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Method of Increasing the Readiness of Airport Ground Vehicle Operators to Work in Extreme Weather Conditions

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Abstract

Modern airports are complex technological systems, on the territory of which several types of transport operate simultaneously, including airport ground vehicles, such as buses for transporting passengers, tractors, catering service vehicles, etc. There are known incidents of collisions between ground vehicles and aircrafts at airports. Typically, these accidents occur under extreme weather conditions, such as snowfall, heavy rain or fog. This study has developed a method to improve the preparedness of airport ground vehicle operators to work in extreme weather conditions, including snow, heavy rain or fog. In extreme weather conditions, the movement of ground vehicles on the airport territory occurs without direct visual contact between operators of ground vehicles and pilots of airliners, while their interaction takes place under the remote control of a dispatcher, which significantly complicates the working conditions of operators and increases the risk of accidents. Working in such an environment requires special training for airport ground vehicle operators. It is for this purpose that a method for improving the preparedness of airport ground vehicle operators to work in extreme weather conditions has been developed. The method involves solving a number of pre-prepared scenarios, which makes it possible to increase the readiness of airport personnel to act in extreme weather conditions. As a result, increased personnel readiness will reduce the risk of accidents in such a complex technical system as an airport.

Keywords: airport; operator; weather conditions; preparation.

1. Introduction

Increasing the level of traffic safety in aviation is one of the main areas of development of the modern transport complex work. Accidents involving air transport often lead to significant loss of life and property damage (Fig. 1) (Lykou et al., 2020; ICAO Safety Report, 2020; Runway Safety Accident Analysis Report, 2020).

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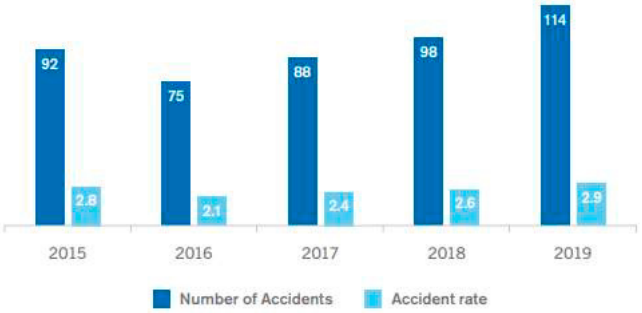

Fig. 1. Accident records: 2015–2019 scheduled commercial operations (ICAO Safety Report, 2020).

Accidents involving air transport occur not only in the air, but also on the ground, including in the collision of airliners with airport ground vehicles (AGV) (Alomar and Tolujevs, 2017; Wilke et al., 2014; Calle-Alonso et al., 2019; Price and Forrest, 2016; Statistical summary of commercial jet airplane accidents: Worldwide operations 1959–2016, 2017; The information from an investigation conducted by the Interstate Aviation Committee, 2021) (Fig. 2).

Fig. 2. Airport accident (https://www.avianews.com/incidents/2021/01/08/wizzair_plane_car_collision_at_gdansk_airport/).

An example of such an event is the collision of a water delivery vehicle and an Airbus A320neo airliner at the airport of Gdansk, Poland, resulting in the airliner's decommissioning (Fig. 2). The described accident was caused by erroneous actions of the vehicle operator.

It can be concluded that one of the ways to increase the level of traffic safety in aviation is to increase the preparedness of operators of airport ground vehicles. This will reduce the risk of accidents involving ground and air vehicles.

Among the factors that can create an emergency situation with the participation of airport ground vehicles, the human factor can be especially highlighted (Shvetsova and Shvetsov, 2020; Barrado et al., 2020; Shvetsova and Shvetsov, 2021; Pérez-Castán et al., 2019; Huttunen, 2019; Davies et al., 2021). Analyzing possible ways to reduce the risk of accidents involving AGV, which are caused by the human factor, the following aspects of the operation of airport ground vehicles can be distinguished:

- airport ground vehicles is usually controlled by a person (operator), and not by a program;

- airport ground vehicles operate around the clock, often in extreme weather conditions, including heavy rain, snowfall, fog, etc., which significantly increases the workload on operators controlling them;
- in extreme weather conditions, movement on the airport territory occurs (Fig. 3). without direct visual contact between operators of ground vehicles and pilots of airliners, while their interaction takes place under the remote control of the dispatcher.

Fig. 3. Joint work of air and ground transport in extreme weather conditions. (https://www.tvc.ru/news/show/id/104098/#gid=gid_104098_0&pid=196923).

The analysis allows concluding that the operator of ground vehicles is one of the main elements of the considered traffic safety system at the airport, and for this reason it is he who needs a special level of preparation for work in extreme conditions in order to prevent him from making mistakes (violations) that could cause an accident.

It should be noted that at the moment, operators, finding themselves in a non-standard situation complicated by extreme weather conditions, often do not have time to independently work out the correct solution in the allotted time period, which leads to accidents.

For this reason, increasing the preparedness of airport ground vehicle operators to work in extreme weather conditions is an important way to reduce the risk of accidents at airports.

2. Methods and results

As one of the measures to improve the preparedness of operators of ground vehicles in order to reduce the risk of accidents involving ground and aircraft vehicles at airports, a method of increasing the preparedness of operators of airport ground vehicles to work in extreme weather conditions has been developed.

The method is based on the use of a special three-element training complex, which makes it possible to prepare operators of airport ground vehicles for work in extreme weather conditions.

The first element of the complex. A model of the corresponding airport (size 1:20). A model measuring 15x20 meters can be installed for training, both indoors and outdoors.

The second element of the complex. A scaled-down model of a ground vehicle, which is driven by a specific operator (recommended size 1:16) with a remote control, with the help of which the operator takes a training course.

The third element of the complex. A set of 25 scenarios of possible non-standard situations (NS) occurring in extreme weather conditions. The scenarios were developed using the method of expert assessments. Expert group includes employees of the North-Eastern Federal University and Vladivostok State University of Economics and Service.

At the first stage of the expert survey, the experts were offered a questionnaire, which included 50 scenarios of possible non-standard situations in extreme weather conditions at the airport. According to this table, the experts selected 25 scenarios, which, in their opinion, should be applied to train AGV operators.

At the second stage of the survey, the experts were offered the following questionnaire, into which data on 50 possible options for the AGV operator's actions in the development of a non-standard situation were entered. According to this table, the experts selected 25 options for the most correct actions of the AGV operator, 1 for each specific non-standard situation occurring in extreme weather conditions.

As a result of the expert survey, a set of 25 scenarios was formed, 3 solutions for each scenario, 1 of which is correct.

The algorithm for training AGV operators using the developed training complex is shown in Fig. 4.

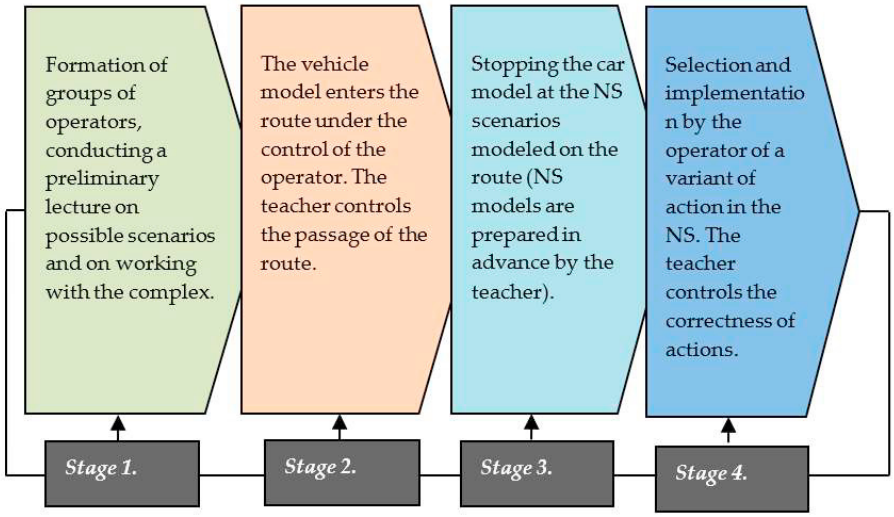

Fig. 4. Algorithm for preparing AGV operators.

Based on the results of the experimental operation of the developed complex, the experts formed the optimal training format (Table 1), using which it is recommended to form groups of operators and the number of NS scenarios.

Table 1. Ground vehicle operator training format.

Number of groups	Number of operators in a group (no more)	Number of NS on the route (no more)	Number of solution options
1-3	5	7	5
4-5	3	5	5
5-7	2	3	5

Based on the results of passing the route, the operators are given marks using the developed rating scale (Table 2).

Table 2. Rating scale.

Number of NS on the route	Number of solution options for each NS	Total number of correct decisions	Evaluation
5	3	5	Excellent
5	3	4	Good
5	3	3	Satisfactory
5	3	2,1,0	Unsatisfactory
3	3	3	Excellent
3	3	2	Good
3	3	1	Satisfactory
3	3	0	Unsatisfactory

3. Discussion and conclusion

The analysis shows that accidents involving air transport occur not only in the air, but also on the ground, including as a result of a collision of airliners with airport ground vehicles. Typically, these accidents occur under extreme weather conditions, such as snowfall, heavy rain or fog.

In order to reduce the risk of accidents involving ground and aircraft vehicles at airports, this study has developed a method to improve the preparedness of airport ground vehicle operators to work in extreme weather conditions. Increased personnel readiness is a prerequisite for reducing the risk of accidents in such a complex technical system as an airport.

A distinctive feature of the proposed method is that initially the operators of airport ground vehicles are asked to find the correct options for action in a non-standard situation themselves. Only if the operator does not have such solutions, the teacher offers a set of possible solutions for a specific scenario. This is aimed at developing the ability of operators to independently make the right decisions in non-standard situations formed in extreme weather conditions.

The developed method can be used to train personnel at an airport in any country in the world due to its unification. A prerequisite is translation into the language of the country in which the airport is located.

A promising option for the continuation of the started research is the development of a computerized version of the curriculum, which will allow for distance learning. This, in turn, will reduce the airport's operating costs for training staff using the curriculum.

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