

Human factor as a cause of aircraft accidents

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Abstract. The human factor in aviation is the system and many sciences concept directly connected with flight safety and professional reliability of personnel. According to preliminary assessment of the Interstate Aviation Committee (IAC) the human factor is a dominant cause of aircraft accidents. The purpose of the date is identification of significant events of aircraft accidents were caused by human factor and justification the directions of aviation psychology for their prevention. The method is analysis of flight safety in civil aviation of contracting states of the Agreement on civil aviation and airspace use from 2012 to 2018 (reports of flying safety: www.mak-iac.org). Results of accidents were caused by human factor in 2012 accounted for about 80%, in 2013 – more than 83%, in 2014 – 82%, in 2015 – 70%, in 2016 – about 94%., in 2017 – more than 80%, in 2018 – 75%. So, the number of accidents were caused by human factor in flight and maintenance operations remains substantial without significantly downtrend. Relevant directions of accident prevention by aviation psychology are as follows: -working out techniques of balanced training using simulators and in the real flight; -development of modern methods of developing the ability to make decisions in emergencies; -introduction of psychological selection which helps to assess the prospects for personal development in professional aviation; -study of professionally important qualities in ground service specialists.

Keywords. Human factor, pilot, aviation psychology, aircraft accidents, flight simulator training.

I. INTRODUCTION

The human factor in aviation is the system and many sciences concept directly connected with flight safety and professional reliability of personnel. According to the Interstate Aviation Committee (IAC) the human factor is a dominant cause of aircraft accidents [1]. Therefore, human factor research at various aspects are relevance.

II. OBJECTIVES

The purpose of the date is identification of significant events of aircraft accidents were caused by human factor and justification the directions of aviation psychology for their prevention.

III. METHOD

The method is analysis of flight safety in civil aviation of contracting states of the Agreement on civil aviation and airspace use from 2012 to 2018 (reports of flying safety: www.mak-iac.org).

IV. DISCUSSION

Results of accidents were caused by human factor in 2012 accounted for about 80%, in 2013 – more than 83%, in 2014 – 82%, in 2015 – 70%, in 2016 – about 94%., in 2017 – more than 80%, in 2018 – 75%. So, a number of accidents were caused by human factor in flight and maintenance operations remains substantial without significantly downtrend.

Between 2012-2018 the common reasons of accidents connected with a human factor were named, the least of which are: violations of flight rules, pilots training and maintenance operating; lack of necessary experience of the high-automated planes piloting, inadequate level of crew proficiency for manual piloting; spatial orientation loss by aircraft crews and entering into spatial position; insufficient training and responsibility of pilots-instructors and instructors-examiners; pilots' overestimation of their skills and capabilities; loss of control in flight; unwarranted maneuvers at the altitudes and with speeds below specified minima followed by rolls and pitch attitudes exceeding aircraft operating limitations, leading to aircraft stall; poor knowledge of flight area/route, neglecting/ignorance of meteorological conditions; flight operations conducted in condition of alcohol intoxication and other circumstances.

In that period the fundamental recommendations to develop and implement English language proficiency requirements for flight personnel as well as for aircraft maintenance and ground handling personnel performing operations on aircraft having maintenance documentation in English; a systematic approach to prevention and detection of aviation staff's addiction to psychoactive substances; the studying of somatogravic illusions emergence and action mechanisms and their prevention in crews training programs were given repeatedly.

Taking into account the unrelenting percentage of accidents connected with human factor in flight and maintenance operations IAC sees fit to develop comprehensive targeted programs on all aspects of human factors safety impact.

In the history of aviation psychology in Russia the first concept explaining human influence on aerial accidents was a concept "personal factor" [2]. In 1920s of the 20th century S.E. Mintz analysed circumstances of aircraft accidents and came to the conclusion about their relationship to the psychological features of pilots. In 1930s of the 20th century N.M. Dobrotvorskyy proved the facts of a pilot errors as a result of airplane imperfection. N.M. Dobrotvorskyy formulated the thesis that the aircraft equipment and device should be made available for pilots with intermediate level of skills.

In 1940-1960s of the 20th century S.G. Gellerstein studied high accident rate and defined a personal factor as a complex of all innate and acquired physical and mental characteristics of a personality that may be connected with causes, the course of process and result of an airplane crash [2].

However, firstly such approach has considered only typological and individual characteristics of a pilot and has disregarded the reason of aviation incidents of technical, ergonomic and administrative character and secondly has recognized negative psychological characteristics of a pilot (indiscipline, assertiveness, conflicts, et.) as a typical cause of aircraft accidents. This idea led to biased conclusions.

In 1970 the USSR joined ICAO (International Civil Aviation Organization). ICAO codifies the principles and techniques of international air navigation and fosters the planning and development of international air transport to ensure safe and orderly growth. The Air Navigation Commission (ANC) is the technical body within ICAO. International Standards And Recommended Practices are developed under the direction of the ANC through the formal process of ICAO Panels. The concept "human factor (human factors)" was recorded in official documents of ICAO and became widely accepted [3].

In the 1970s of the 20th century it has become clear that the human factor compared with the personal factor reflects cause and effect relation in the investigation of each aircraft accident more fully and objectively, encompassing daily living of the aviation organization.

N.D. Zavalova, V.A. Ponomarenko, G.M. Zarakovsky, V.V. Lapa, V.A. Bodrov gave the definition of human factor as an attribute of flight safety in military and civil aviation. According to V.A. Ponomarenko the human factor is cumulative quality that integrates all elements of a transport system carrying out regulatory function for useful effect [4].

D.V. Gander emphasizes that the human factor is a reliable and effective interconnection between characteristics of human activity and the equipment. The term "human factor" includes assessment methods of flight personnel, elements of operating environment, factors of a flight, professional skills, regulation, management, ensuring of training and labour [5].

Now, the terminology "Human Factors" is official in international papers, for example, in Aircraft Handbooks recommended by Federal Aviation Administration USA. Human Factors include: Mental State; Human Limitations; Emotional State; Physical State; Environmental Conditions; Human-Machine Interface; Human Capabilities. Human

factors are comprised of many disciplines. They are: Clinical Psychology, Experimental Psychology, Anthropometrics, Computer Science, Cognitive Science, Safety Engineering, Medical Science, Organizational Psychology, Educational Psychology, and Industrial Engineering [6]. Under the methodological tradition in Russia is commonly realized that a human factor is studying such as branches of sciences as aviation medicine, aviation psychology and aviation pedagogy with their differentiation and specialization.

By ICAO definition, "The human factors is a science about people in their living and working situations; about their relationship with machines, with procedures and with the environment about them; and also about their relationships with other people (at work). In aviation, Human Factors involves a set of personal, medical and biological considerations for optimal aircraft and air traffic control operations" (ICAO, 1989, ch.1, p.2). V.V. Kozlov opined that this definition 1) joins the concepts of a personal factor and a human factor and 2) most closely meets the standards of up-to-date civil aviation [7].

V. FINDINGS

Consider some studies, related to a human factor in aviation. In the article dedicated to analyzing the practical impacts of integrating simulation-based training into an *ab initio* pilot-training course, the interesting knowledge was taken: the integration of simulation was found to have 2 primary impacts. Although a small decrease in aircraft training hours was evident, there was also a significant increase in the overall training time once simulation-based training was incorporated.

As it turned out, the integration of simulation was found to have 2 primary impacts, namely although a small decrease in aircraft training hours was evident, there was also a significant increase in the overall training time once simulation-based training was incorporated. The authors concluded that simulation will always provide significant safety and risk-reduction benefits to flight training; however, when considering the practical implications of integrating simulation-based training, the current data provide a cautionary tale that positive outcomes for training efficiency and cost-effectiveness are not always guaranteed. So, more targeted inquiry is still needed to assist flight schools to properly operationalize the findings from the research literature to effectively integrate simulation into their flight-training curriculums [8].

I.M. Zhdan'ko, A.A. Vorona provided to develop a complex of important qualities necessary for a military aviator like stress tolerance, disorientation resistance, image thought, mental flexibility, intellectual ability, immunity, physical courage. These qualities determine high performance in unity of space-time under the conditions of the combined actions. Advanced learning tools are: dynamic stand as modelling of maneuverable overloads, changing spatial visibility conditions of combat, different types of a pilot's disorientation; varied flight simulator training that aim to create great professional skills [9].

Successful professional development is based in large part on preliminary preparation in school days. So, aviation psychology focuses on promoting improved and upgraded methods of professional orientation. Future pilots must gain

the adequate knowledge about this dangerous profession, to create and enhance educational and career motives. The role of cadet troupe, Suvorov Military Schools, general education boarding schools with initial flight training is very importance for professional orientation in aviation [10].

The methodology of professional selection in aviation is directed to diagnostics of certain physical, psychophysiological, psychological, personal qualities. Such integrated approach is reasonable and balanced. In our view, development of personally-oriented forecast assessment of success in aviation, first of all, the basis features of motivation, readiness for self-education, ability to cooperation is huge opportunity for professional selection [10, 11].

Reliable interaction of ground crew (for example, air traffic controllers) also provides aviation safety. Technology of operating is continually being improved, but neuropsychological tension of personnel still remains relatively high. For example, the study by M.A. Bolotova, V.V. Kupin, M.V. Petrova looked at professional health of air traffic controllers based on the assessment of body functional reserves. Particularly, in the homogeneous sample of examined persons reduced adaptation functional reserves in terms of parameters of vegetative and regulatory body systems are shown to correlate with the length of service. This decline also indicates the presence of chronic occupational stress.

The most important component of professional health of air traffic controllers is adaptation reactions as the integrative indicator of the body's natural response to the effect of mental, emotional, other harmful factors of activity, on the one side, and response to professional stress, on the other side. Full adaptation functional reserves was showed by 67 % examined air traffic controllers of age category less than 30 years, 38 % – at the age of 31–40; 11 % – at the age of 40–50 [12]. Therefore, specification of professional important qualities in air traffic controllers under contemporary work conditions is one of the productive task.

So, the human factor (human factors) obviously impacts on aviation safety, covering medical, psychological, ergonomic, educational aspects of the professional environment. Aviation psychology, for its part, among the other sciences of human factor is aimed at development of practical recommendations, including prevention of aircraft accidents.

VI. CONCLUSION

Relevant directions aimed on prevention of aircraft accidents by aviation psychology are as follows:

- working out techniques of balanced training using simulators and in the real flight;
- development of modern methods of developing the ability to make decisions in emergencies;
- introduction of psychological selection which helps to assess the prospects for personal development in professional aviation;
- study of professionally important qualities in ground service specialists.

REFERENCES

- [1]. Interstate Aviation Committee. <http://www.mak-iac.org/>.
- [2]. K istorii otechestvennoj aviatsionnoj psikhologii. Dokumenty i materialy; pod. red. K.K. Platonova. M.: Nauka, 1981. 320 s.
- [3]. Podgotovka personala. ICAO, 2016. Doc 9868.
- [4]. Ponomarenko V.A. Psikhologiya dukhovnosti professionala. M.: RAO, 1997. 295 p.
- [5]. Gander D.V. Aiatsionnaya psikhologiya. M.: Voentekhizdat, 2010. 207 p.
- [6]. Aviation Maintenance Technical Handbook – General. U.S. Department of Transportation. Federal Aviation Administration, 2018.
- [7]. Kozlov V.V. Bezopasnoct' polyotov: ot obespecheniya k upravleniyu. M.: OAO «Aeroflot-rossijskii avialinii», 2010. 270 p.
- [8]. McLean Gregor M. T., Lambeth S, Mavin T. The Use of Simulation in Ab Initio Pilot Training // The International Journal of Aviation Psychology. 2016. Vol.26. P.36-45.
- [9]. Zhan'ko I.M., Vorona A.A. Aktual'nyje problemy razvitiya aviatsionnoj psikhologii // Institut psikhologii Rossijskoj akademii nauk // Organizatsionnaya psikhologiya I psikhologiya truda. – 2018. – T. 3. № 4. – P. 154-167.
- [10]. Gander D.V., Lyssakov N.D. Nauchno-metodicheskiye aspekty rasshireniya praktiki ranney professionalizatsii na lyotnyyu professiyu // Chelovecheskiy kapital. – 2016. – № 4 (88). – P. 32-33.
- [11]. Art'yomov A.D., Lyssakov N.D., Lyssakova E.N. Chelovecheskiy faktor v ekspluatatsii aviatsionnoj tekhniki: monografiya. – M., 2018. – 156 p.
- [12]. Bolotova M.A., Kupin V.V., Petrova M.V. Otsenka sostoyaniya professional'nogo zdorov'ya aviadispatcherov // Vestnik psikhoterapii. – 2007. – № 21 (26). – P. 101-110.