Chapter 32
Analysis of the Development Situation and Forecasting of Development of Emergency Situations in Socio-Technical Systems

Yuliya Sikirda
https://orcid.org/0000-0002-7303-0441
National Aviation University, Ukraine

Tetiana Shmelova
https://orcid.org/0000-0002-9737-6906
National Aviation University, Ukraine

ABSTRACT

In this chapter, socio-technical analysis of Air Navigation System (ANS) has hold in the result of which the heterogeneous factors of professional and non-professional activities influencing on the decision-making (DM) of ANS's human-operator (H-O) in expected and unexpected aircraft's (AC) operating conditions have classified, systematically compiled and formalized. The method of generalization of heterogeneous factors, which allows taking into account the structural hierarchy, heterogeneity, dynamic instability of factors of professional and non-professional activity influencing on the ANS's H-O DM has developed, the conditions for their evaluation have determined. The vector of actions of the ANS's H-O in the expected and unexpected AC operating conditions, taking into account the model of the operator's behaviour, has considered. The authors have obtained the models of bipolar choice of operator of Socio-Technical System (STS) for using of reflexion theory and Markov network. They present the results of choosing in the direction of positive, negative pole, a mixed choice and forecasting of development of the situation. The authors demonstrate the methodology for analysis of flight situation development using GERT's and Markov's networks.

DOI: 10.4018/978-1-7998-5357-2.ch032

MODELING AND OPTIMIZATION OF AIR NAVIGATION SYSTEM'S HUMAN-OPERATOR ACTIVITY IN EXPECTED AND UNEXPECTED AIRCRAFT'S OPERATING CONDITIONS TAKING INTO ACCOUNT THE SOCIAL ENVIRONMENT FACTORS

In the transport system of Ukraine the important role belongs to aviation. A necessary part of air transport is the ANS – a complex human-machine system that provides the safe, regular and efficient air navigation services. Statistic data of aviation accidents (ACs) over the past decade indicate the dominant role of human factor influence on the total number of ACs (80%) (Cross-Cultural Factors in Aviation Safety: Human Factors Digest Nº 16, 2004; Leychenko, Malishevskiy & Mikhalic, 2006; Shvets & Alekseev, 2008). Analysis of ACs reasons shows that on a person who makes decisions significant influence have external factors which not related to the level of H-O's preparedness and technologies in the system. This suggests, in first, that the ANS on the principles of operation should be considered a STS and, in secondly, that it is optimizing of socio-psychological factors both during the flight operation and at the stage of pre-flight training causes significant opportunities to reduce the number of ACs.

Solving the problem of providing H-O's functional stability in the ANS is to model the behavior of the operator in expected and unexpected aircraft's operating conditions considering the influence of environmental factors, optimizing DM in emergency situations, operational forecasting of flight situation development, minimizing DM risks, which generally leads to flight safety increasing. Evolution of aviation systems towards the socio-technical systems can be investigated the changes and amendments of known human factor model SHEL, 1972 (Human Factors Guidelines for Safety Audits Manual, 2002): Software (procedures) - Hardware (machines) - Environment - Liveware by interfaces associated with the culture of human-operator –SCHELL model and CRM, 2004 (Keightley, 2004; Human Factors Training Manual, 2005; Safety Management Manual (SMM), 2013): Software (procedures) - Culture - Hardware (machines) - Environment - Liveware - Liveware (humans) and Crew - Resource - Management (Figure 1).

Figure 1. SCHELL model and CRM