Applications of Decision Support Systems in Aviation

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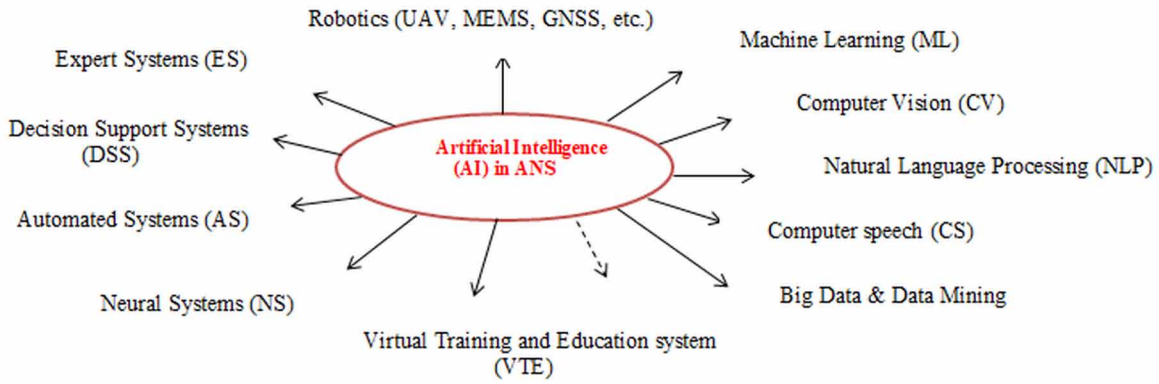
INTRODUCTION

The air transport industry plays a major role in world economic activity and to maintain the safe and efficient operation of aviation enterprises that allows maximum use to be made of enhanced capabilities provided by technical advances. Nowadays the International Civil Aviation Organization (ICAO) has added in its documents new approaches for achieving the main goals of the organization, which are: to enhancing the effectiveness of global aviation security and to improve the practical and sustainable implementation of preventive aviation security measures. These new approaches include the development of progressive technology and human capability, the improvement of technological resources to improve the quality of decision making of aviation personal (pilots of manned and unmanned aircraft, air traffic controllers, engineers, etc. (ICAO, 2017; ICAO, 2018). The quality of decision dependences is using innovative technology in aviation such as Artificial Intelligence (AI). The AI document "White paper" of IATA (International Air Transport Association) presents the results of IATA research and development activities on AI in collaboration with airlines. The new technologies of AI can be clustered in the following capabilities, such as Machine learning (ML), Natural Language Processing (NLP), Expert Systems, Vision, Speech, Planning, Robotics (IATA, 2016; ICAO, 2018). To increase the productivity of work at each stage of the life cycle (LC) of aviation systems, different AI technologies and methods can be effectively applied (Figure 1).

Figure 1. The synergetic effect - LC of aviation technique with using AI capability



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Artificial Intelligence is the simulation of human intelligence processes by modeling, computer systems, and machines. These processes include learning (the acquisition of information and rules for using the information); reasoning, estimation, and modeling (using rules to reach conclusions (approximate or definite results)); self-correction (estimation of obtained models). Particular applications of AI include Expert System (ES); Decision Support System (DSS); Automated systems; systems of pattern recognition, speech recognition, and machine vision, etc. (ICAO, 2017; IATA, 2016). AI (and DSS) are effective for minimization risks and improve the quality of decisions in the aviation system.

BACKGROUND

Support for the safe functioning of ANS is one of the most important scientific and technical problems. Statistical data show that human errors account for up to 80% of all aviation accidents (ICAO, 2004). According to ICAO data (ICAO, 2013), compared with 2011, in 2012 the number of incidents in the world decreased by 21%, in 2013 – on 13%; the number of fatalities in 2012 decreased by 10%, in 2013 – on 55%. Consequently, the least number of deaths has been fixed in 2012-2013, starting from 2004. As a result of the decreased number of incidents, an increased number of departures, the frequency of incidents in the world in 2012 has been reduced to 3,2 events per million departures and in 2013 – to 2,8 events per million departures. This is the lowest value since the ICAO started to monitor the frequency of incidents in the world. Aviation systems cannot be wholly free from dangerous factors and connected with them risks, while, the elimination of aviation events and serious incidents continues to be the final goal of human activity in the sphere of aviation safety. Neither human activity nor systems created by it guarantee a total absence of operating errors and their consequences (ICAO, 2013). In such a way, safety is a dynamic characteristic of aviation with the help of which risk factors for flight safety should steadily decrease. It is important to note that the adoption of efficiency indices of ensuring flight safety is frequently influenced by internal and international standards and also by cultural features (ICAO, 2009). While risk factors for flight safety and operating errors are under control, such an opened and dynamic system as civil aviation may be controlled providing the necessary balance between flight performance and safety requirements.

Latest demands of international aviation organizations directed on the implementation of an integrated approach for the improvement of aviation safety. Many ICAO documents describe the problems in aviation and include recommend the creation of support for a solution in each professional situation (ICAO, 2005a; 2005b; 2009). One of the ways to increase safety by timely is the support of pilots in emergency situations (ICAO, 2012). A modern approach, founded on the characteristics (Performance-Based Approach – PBA) (ICAO, 2009), based on the next three principles:

– a strong focus on desired/required results;
– informed decision making (DM) driven by those desired/required results;
– reliance on facts and data for DM.

Herein the principle “using facts and data while DM” admits that tasks shall comply with the widely known in Western management criteria ***SMART***, which correspond to the abbreviation of five English words: Specific, Measurable, Achievable, Relevant, Time-bound.

So-called aeronautical DM is DM in a unique environment – aviation. It is a systematic approach to the mental process used by pilots to consistently determine the best course of action in response to a