Chapter 33

Analysis of Aviation Incidents Using the GERT–Network Taking Into Account the Psychological Characteristics of the Operator

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ABSTRACT

In this chapter, the authors considered the construction of network models of aviation incidents taking into account the psychological characteristics of the operator. In particular, the GERT-network of aviation disaster was built. Applying of software to calculate the elements of the GERT-network was presented. The use of network models in the analysis of aviation incidents allows one to visualize the cause-and-effect relationship in aviation incidents and gives the opportunity to obtain quantitative characteristics of the incident for subsequent analysis.

BACKGROUND

Civil aviation is an area of increased danger and responsibility. Civil Aviation solves the problem of ensuring the growing demand for all types of air transportation, increasing the regularity and cost-effectiveness of flights, providing a high level of safety of flights. Due to the fact that conducting natural experiments in

aviation is not permissible, and the safety of flights needs to be improved, each aviation event is subject to a posteriori analysis. The a posteriori analysis allows us to develop recommendations for the future, as well as provides initial data for building different mathematical models of aviation events In particular, the use of GERT-networks for modeling aviation events can analyze and predict the development of a special case in flight, and also allows to build adequate models of flight situations development.

The report on the investigation of the aviation event is the basis for taking measures to ensure the safety of flights necessary to prevent the subsequent aerial events for the same reasons. Therefore, the final report on the aviation event must clearly identify what happened, how it happened and why it happened. The conclusions, causes and / or concomitant factors presented in the final report should facilitate the preparation of safety recommendations so that the necessary precautionary measures can be taken. The analytical part of the final report should include an assessment of the data obtained during the collection of actual information and the analysis of the circumstances and events that have occurred or could have occurred. The rationale should be logical and promote assumptions that will then need to be discussed and verified by matching existing evidence (ICAO, 2013, ICAO, 2014, ICAO, 2015). The use of GERT-networks for quantitative analysis of the above-mentioned factors and causes allows us to elucidate the logical and causal relationships that contributed to the occurrence of this aviation event. Formalizing the actions of the operator of the air navigation system as a human operator in special cases of flight with the help of a network planning device allows determining the optimal sequence and time of execution of operational procedures aimed at parrying special flight situations. The use of network charts in the a posteriori analysis allows qualitative and quantitative analysis of aviation events to improve flight safety.

In the event of a special case in flight, the operators of the aeronautical system - the air traffic controller and commander fall into the conditions of an acute shortage of time and significant psychophysiological load, which greatly complicates the decision-making process. In addition, information on the occurrence of a special case in flight is characterized by a high level of incompleteness and uncertainty of information. Therefore, it is expedient to construct mathematical models that would allow quantifying the possible options for completing the flight and, being components of the decision support system, would help to adopt the optimal solution for the given time conditions. In the general case, the guideline documents define the list of actions that must be performed in accordance with the pilot's and the controller, if a special case has occurred with the aircraft. But the activity of aeronautical system operators in the a posterior analysis is worse for algorithmization due to the presence of a component of the psycho-emotional state of the operator.

Problems of professional selection, training and professional training of aeronautical system operators are described in many papers, in particular in the works of A. Vitryak and G. Kryzhanivsky, S. Melnychenko, V. Kharchenko, and V. Chynchenko (Adrianova, 1974, Vitryak, 2008, Kryzhanovsky, 1981, Zyryanov, 2012, Kharchenko, 2006, Kharchenko, 2012). Mathematical models based on graphs are presented in works by V. Karnaukhov, V. Grygi, D. Vinogradov, R. Dunets, J. Fax, A. Jadbabaie, V. N. Kasyanova, A. Kochkarova, S. Shahrampour, R. Olfati-Saber, T. Panyukova, M. Himsolt, I. Parasyuk, W. Ren, H. Tanner, Z. A. Felk (Himsolt, 1996, Olfati-Saber, 2010, Tanner, 2007, Grieg, 2008, Karnaukhov, 2009). The description of network models is presented in the works of D. Philips and A. García-Diaz, K. Neumann, A. Pritsker, A. Ventsel, A. Shibanova, D. Pismana, S. Semenova, A. Smirnov, M. Dorrera (Neumann, 1990, Pritsker, 1966, Wentzel, 2012, Zyryanov, 2012, Shibanov, 2003). Data mining technology in e-learning, ontological engineering in e-learning and intellectual e-learning systems are presented in works by Abdel-Badeeh M. Salem (Abdel-Badeeh, 2008, Abdel-Badeeh, 2010, Abdel-Badeeh, 2011). The idea of using the GERT network was based on many researches. In particular, this is the work of

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