PREVENTION OF ACTS OF UNLAWFUL INTERFERENCE AT INFRASTRUCTURE FACILITIES

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ABSTRACT

Threats of committing acts of unlawful interference with transport urgently require scientifically based measures aimed at improving the level of security of infrastructure facilities. As one of these measures, the authors developed a method for assessing the risk of unlawful interference using the method of expert assessments and the coefficient of concordance proposed by Kendall. The proposed methodology will make it possible to more effectively plan measures to increase security of transport infrastructure facilities against acts of unlawful interference, including the threat of terrorism with the use of explosive devices.

Keywords: transport, safety, security, infrastructure, act of unlawful interference, risk assessment, methods.

Background. *One of the most important tasks in the transport sector remains invariably ensuring security at transport infrastructure facilities in order to protect them against acts of unlawful interference.*

The act of unlawful interference is «an unlawful act (inaction), including a terrorist act that threatens the safe operation of the transport complex, entailed harm to human life and health, material damage, or created the threat of such consequences» [1].

As an example of an act of unlawful interference perpetrated at a transport infrastructure object, an incident characteristic of the active phase of terrorism can be cited. «On the evening of November 27, 2010, the fast train No. 66 «Nevsky Express» on the route Moscow–St. Petersburg crashed on Oktyabrskaya railway near the settlement of Erzovka, about 1 km from the administrative border of Novgorod and Tver regions. According to the Federal Security Service of the Russian Federation, the cause of the crash was the explosion of a homemade device with a capacity of 7 kg in TNT equivalent. As a result of the explosion, which occurred under the locomotive, the last three cars of the train derailed. In the crash 28 people died, more than 90 were injured» [2].

Acts of unlawful interference at transport facilities are a problem not only in Russia. Thus, on January 18, 1961, the «Strasbourg–Paris» express train crashed in France. The catastrophe was caused by the explosion of a device laid on the railway by representatives of the OAS terrorist group. 28 people died and about 100 were injured. [3] Many studies published in the last decade [4–15] are devoted to the study of such accidents.

The threat of committing of new acts of unlawful interference at transport facilities urgently requires development of evidence-based measures aimed at improving security of transport infrastructure. One of these measures, we believe, can be the methodology for assessing the risk of acts of unlawful interference created by us.

Objective. *The objective of the authors is to consider a new method of risk assessment of acts of unlawful interference at infrastructure facilities.*

Methods. *The authors use general scientific and engineering methods, comparative analysis, evaluation approach, mathematical methods.*

Results. *The method involves the use of the method of expert assessments. This requires an expert group of at least seven professionals, professionally trained in matters of transport safety and security.*

The risk of an act of unlawful interference at a transport infrastructure facility is calculated by experts using the formula:

$$R = 1 - P_{prevention}, \quad (1)$$

where R – risk of an act of unlawful interference;

$P_{prevention}$ – probability of preventing an act by the security forces deployed at a facility.

In turn $P_{prevention}$ is determined by the dependence:

$$P_{prevention} = 1 - [(1 - P_{refusal}) \cdot (1 - P_{detect}) \cdot (1 - P_{prevention})], \quad (2)$$

where $P_{refusal}$ – probability of refusal of the offender to commit the act;

P_{detect} – probability of detecting the offender when he intrudes the facility;

$P_{prevention}$ – probability that the security forces will prevent the commission of the act.

The probability of prevention of the commission of an act will be a function of personnel readiness to act in extreme situations. The probability of detecting an offender when he intrudes the object is a function of adequacy of equipping infrastructure facilities with engineering and technical security protection systems and the ability of personnel to operate them correctly. The probability of the offender's refusal to commit an act is a reflection of the threat function to be detected when entering an object, which is the higher, the more security and tracking forces ensure safety. The numerical values of $P_{refusal}$, P_{detect} and $P_{prevention}$ are determined by experts.

Using the proposed approach, a group of specialists can evaluate, using formula (2), the probability of preventing the act of interference, and then using formula (1), the risk of its occurrence at the facility.

For example, if $P_{refusal}$ = 0,257, P_{detect} = 0,428, $P_{prevention}$ = 0,642, then when calculating using the formula (2) $P_{prevention}$ will be 0,848, and continuing the calculation with the formula (1) will give R = 0,152.

The consistency of the opinions of the expert group should be checked using the concordance coefficient proposed by Kendall.

The assessment of the consistency of opinions is carried out in four stages.

Stage 1. Establishment of an expert commission. The number of factors n = 3, the number of experts m = 7.

Table 1

Expert assessment

Factors	Experts						
	1	2	3	4	5	6	7
$P_{refusal}$	0,1	0,5	0,1	0,4	0,3	0,1	0,3
P_{detect}	0,7	0,4	0,5	0,3	0,4	0,3	0,4
$P_{prevention}$	0,8	0,6	0,7	0,5	0,6	0,5	0,8

Table 2

Table of ranks

Factors	Experts							Sum of ranks	Deviation from average sums of ranks	Squares of deviations of sums of ranks
	1	2	3	4	5	6	7			
$P_{refusal}$	1	2	1	2	1	1	1	9	-5	25
P_{detect}	2	1	2	1	2	2	2	12	-2	4
$P_{prevention}$	3	3	3	3	3	3	3	21	7	49
Total										78

Stage 2. Collection of expert opinions through a questionnaire survey (Table 1).

Stage 3. Processing expert survey data.

Estimates of experts are sorted by ascending, position in the sample – rank, total – table of ranks (table 2).

Calculation order:

1. Calculate the sum of ranks received by each factor.

2. Calculate the average arithmetic sum of ranks.

3. Calculate the deviation of the sum of ranks of each factor from the arithmetic mean of the sum of ranks.

4. Raise the deviation of the sum of ranks of each factor into a square and sum up the numbers obtained, find the sum of squares of the difference of ranks (S).

Stage 4. Assessment of consistency of expert opinions.

The coefficient of concordance:

$$W = \frac{12S}{m^2\left(n^3 - n\right)} = 0,796\,, \qquad (3)$$

where S = 78, n = 3, m = 7.

The coefficient of concordance varies in the range of 0 < W < 1, and 0 is a complete inconsistency of expert opinions, 1 is complete consistency.

The result W = 0,796 indicates a high degree of consistency.

Conclusions. *A method has been developed for assessing the risk of acts of unlawful interference at a transport infrastructure facility. The application of the proposed method will allow more efficient planning of measures to improve security of transport infrastructure facilities against acts of unlawful interference.*

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