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Y.V. Hryshchenko PhD of Tech. Sci., E.A. Starchenko
(National Aviation University, Ukraine)

Engineering-psychological problem of flight safety in case of failures in avionics

According to the last 100 years statistic of air accidents, the main reason of their happenings is human factor. Combined method for determination the level of human tension is proposed.

Introduction and problem statement

"... The main culprit of the accident was the crew ..." Similar phrases appear in the media and in official documents. Approximately from the middle of the seventies the concept of the "human factor" firmly took its place in the vocabulary of pilots first, and then in other aircraft specialists. What is this factor about? Because of what has it role so increased recently?

According to ICAO statistics, 85% of accidents in aviation sphere during the last five years are related to the human factor.

The definition is really hazy. Specifically, in aviation, "human factor" is the component of the causes of accidents, which depends on the flight crew of the aircraft.

Let's start from the opposite - from the plane. A modern aircraft, packed with sophisticated electronics, is able to fly independently from procedure of taking off till engine shutdown. All steps of flight: taxiing, take off, entire flight and landing - all completely works without human intervention. At the same time, automation can not to "understand," "be mistaken," "be distracted," "be not on time." Automation does not know the words "take a chance" and "save money". Yes of course, automation allows failures to be happen, but notice, only fifteen percent of accidents are attributed to technical and other reasons not related to the crew.

Moreover, during many stages of flight, for example, during approaching landing in difficult weather conditions, rules prescribe to perform responsible procedures only in an automatic mode. What is it? It is another attempt to reduce the influence of a person during such critical stages.

The flight itself, in fact, it is already a human factor. The plane was invented, designed, built, raised in the sky by a man.

The process of automation of pilot activity is still in process. The person is also responsible for making decisions in a very complicated situation, person needs to be aware of all the "or-if-or" and a number of "and-if-and." Decisions are unequivocal, but they resolve many contradictions. And the decisions are correct. But the correctness of decision is laid under the preparation of a person for the adoption of these decisions. This is another topic, so we will assume that like correct statement.

The person is also able to make a decision in some unpredictable situations and implement this decision for solving a problem.

Taking everything into account, everything is fine and the human ability to think is perfect. Since a person differs from an automatic system by the ability to think it means that inherent aspect of a human being is beautiful. And the human factor, as such, stop ... Stop, stop, but what about 85-100%?

On the other hand, we have the same result. A man thinks. The only problem is the way of his thoughts is unpredictable. So this 85% is the very essence of its unpredictability. And the human ability to think all in all became just one of the factors that lead to trouble. It is amazing, is not it?

Analysis of air traffic accident statistics

Conditionally we will divide the history of air crashes for 5 periods: 1) 1908-1929; 2) 1930-1939; 3) 1940-1949; 4) The second half of the XX century; 5) The XXI century [1].

First period: the plane crashes during 1908-1929. The first period includes air crashes, which occurred at the "dawn" of aviation. There was 36 air crashes.

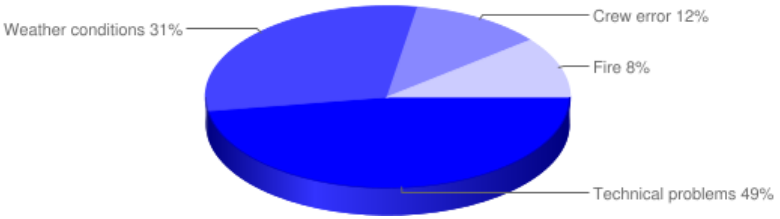

Fig. 1 The main reasons of air craches during 1908-1929

This diagram shows that the main cause of airplane crashes of the first period is the technical malfunction of aircraft (50%), the second place is meteorological conditions (31%), the third is pilot error (12%) and the fourth place is the airplane crash (8%). But this is not surprising, because in those years the aircraft designers did not yet apply high technologies, there were no security systems, computer programs.

Second period: air crashes of 1930-1939. Between 1930 and 1939, 89 crashes were registered (53 more than in the first period).

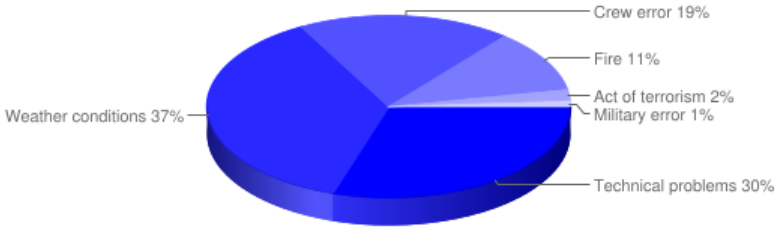

Fig. 2 The main reasons of air craches from 1930 to 1939

From this diagram it can be seen that the main causes of the air crashes of the second period were the meteorological conditions, and there were also new causes - terrorist attack and military error.

Third period: air crashes of 1940-1949. During the period from 1940 to 1949, 190 aircraft crashes were recorded.

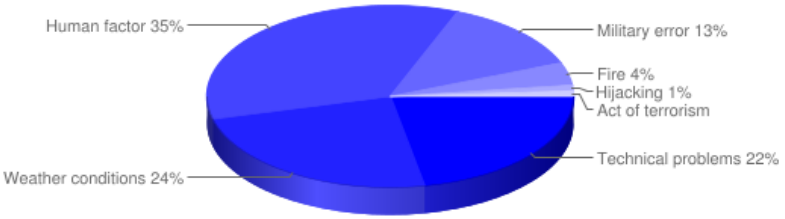

Fig. 3 The main reasons of air craches during 1940-1949

Based on this diagram, we can conclude that the main cause of the crashes of aircraft in 1940-1949 was the human factor - the error of crew members, dispatchers and technical specialists.

Fourth period: air crashes of the second half of XX century.

Increasing the reliability of aircraft and improving safety standards led to a decrease in the growth of air crashes in the first half of the 1950s.

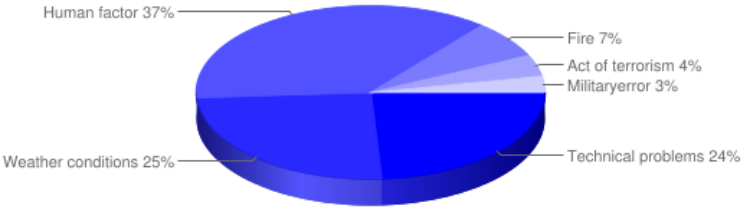

Fig. 4 The main reasons of air craches of the second half of XX century.

Fifes period: air crashes of the XXI century.

In the 21st century, measures were taken to improve the level of safety in air transport. In connection with the increased incidence of terrorist acts, control over passengers was tightened. However, the flow of passengers and cargo is constantly increasing, so this leads to the growth of the world fleet of aircraft, so the number of air crashes does not decrease.

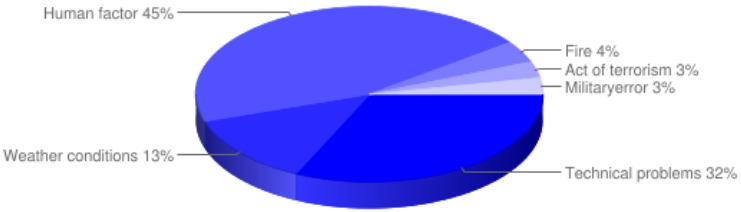

Fig. 5 The main reasons of air craches of the XXI century.

After studying this diagram and comparing it with the diagram of the first period, we can conclude that during this period (from 1908 to 2013) the share of technical failures decreased, but the number of air crashes that occurred due to errors of crew members and air traffic controllers increased significantly**.**

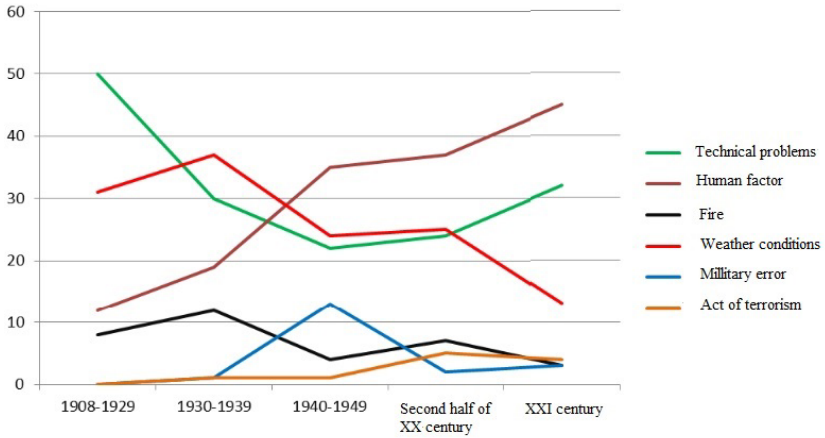

Fig. 6 Ratio of reasons of air crashes during different periods of world aviation

This diagram clearly shows the constant growth of air crashes caused by the human factor. In addition, a significant part of the catastrophes that occurred due to technical problems [2].

Ways of problem solution

Without any doubt, now we have understanding that huge amount of air crashes happened because of human factor, if to be more concrete, because of human nature. How and where could we find solving of this sharp question?

The options of solving this problem are determination of the level of human tension. This determination occurs with the help of two methods: first one is method of autocorrelation functions [3].

The second one is method of trending algorithms. Trending algorithms were implemented for determination of the level of human tension on the planes of old generation. Day by day aviation develops and we observe appearance of new modernized aircrafts. So, now we have new question of how to decrease human factor influence on the board of new generation aircrafts [4].

The decreasing of the quality of the piloting technique due to stress and unavailability to cope with large number of failures clearly leads to the crash of the aircraft. But fully automatic aircrafts can also have failures in their systems and at the same time at this situation there would not be an experienced pilot on board who will be able to get out of the situation and land the aircraft. In any case, a safe flight is a synergy and balanced work of the crew and the automatic system.

References

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