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Air Traffic Controllers Training in the Air Force Academy in Dęblin

T. COMPA[a], A. FELLNER[b] , H. JAFERNIK[b]

[a] Air Force Academy in Dęblin , WSOSP, Dywizjonu 303/12, 08-521 Dęblin, Poland

[b] Faculty of Transport, Silesian University of Technology, Krasińskiego 8, 40-019 Katowice, Poland,
EMAIL: henrykj21@interia.pl

ABSTRACT

Flight simulators are the media without which it is difficult to imagine flying personnel, technical service personnel and air traffic service personnel training. The present study concentrates on simulators and simulating techniques used in Air Traffic Service Training Centre WSOSP (Air Force Academy) in Dęblin

There are two centres equiped with ATC simulators i.e. Aviation Training Centre PAŻP and Air Traffic Service Training Centre WSOSP (Air Force Academy) in Dęblin. It can be said that the simulator used in Air Force Academy is a unique piece of equipment worldwide because several functions are combined in it. It is a simulating complex enabling to carry out air traffic controller training and forward air controller – "battle field operators" training

KEYWORDS: Air Traffic Controller, ATC, simulator

1.Introduction

An Air Traffic Service training centre (the second in Poland) has existed in the Air Force Academy in Dęblin since 5 October 2009. The training in the centre is carried out according to international standards. In Europe the training standards are cerommended by EUROCONTROL. For the time being, these are only recommendations, which the country can reject and introduce its own standards, defined in the national aviation law. In this situation, it can be expected that the national licence will not be respected in other European countries, despite the fact that e.g. training standards are consistent with the recommendations included in Appendix 1 (personnel licences) to Convention on International Civil Aviation.

EUROCONTROL has worked on the standardization of training in the dimension independent from national conditions for many years. The solutions recommended by the organisation mentioned above were adopted in the Air Traffic Service training centre established in the Air Force Academy in Dęblin. According to the EUROCONTROL standards, air traffic controller candidates undergo basic training giving knowledge essential for every controllerThe process of air traffic controllers training can be divided in two main phases, basic and advanced.

The aim of basic training is to prepare the candidates for on-the-job training, which prepares them for future job. After completion of theoretical training an examination is carried out, confirming acquisition of knowledge at appropriate level and readiness for simulator training.

The candidate who starts the training has to go through at least two phases, before he or she starts practical training:

- Phase I – Basic Training
- Phase II – Rating Training

After basic training the candidates are referred to practical training. Simulators are used on this stage of practical training.

Fig. 1. Tower module of the simulating complex (phot. T. Compa)

K. Kosarzycki, carrying out research in Air Traffic Agency, said: if an ATC candidate-trainee was placed on an operating position without any practical training, it would be an act of extreme irresponsibility. We would gain worldwide publicity in the negative sense of the word. Air traffic safety would decrease drastically because of:

- low rate of information processing
- longer reaction time to events
- quality of decisions
- divided attention
- quality of communication

Flying economy would also deteriorate significantly, because:

- assigned flight levels would be far from perfect
- assigned routes would be far less than optimal
- distances between aircraft would be far from the minimum
- decisions would be suboptimal and execution delayed

Effectiveness of on-the-job training would call into question.

Considering the above, it is concluded that initial training must be provided out of the operational positions. Therefore, ATC simulators are an essential part of the training system.

In the Air Force Academy the principle is that after passing the examinations allowing to train in the simulator, the training is moved from the lecture halls and laboratories to the rooms imitating functionally future workplace. The training based on the simulators lasts for about three months (50 to 70 hours per participant) and is divided in three advance levels.

Level one, where the amount of simulated air operations is limited and serves as familiarization with functioning of the air traffic control system as well as improvement of aviation phraseology.

Level two, working in the traffic of medium intensity, which serves as improvement of professional skills and ability to apply separation variously.

Level three, which is acting in the environment of high air traffic intensity and simulation of special situations, such as e.g. communication loss, failure of navigation aids, aircraft failure, sick on board, hijack, failure on board, aircraft fire, engine fire, landing gear failure, damage of navigation aids, landing with armament, collision on the runway, collision in the air, e.g. with birds and others.

2. Characteristics of Air Force Academy ATC simulator

In most cases, ATC simulators are built to individual order. They are not generally available, "off the shelf" products, because there is no uniform environment in which they work.

Tactical-technical requirements for the ATC simulator have been developed in the Departament of Air Navigation directed by Dr Tadeusz Compa. Considering the needs of Air Force Academy for simulating systems and modest financial capabilities, a bold assumption was adopted: to build a simulating complex, where air traffic controllers can be trained (airport, approach and precision approach) and forward air controller at the lowest purchase and operation cost. We thought that joining "three in one", needed simulators would be purchased considerably cheaper. Further operation cost of the complex would also be lower than in the case of single simulators.

We concluded, that a set of simulators must be a sophisticated tool for comprehensive training o fair traffic controllers in accordance with international standards and the forward air controllers in accordance with NATO standards. It was also concluded, that: the simulator is to enable both students' basic training and experienced controllers' training in emergency and dangerous situations, but also enable to carry out project work in the field of aviation procedures or airspace structures modeling.

Conceptually, the ATC simulator is a set of appropriately grouped workplaces of various types (see fig. 1)

The tower module is shown in figure 3, where there are:

- administrator's (instructor's) position – in the foreground;
- trained controller's position (on the left, in front of the screens);
- controller's assistant's position (in the middle, in front of the screens);
- ground traffic controller's position (on the right, in front of the screens).

Pseudo-pilots' positions are in a separate room, and the administrator's (instructor's) position can also be used

Fig. 2. Radar position: PAR (on the left) and APP (on the right), In the middle APP assistent's position (phot. T. Compa)

as a pseudopilot's position. Each instructor's position enables preparation and choice of different training scenarios and a direct monitoring of the training as well as controlling the status of simulated radars and navigation aids, weather conditions, etc.

Current situation in the sector of responsiblity is presented in the instructors' and assistants' positions of the tower module as well as radars. This enables issuing audio commands by pseudo-pilots, who executing these commands make changes to the flight parameters of aircraft in the sector of responsibility, or to the vehicles on the tarmac. The pseudo-pilot's position enables to modify flight parameters of planes in the sector or vehicles on the tarmac as a result of commands issued by the controller. Following can be done from the position: route, speed or altitude changes, approach maneuver, landing, information transfer from one pilot to another, operations connected with transponder code changes, adding or removing aircraft in the training sector and much more. The pseudo-pilot performs all the operations on the created routes, which in result give an impression of a real situation on the screens of remaining positions.

The radar module (see fig. 2) consists of two operating positions: precision approach controller's position (PAR) and approach controller's position (APP).

Function positions can be grouped in any way. It seems, however, that the best set enabling multi-sector training includes the teacher's position and two more groups of positions: controller's, assistant's and pseudo-pilot's position. All positions carry out separate functions, and there is a set of operating functions available to do this. However, a common feature of all positions is a possibility to present a selected area of airspace and operating situation.

Functioning of a simulator and its capability depends on the type and quality of the operating system. Distributed operating systems functioning in real time are used in aviation simulators. A real time system is a computer system, which functions parallel to the external process. The main functions of such systems are: monitoring, control and timely response to the events. The ATC simulator is a classical real time system, because simulation speed must be compatible with the speed of physical processes. Co-operation of the simulator and the real system is based on data and control exchange. Each simulated physical process of a continuous nature (e.g. movement of an aircraft in the airspace) must be simulated with a specific time step, whose value is defined by its designers in the assumptions of the system. The size of the time step must be a compromise between the accuracy of the object's work mapping and computational complexity (cost) of its simulation.

Simulated physical processes in the ATC system can be divided, considering their speed, into three kinds:

- rapidly changing processes (e.g. radar signals), for which the simulation step is in the order of a part of a microsecond and for this reason, it is not worth to process them directly in the computer, simulation of this kind of processes is performed in specialized external devices;
- medium changing processes (e.g. aircraft flight), where the simulation step is in the order of a second and the simulation is performed by means of an appropriate computer program;
- Slowly changing processes (e.g. clouds movement), whose simulation step is in the order of a few minutes and the simulation is performed in the computer.

The division presented above illustrates the way, in which speed of changes in a physical process determines the method and place of simulation. Representation of the actual speed of the course of events is particularly important in the case of training systems, because the training's aim is to develop correct responses of trained people in the environment of real changes rate of external processes coupled with real system's objects.

Opened In October 2009 simulating complex is the basic tool enabling realization of practical training – preceding OJT. The complex consists of following positions:

- airport controller's position (TWR);
- airport controller's assistant's position
- ground movement controller's position (GND);
- TWR instructor's position;
- position (terminal) handling flight plans;
- forward air controller's position (FAC);
- laser object pointer operator's position;
- FAC instructor's position;
- approach controller's position (APP);

- approach controller's assistant's position;
- APP instructor's position;
- precision approach controller's position (PAR);
- PAR instructor's position;
- external didactic module;
- pseudo-pilots' positions.

The set of devices for air traffic controllers training consists of two integrated modules: radar (APP, PAR) and tower (TWR, GND). Each operating position is equipped with appropriate panels, which exist in real work place, the instructor and the trained person can make changes to the environment with their help. Each position has the necessary equipment enabling execution of exercise (headphones, revolving chairs, software, manuals, consumables, tools).

The position for airport controllers' training (TWR, GND) is equipped with:

- large indicators of diagonal 52", presenting 3D picture of the airport and airspace above the airport in the visibility of 240 ° horizontally (to the left and to the right) and 70° vertically;
- widescreen indicator (monitor 21") to present information from the tarmac observation radar;
- communication control panel (of aviation radios, wired communication, intercom) based on VCS;
- control panel of radio navigation aids and airport lighting (monitor 21");
- control panel of braking devices;
- monitor (21") to present the results of local weather observation provided by meteorological station (cloud base, visibility, wind direction and speed, air pressure (QNH and QFE);

Fig. 3. Illustration of the team's of tactical airspace control potential area of operation on the FAC module's indicators (phot. T. Compa)

- ATIS terminal, enabling to place messages through the computer keyboard;
- monitor (21") to view the airspace situation in the vicinity of the airport (view from the radar of airport vicinity control);
- physical situations board (procedural bays) for learning procedural monitoring with
- the use of flight progress bars.
- FAC training position (see fig. 3) is equipped with:
- large indicators to illustrate the team's of tactical airspace control potential area of operation enabling to perform guidance from high and low altitudes, at day and night time, in different atmospheric conditions and battlefield conditions.
- laser object pointer

Controlling the battlefield objects is performed on a separate pseudo-pilot's position, which can be used simultaneously at the time of tightening cooperation of the pilot-FAC team within Close Air Support. It is possible to present on the pseudo-pilot's indicator the image seen from the cockpit through the pilot's eyes. It is very important in pilots' training in CAS and tightening cooperation of the FAC-pilot team. It should be stressed that the administrator's (instructor's) position can also be the pseudo-pilot's position.

FAC training position is a separate element of the simulating complex and is equipped with vision panels enabling to illustrate the hypothetical battlefield (3D). The display on large monitors enables to present an open, urban, mountain, water and land area – with all elements characteristic for the given environment.

Position for approach controller's training is equipped with:

- widescreen, raster indicator with a diagonal of 27" with electronic map containing the basic elements of the airspace;
- meteorological data view monitor with a diagonal of 21";
- physical situations board for procedural monitoring with set of standard holders;
- means of communication control panel;
- module signaling operation of instrumental landing approach systems (ILS, VOR, DME, NDB).

Position for precision approach controller's training (see fig. 4) is equipped with:

- widescreen, raster indicator with a diagonal of 27" with incorporated electronic descent path and the flight path;
- meteorological data view monitor with a diagonal of 21";
- means of communication control panel;

It is possible to carry out independent operations on each position and cooperate with other operating

Fig. 4. Precision approach controller's position: on the right GCA 200 radar indicator, on the left weather information indicator.

positions (not applicable to FAC). Each training position has equipment like the equipment of operating positions in the airport tower.

A simulator provides the opportunity to register exercises (including voice communication), to replay the exercise record, to stop the record at any time and repeat the exercise from a certain point to prove, and then eliminate the mistakes made by trainees.

A communications system provides phonic communication between trained people, instructors and pseudo-pilots who execute commands of the trained in real time, making changes to the aircraft flight parameters or vehicles movement. A communications system provides the hotline functions allowing direct communication between workstations without the communication channels in use. Communication between the trained and pseudo-pilots is carried out with the use of headphones and speakerphone devices.
The simulator consists of three main modules: Tower, Radar and FAC.

Tower module has following application features:

- It allows display of aircraft with which the controller will have contact and provides a realistic view of the environment from the tower (it provides visibility of the aircraft at a distance of about 5 km - with good visibility). The simulator's system software has a database of aircraft which military and civil aviation of NATO countries are equipped with.
- It has the ability of imaging vehicles that are commonly used on military and civilian airports: trucks, tugs, "follow-me"-type vehicles, repair vehicles, lighting runways vehicles, rapid response cars (ambulances, firefighting vehicles, vans), snow ploughs, maintenance trucks, runway repair cars. System software can recognize them from a distance of 3 km, in good visibility. The possibility to supplement the database with new vehicles introduced as aviation equipment is ensured.
- It has the possibility of programming tactical operations and changing combat formations during the flight. The software allows to make changes in the flight parameters of airplanes quickly, especially their speed and behaviour in different flight phases. Terms of flight simulation parameters correspond to the performance of military and civilian airplanes and helicopters, faced by controllers in operational practices. There is a possibility of programming formations, making collections, dissolving aircraft, action of the type: leaving and entering the formation, simulated fire fighting and various other emergency procedures.
- It allows to change quickly scenarios of emergency situations that require the trainee to respond adequately in the field of emergency in the air and on the ground. The software allows to simulate an emergency landing of military and civilian aircraft and operation of emergency services. The software allows mapping of dangers connected with the flight as well as other risks, such as birds, weather conditions, etc.
- Allows to visualize the complete airport environment, including configuration of runways and taxiways, aprons, aircraft armament plane, airport's basic equipment (navigational aids, obstacles, etc.), the natural terrain surrounding the airport, objects built by man (hangars, pilot's house, etc.) and obstacles as seen from the tower. Three-dimensional model (3D) of the airport and terrain allows to watch the airport's surface at any angle and from any level.
- It reflects realistically the seasons, time of day and weather conditions, including changing clouds layers, different levels of horizontal and vertical visibility, changing weather conditions, information about wind, conditions on the runway. Moreover, it reflects the appearance of clusters of clouds and the typical phenomena associated with different configurations of clouds, for example: a non-developing layer of clouds, precipitation of low intensity, clouds causing heavy rainfall and thunderstorms.
- It has the ability to change the visibility of objects, depending on the light intensity due to e.g. overcast developing, rainfall, fog.
- It maps the conditions on the runway and any related actions that may arise during occurrence of rain, snow, freezing drizzle, etc. They include a wet runway, dense snow, ice, loose snow and other conditions that cause a threat to aircraft. Weather conditions from meteorological observations are presented on a separate monitor.

- It allows to display information including the times of the day to enable the controller to carry out training in a realistic environment. The system reflects the situation at different times of day: daytime, dusk, night and dawn with light at these times.
- 10.It provides a "view with binoculars" from all positions. The "view from the binoculars" enables to check the aircraft undercarriage and flaps ejection and fuselage damage caused by the use of arms, collision with birds or other aircraft. Close-up made with binoculars conforms to the standards for air traffic controller in 10x50 magnification.

The radar module consists of two operating positions (APP and PAR) and allows the training of procedural approach controllers, radar approach controllers, APP assistants, precision approach controllers (PAR), and assistants.

Approach control simulator is characterized by the features described below.

- It allows Primary Surveillance Radar (PSR) and Secondary Surveillance Radar (SSR) to generate radar signals. It is possible to work on only the primary or the secondary representation or representation derived from both the PSR and SSR.
- It allows to initiate the primary position of the moving aviation objects at any points of virtual airspace described by geographic coordinates or polar coordinates in relation to the station. Moving objects generated in the imitator's computer and visualized on the indicators' screens are characterized by a full representation of the flight parameters – active objects, partial representation of the flight-tactical properties – inactive objects.
- The range of visibility on the primary observation is about 60 NM, and on the secondary observation about 100 NM. The altitude of detection and object tracking – up to 20,000 m.
- Display of radar information on the indicator is presented in the form of:
  - › blips – information from the Primary Surveillance Radar
  - › radar position symbol with a tag – information from the Secondary Surveillance Radar;
  - › correlated blips with radar position symbols with tags – information from the PSR and SSR.
- The tag contains: aircraft identification (call sign and transponder code), altitude (flight level), velocity vector, the history of flight (trace of the last five positions/items).
- An electronic map, which the instructor can modify freely, is applied to the indicator, as well as distances and azimuths grid. In addition, there is a graphical map editor that allows to modify the map in any way.
- The calibration is from 10 NM to maximum range, every 10NM, with the possibility of changing the means of representation. The indicator is calibrated in SI and English units. The instructor can select units of measurement.
- Approach control simulator allows to determine aircraft position by latitude and longitude, the navigation aids, reporting points, and significant off-road facilities.

Approach control simulator has the following functions:

- › enables automatic coordination (hand - off function);
- › indicates duplicated SSR codes;
- › indicates undervaluation of separation;
- › indicates the use of alarm codes;
- › displays occurrence and movement of storm clouds, heavy rainfall and other dangerous weather phenomena;
- › allows to introduce atmospherics, interference caused by reflections from solid objects and those resulting from anti-radio-electronic effect (use of foil, dipoles, etc.).

- The simulator software provides generating and presentation on the indicators graphics and coordinates entered by the instructor or trainee.
- The indicator is operated with the help of a friendly graphical interface.
- The precision approach control simulator (PAR) has the following parameters and properties:
- The range is more than 15 NM, descend path angle -1^0 do + 7^0 with a possibility of smooth adjustment, the sector coverage in azimuth 15^0 to the left and to the right of the axis.
- Display of the aircraft on the indicator in the form of a blip with a tag. The tag contains ID of the flight, the altitude by QNH or QFE, the history of flight (the last five positions/items). The size of the blip allows for the actual size of the aircraft (reflectivity surface).
- The range of coverage of the system in the elevation, radar location, touchdown point, a line of decisions altitude, the line of descent path, the line of minimum safe altitude, the line of touchdown altitude, marker of the information about the system, range marker, terrain obstacles, dangerous weather phenomena (storm clouds, precipitation), controlled axis of the runway, runway axis extension are displayed on the indicator.
- The indicator is calibrated in SI and English units. The instructor selects the used units of measurement.
- The Simulator provides:
  - › signaling the use of alarm codes;
  - › signaling safe altitude exceeding;
  - › signaling descent below decision altitude;

› signaling the aircraft leaving the path of the flight route;
› allows to introduce atmospherics, interference caused by reflections from solid objects etc.).

Imitator of communications, based on the VCS, imitates the work of multi-channel radio and telephone communications between the trainees. It allows:
› selection respectively - one of a dozen - radio channel;
› calling pseudo-pilot and establishing communications with it;
› choosing between two types of work loudspeaker - microphone or headset;
› controlling the volume level of received audio signals;
› introducing of interference characteristic for „ground-plane" communications;
› recording and replaying of communications.

The simulator is capable of simulating various specific situations that may arise during the flight, such as: collision with another aircraft in the air, collision with an obstacle on the airport's maneuvering area, wheeling out the runway, tire damage during take-off, tire damage during landing, brakes damage, loss of direction during take-off, loss of direction during landing, aircraft engine failure in the airport area, damage to the aircraft control systems, landing with damaged undercarriage, landing without flaps, landing on the remains of fuel, loss of communication with the aircraft, aircraft's guidance and navigation system's (instruments') failure, landing with suspended armament, the emerging of obstacles on the runway, landing on a damaged runway, landing on the taxiway, landing on a grassy part of the airport, engine fire, aircraft fire, crew fainting, loss of spatial orientation, loss of geographic orientation, emergency descent of the aircraft, depressurizing of the cabin at high altitude, operation of airport services in the case of hijacked aircraft landing, operation of the airport's rescue in various situations encountered during the flight.

3. Conclusion

Significant training and economic effects are obtained thanks to the use of simulators in the process of basic training and perfecting skills of ATC controllers.
The benefits include:

- Practical training and testing of new methods of operational activities and developing controllers' of different operating positions abilities to cooperate.
- Developing effective methods of emergency action limiting functioning capabilities of the ATM system.
- The possibility to train complex procedures in complicated traffic situations, and at heavy overloads of the system.
- Developing motor responses for certain procedures and ability to perform operations assigned to specific workplace efficiently;
- Modeling and testing used or modified procedures, as well as verifying the assumptions in order to develop optimal solutions.
- Conducting periodic inspections of the level of controllers' qualifications according to uniform methodological principles, and also conduct of examinations.
- Faster mastering of skills needed in the workplace.

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