable to a computer located in the cockpit. It allows for an easy modification or a replacement of cockpit elements\textsuperscript{20}.

### Helicopter cockpit

For the purpose of the simulator, a cockpit resembling a helicopter cockpit was designed and constructed. The shape of the cockpit resembles Mi-24 helicopter cockpit

---

\textsuperscript{19} HOTAS - Hands On Throttle And Stick, indicating the manner of control of modern military aircraft involving distribution of all avionics and armament control switches to be operated without taking hands off the stick and throttle. Currently, HOTAS control system is used in most combat aircraft.

\textsuperscript{20} See: Final report on the implementation of a development project entitled ‘Comprehensive system of the assessment of suitability for the profession of a military pilot with the use of flight simulators’, p. 50.
while the equipment corresponds to the equipment of the first (left) pilot of W-3PL helicopter. The cockpit is equipped with flight instruments displayed on LCD screens (see Img. 3). The LCD screen is covered with a masking panel with holes in places where the instruments are located. Changing classic instruments panel into glass cockpit version is conducted through the replacement of a part of the masking panel. This allows to change the instrument configuration. The control stick and collective pitch lever are not interchangeable. Additionally, the cockpit is equipped with a radio navigation instrument control panel which does not correspond to the system in use in a real helicopter but it allows to perform flights with the use of radio navigation aids.

The cockpit is equipped with communication and sound amplification systems. The communication system is provided with earphones for communicating with an instructor. The sound amplification system contains loudspeakers allowing to simulate the sounds coming from a power unit, chassis, armament, etc.

The cockpit is equipped with its own PC for displaying instruments on LCD screens, simulating flight dynamics, simulating background sounds, communicating with the instructor’s position and generating voice commands to the psychological test system. Dynamics of the simulated helicopter corresponds to W-3PL Głuszec helicopter.

![An instrument panel of the ‘SELEKCJONER’ simulator with a module of W-3PL Głuszec helicopter](source: author’s own material)

Each desktop or a device such as a control stick, an engine control lever or pedals are connected via USB cable to a computer located in the cockpit. This allows an easy modification or a replacement of cockpit elements.

**Instructor’s working position with PCs and monitors of computerized system**

The instructor’s position is designed to activate and supervises the exercises, as well as a simulator as a device. The instructor’s position was constructed as a desk with built-in three PCs of a simulator computerized system, an emergency power supply system (UPS), power management unit and monitors.

---

21 See: Final report on the implementation of a development project entitled ‘Comprehensive system of assessment of suitability for the profession of a military pilot with the use of flight simulators’, p. 51.
22 UPS – Uninterruptible Power Supply.
The instructor’s position is equipped with a console for launching and deactivating (in normal and emergency situations) of the simulator. It is installed with a control stick, an engine control lever and pedals for the instructor to take control of the student’s plane or to perform a flight in pair flights. Monitors installed at the instructor’s position display the following: simulator control interface, map, monitoring of training aircraft cockpit view, monitoring of training aircraft instruments, monitoring of an aircraft cockpit piloted by the instructor together with its instruments, monitoring of the camera placed above the projection system screen. Hardware consists of computers, monitors, manipulators (keyboard, mouse), loudspeakers, earphones with microphones, CCTV camera, Ethernet switching concentrator and cabling. The system has a modular structure and can be easily upgraded, maintained and repaired\(^\text{23}\).

### Visualization system

The visualization system consists of a front projection spherical screen with the field of view 180x60\(^\circ\), three projectors along with geometry, color and image correction system on the edges, as well as PC being the image generator producing a three-channel image with 60 Hz frequency\(^\text{24}\).

### Software

The simulator system includes both commercial programs and the programs designed specifically for the simulator. The following software controlling the operation of the simulator was designed, created, launched and tested: the instructor’s program, map program, virtual environment simulation program, visualization program, combined visualization and repetition program of F-16 and W-3PL, F-16 dynamics and installation program, W-3PL dynamics and installation program, F-16 instrument panel

\(^{23}\) See: Final report on the implementation of a development project entitled ‘Comprehensive system of assessment of suitability for the profession of a military pilot with the use of flight simulators’, p. 52.

\(^{24}\) Ibidem, p. 53.
program, W-3PL instrument panel program, F-16 cockpit controller program, W-3PL cockpit controller program, audio background simulation program. The applications are connected via computer network operating in UDP/IP standard\textsuperscript{25}.

The studies concerning candidates for military pilots with the use of ‘SELEKCIJONER’ flight simulator are conducted in aircraft and helicopter cockpits in a classic version. The main objective of research for this group is to determine their aviation suitability which is necessary for a pilot. Developed exercise scenarios involve performing simple elements of flight (see Fig. 4) which include, among others: straight flight, descending and climbing flight, turns in level flight, while descending and climbing\textsuperscript{26}. To illustrate performed tests, the graphic examples of the helicopter were shown, with similar tests performed while simulating the aircraft.

Fig. 4. An example of graphical flight plan in accordance with exercise no. 2 „Zone flight”


This is one of many possible exercise scenarios to be conducted on ‘SELEKCIJONER’ simulator forming part of the ‘SELEKCIJA’ system flight training devices. The entire assessment of the candidate is determined by the evaluation issued by the instructor based on the candidate’s behavior during mission performance. This assessment is affected by the following factors:

- response time to errors and received commands;
- divided attention abilities;
- an ability to make proper decisions and actions during flight;
- flexibility in flying;
- calmness and composure during task’s execution.

\textsuperscript{25} Ibidem, p. 53.

\textsuperscript{26} Ibidem, pp. 108-110.
Conclusion

The ‘SELEKCJA’ system was designed for the needs of flight training conducted at the Polish Air Force Academy. A comprehensive system supporting instructors and didactic and scientific staff of the Eaglets’ School enabling an effective and objective selection of candidates for pilots was developed by experts responsible for training of many generations of pilots in Poland\textsuperscript{27}.

The ‘SELEKCJA’ system is used for a systematic collection of test and simulator data characterizing candidates for military aviation, as well as persons being active military pilots. It is, therefore, a tool that can be used to conduct research on aviation personnel. Thus, it will provide systematic feedback on successfully qualified candidates, and subsequently, on professionally trained and improved military pilots\textsuperscript{28}.

The fact that the new training concept\textsuperscript{29} appears to be effective is proved by the results of PPL exams taken in the Civil Aviation Authority (ULC) by the Polish Air Force Academy cadets (see Fig. 5). Successful PPL exams were taken by the cadets admitted to the academy in 2012, 2013 and 2014. Among the group of successful cadets there were individuals\textsuperscript{30}, who joined flying group as a replacement of colleagues who were withdrawn from the pilotage specialization. Exam passing rate at the level of 100\% among jet aircraft pilots and transport aircraft pilots can be the evidence of high efficiency training in flight training organization of the Polish Air Force Academy.

![Fig. 5. Passing rate of PPL(A) exams among cadets in the period 2012-2014](image)

\textit{Source: author’s own material.}

Advanced technical solutions used in aviation require more simulator classes before moving on to practical exercises. ‘SELEKCJA’ simulators perfectly fulfill such a requirement applied in aviation. A potential pilot must operate a number of instruments at the same time and operation of advanced equipment is becoming more

\textsuperscript{27} The project leader was Marek Bylinka, Col. Pil. PhD, Eng., a former Vice-Rector of the Polish Air Force Academy for military matters.

\textsuperscript{28} See: J. Ślusarski, Subsystem of psychological tests with the use of ‘SELEKCIJER’ system simulator, Dęblin 2012, p. 22.

\textsuperscript{29} See: Concept of education and practical training of Air Force Academy cadets approved by the Minister of National Defence on 13.12.2011.

\textsuperscript{30} In cadets’ language called as ‘pursuit group’, who must catch up because of the later start of studies at pilot specialities.
important in piloting aircraft worth lots of money. Training with the use of the ‘SELEKCJA’ simulators allows to verify psychomotor skills of future pilots.

Dęblin experience denies the claim – the more kerosene the better mastery of flying skills\textsuperscript{31}. Training system, due to the use of ‘SELEKCJA’ flight training devices, allows to select candidates capable of handling military aviation difficulties and save on training of random candidates unable to work hard. Due to the capabilities of training devices, the ‘SELEKCJA’ system gives the possibility to perform various tests (see Fig. 6). During exercises, a student-pilot, while flying, performs different tasks, for example, in task no. 5.4b, he/she observes a map for a few seconds on a multifunction display, then, he/she provides answers (orally) to the questions, for instance, about the river or the number of cities/towns, etc. ‘SELEKCJA’ system is friendly not only for a student-pilot and an instructor, but also for a taxpayer. This is a fact not to be underestimated in the times of seeking a compromise between the quality and the cost of pilot training.

\begin{figure}[h]
\centering
\includegraphics[width=\textwidth]{figure6}
\caption{Example of graphical flight plan for the conduct of psychological tests}
\end{figure}


\textsuperscript{31} Cf.: Golawski A., Ikar vs cyborg, Polska Zbrojna nr 3(794), June 2012, p. 14.
The ‘SELEKCIJA’ system allows to combine data from three sources, for instance, from psychological tests, simulators and from theoretical and practical training. Such an approach gives maximum chances of counteracting the phenomenon of pilot-under-training turnover and selection of precisely individualized professional career path, for example, education, training and professional improvement of pilots and pilots - instructors of different types of aircraft in military aviation 32.

‘SELEKCIJA’ system allows data collection and control during all phases of flight training of candidates for military pilots. It would be reasonable to permanently place its elements in DęblinAeroclub, which is responsible for a selective training 33. This would ensure obtaining information on candidates for military pilots at the pre-recruitment stage.

‘SELEKCIJA’ system is an effective tool for commanding staff of the Eaglets’ School. A deep insight into student-pilots’ progress enables adjustments of curricula or even changes in organizational structures related to flight training. In the times of rapidly changing reality it may finally contribute to educating aviation personnel completely prepared to serve in the aviation of the Polish Armed Forces.

**BIBLIOGRAPHY**


Final report on the implementation of a development project entitled ‘Comprehensive system of assessment of suitability for the profession of a military pilot with the use of flight simulators’.


Synthetic description of results obtained in the form of an offer for companies, Annex 1 to the final report of research project No. 0014/R/T00/2009/08 entitled ‘Comprehensive system of assessment of suitability for the profession of a military pilot with the use of flight simulators’.

---

32 Ibidem, p. 23
On-line resources:
http://mon.gov.pl/