How to Evaluate the Actual Psychological Readiness of Atco

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Abstract

The main goal of this article is to study the importance of the impact of the human factor in aviation. It analyses the factors which affect the work performance of air traffic controller and possibilities of increasing or decreasing the level of safety during the training phase. The aim is to point at the circumstances that could affect the work performance in the air traffic control. A work performance is measured by a verification device designed by Flight preparation department.
KEY WORDS: *air traffic control; psychological readiness; human factor*

1. Introduction

The air traffic controller ensure the safety of aircraft by authorization of the statement to each aircraft. Due to this statements is possible to ensure the minimal horizontal or vertical separation. It is in the air traffic controller's responsibility to secure arrivals, departures and the movement of the aircraft on the airfield. All these activity is in duty for 24 hours a day. A prevention of collisions is known as separation and this term means assuring the safe distance between each aircraft by sides, vertical and longitudinal minimums of a separation. The air traffic controller needs to assure a high level of a capacity of air space. The work performance is connected with the high demand on the individual characteristics, a knowledge, an abilities and of course an individual responsibility of the air traffic controller. The air traffic controller presents the last executive section in the system of the air traffic control. He or she has the absolute responsibility for theirs acts.

2. Research of ATCo Training

The object of research is presented by students, whom study on study program of the air traffic controller at the Department of the Flight Training. The students are systematically and organizationally watched out, during the practical training on the simulators of the air traffic control. Scientific is trying for maximization the objectivity during the observation and evaluation of students.

Before the practical training on the LETVIS simulator, which simulate surveillance air traffic control, students passed the theoretical preparation in the field of civil aviation in the mandatory subjects Aviation Law, Air Traffic Control, Meteorology, Navigation, Aircraft, Human Factor, Equipment and Systems, Professional environment, Radio-communication, Aviation English. All these subjects are passed within Commission Regulation (EU) 2015/340.

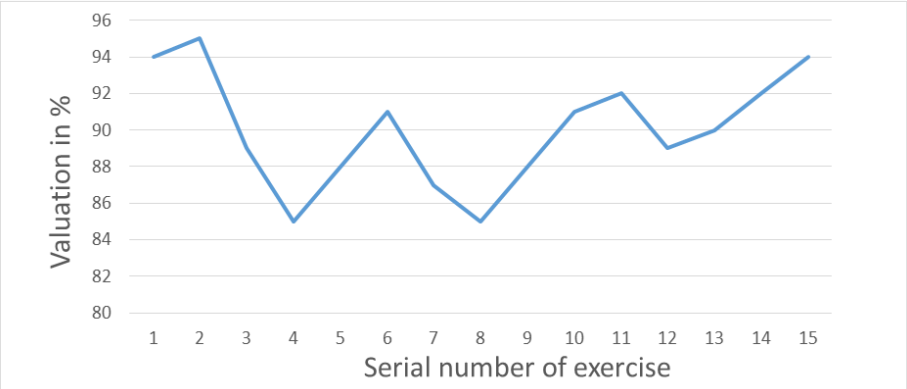

Fig. 1 Average rating

The training programme at Faculty of Aeronautics in the field of practical control consist of 15 practical exercises in the surveillance control on the LETVIS simulator. This is prevented by training on the simulators of the

procedural control. In the years 2010-2015, 56 ATCo passed the practical training. During the practical training there are 6 parts monitored: Safety, Air Flow, Economics, Air Situation Overview, Phraseology, Reports and Instructions. The general results consist from monitored parts, which were already mentioned. The Fig. 1 shows the average results of 56 ATCo.

The behaviour of the exercises could be presented in the general results as directive. The definition of the average general results is needed for evaluation the students individually. The each exercise have different intensity and it is not possible to expect 100% fruitfulness from the students. Thanks to the established average evaluation, it is possible to monitor abnormality of the student's results in a dependence on the measured data with the verification equipment. Before every practical exercise, the ATCo need to take a test on the verification device, which should define his or her actual psychic readiness [3].

3. The Response Time Measuring

The response time conditional the most on genetics, what means that is least developed by training. It belongs to structure of kinetic abilities. It's possible to divide it to simple, when individual reacts only on one suggestion, or complicated, when there is more suggestions to react on. The response time consist of few characteristics. The main characteristic of a reaction time is represented by the time of reaction. If the reaction time is better it means that the time of reaction is shorter. For the needs of measuring the response time of the air traffic controller the verification device was created, for the purpose of the measurement the response time of an answering at the random generated task. The verification equipment follows the speed of the response time, a correction of a motoric function and the reactions on the aural and visual stimulations in the testing group. [2] [4]

A verification device has been designed at the Department of the Flight Preparation in order to measure the response time in an answering randomly generated tasks. The verification device monitors the subject's rate of reaction, the proper motor function, and the reaction to aural and visual impulse. The verification device includes: Monitor, PC, 3 hand-operated buttons, 2 foot-operated buttons, keyboard with numerals 0-9, and MBED. Individual components are shown in Fig. 2. After running the test, the screen shows three sectors. In the each sectors 2 yellow, 2 blue, and 2 green points of the same size and shape are shown. Within the each sector, a red point of the same size and shape can also appears. A pair of points of the same color is spaced 150 px apart. In the each sector there may be an approximation of the same colored points by 30 px.

The system randomly generates six tasks:

- 1 * button left hand-operated (H1)
- 1 * button middle hand-operated (H2)
- 1 * button right hand-operated (H3)
- 1 * button left leg-operated (L1)
- 1 * button right leg-operated (L2)
- 1 * button for sound (sound 0-9)

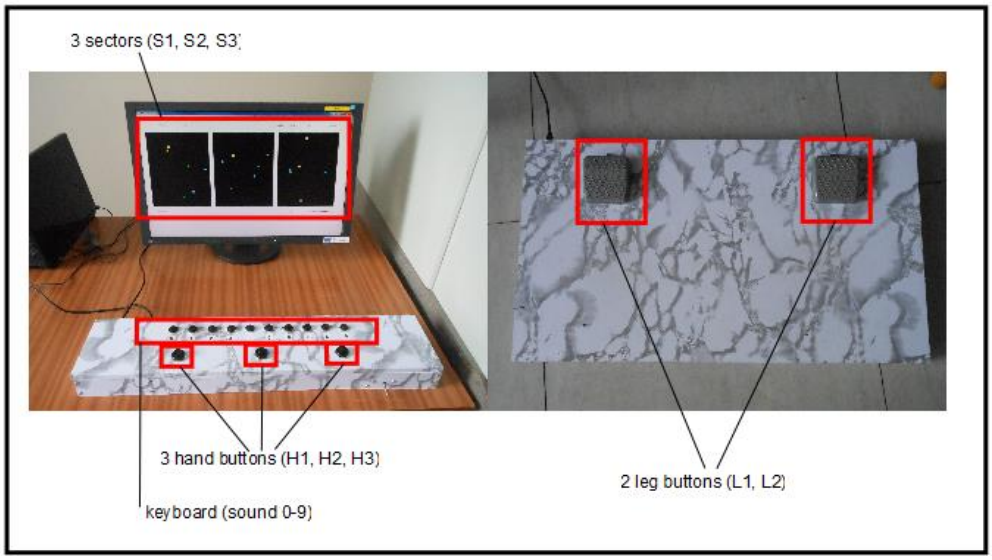

Fig. 2 Verification device

At the start of the each new set of 6 tasks, the system automatically launches beeps at the regular intervals of 2 seconds. The maximum number of beeps is set by the software and is limited to 9. The system evaluates the correct and incorrect answers. If there is a convergence of two points of the same color in the sector 1, the system considers the pressing of button H1 for the correct answer. If there is a convergence of two points of the same color in the sector 2, the system considers pressing button H2 as the correct answer. If there is a convergence of two points of the same color

in the sector 3, the system considers button H3 as the correct answer. If a red point appears in the sector 1, the system considers the pressing of the foot L2 button as the correct answer. If a red point displays in the sector 3, the system considers the pressing of the foot L1 button as the correct answer. If a red point appears in the sector 2, the system considers the correct answer as pressing of the SOUND 0-9, depending on the number of beeps. The time for getting the correct answer is limited by the software to 60 seconds. If the correct answer is not entered in time, the system writes the letter N (unanswered task) to the file, as well as the number of incorrect responses to the task, and then generates a new task. The system is fully automatic and does not require any additional control persons who would oversee the fairness of the test [1].

4. Measurment of Actual Psychological Readiness of ATCo

For testing of the psychological readiness of the air traffic controller, 95% confidence interval for the mean error ratio was constructed. It was assumed that the random selection error ratio has normal distribution Nμ, σ2, where μ is the mean and σ2 is the variance (standard deviation) of the error ratio. The normal probability distribution was used because of the law of large numbers (central limit theorem), every probability distribution converges to the normal distribution with a sufficient number of attempts. The random selection is formed by random variables X1, X2, ..., Xn – error ratios of samples 1, ..,56. [5][6]

100(1-α)% confidence interval, in general, can be expressed as:

$$(\overline{X}-\frac{s}{\sqrt{n}}t_{1-\frac{\alpha}{2}},\overline{X}+\frac{s}{\sqrt{n}}t_{1-\frac{\alpha}{2}}), \tag{1}$$

X - selective median; *S* - selective standard deviation of random variables; *t* - student distribution with *n*-1 degrees of a freedom at the significance level $\alpha = 0.05$.

$$\left(\overline{X}-\frac{s}{\sqrt{n}}t_{1-\frac{\alpha}{2}},\overline{X}+\frac{s}{\sqrt{n}}t_{1-\frac{\alpha}{2}}\right)=(295;308). \tag{2}$$

Error ratios of the tests are made of random variables:

$$Y_1,Y_2,\dots,Y_n.\ \text{if}\ \ \overline{Y}\in(\overline{X}-\frac{s}{\sqrt{n}}t_{1-\frac{\alpha}{2}},\overline{X}+\frac{s}{\sqrt{n}}t_{1-\frac{\alpha}{2}}). \tag{3}$$

The lower limit of the confidence interval can be set to 0, since below the mean error ratio – as the lower limit of the confidence interval –means better mental condition. Thus, in the test program, the condition:

$$\overline{Y}\in\langle 0,\overline{X}+\frac{s}{\sqrt{n}}t_{1-\frac{\alpha}{2}}\rangle=\langle 0,308) \tag{4}$$

was tested to decide whether the air traffic controller is mentally prepared to do the task.[1]

5. Error Ratio in Different Types of Tasks

From the measured results was randomly choose 100 of testing's subjects, each about 300 task, where occurred 2439 wrong answers. A ratio of the mistakes are displayed on the Fig. 3.

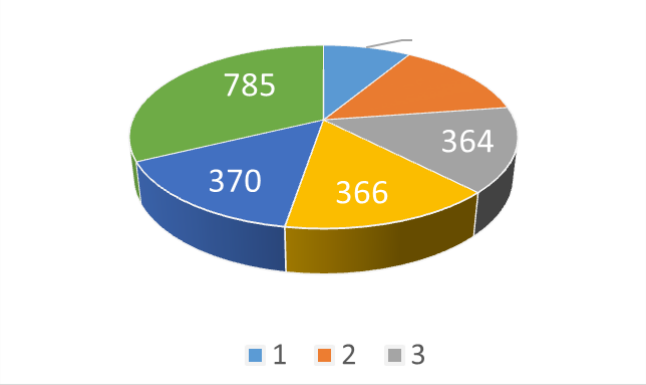

Fig. 3 Error ratio in different types of tasks

By the measuring of the response time the following was figured out:

- Average response time at 1 task - 0,892962 s;

- Time, when averagely the one mistake occurs - 10,98 s;
- Approximation of two same colored points in the sector 1 – error rate 8,69%;
- Approximation of two same colored points in the sector 2 - error rate 14,02%;
- Approximation of two same colored points 3 - error rate 14,92%;
- Red point in the sector 3 - error rate 15%;
- Red point in the sector 1 - error rate 15,17%;
- Red point in the sector 2 - error rate 32,18%.

As the most difficult seem to be the task, where the aural section are included, its established on the level 32, 18% from all the errors.

6. Conclusion

The article is addition in solving the problems of the human factor in the air traffic control. This affects the level of safety in the air transport. The article consist of the methods, which allows the monitoring of the absolute overload of the air traffic controllers. This could influenced the level of the safety in the each process in the system of the air traffic control. This problems is closely connected with the process of increasing the capacity of the European air space.

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