

FUNDAMENTAL OF MODELING FOR THE ASSESSMENT OF ORGANIZATIONAL RISKS IN THE INTEGRATED SAFETY SYSTEM AT EXPLOSION AND FIRE-HAZARDOUS ENTERPRISES

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Abstract

The article examines the problem of quantitatively assessing organizational risks within the integrated safety system (ISS) of explosion and fire-hazardous enterprises. An approach is proposed for representing the ISS as an organizational management system, in which organizational risks are considered to be causal factors influencing the probability of hazardous events such as accidents and fires. For a normative evaluation of the contribution of organizational risks, it is proposed to use a conditional information measure, the "conditional bit." It reflects the contribution of a specific risk to a realized hazardous event. The possibility of applying an additive weighted model and an interval scale for ranking organizational risks is substantiated. The practical significance of the results lies in their potential use by the ISS management body while developing measures aimed at reducing organizational risks and the probability of accidents and fires.

Keywords: organizational risks; integrated safety system; conditional bit; rank order centroid; indicator of quantitative evaluation.

The list of abbreviations:

deficiencies	Ds
explosion and fire-hazardous (enterprises)	EFH
fire safety	FS
hazardous event(s)	HE(s)
insufficient actions	IA(s)
insufficient personnel actions	IPA(s)
industrial safety	IS
integrated safety system	ISS
management body of production structural units	MB of PSU
normative documents	NDs
occupational health and safety	OHS
organizational risk(s)	OR(s)
production structural units	PSU
regulatory legal acts	RLAs

I. INTRODUCTION

In the field of organizational risk (OR) assessment, particularly in specific areas (emergency, fire, and occupational risks) where risks are converted from qualitative to quantitative terms, it is proposed to use an ordinal scale as the output data (assessed ORs are ranked in a list in descending order from highest to lowest) [1]. It will allow the identification of OR groups:

- those requiring an immediate response for their prevention;
- those for which there is a time buffer for a preventive response;
- those that can be disregarded in the process of managing the integrated safety system (ISS).

For a reliable assessment of ORs, it is proposed to develop approaches using well-founded (confidence) values on an interval scale to obtain parametric values for the assessment of the negative impact of individual ORs on the outcome in the form of hazardous events (HEs) (an accident and fire) [2]. The use of a ratio scale is justified by the priority of the ranked series for all assessed ORs. It makes it possible to digress from results with point (scalar) values that contain numerous errors, leading to variability in assessment results and reduced comparability of the obtained values when using different initial assumptions. Well-founded values possessing reliability (correctness, fairness) for ORs will be obtained. All of it at explosion and fire-hazardous enterprises (EFH enterprises) will allow the ISS management body to make informed decisions on OR prevention and thus, when using a risk-based approach, achieve new qualitative results [3].

The problematic situation that requires the need to manage ORs which manifest as HEs (accidents and fires) is denoted. A model-based approach is required for the quantitative assessment of ORs within the ISS at EFH enterprises, in order to support management decision-making aimed at preventing such risks.

The object of the study is the integrated safety system which occurs at explosion and fire-hazardous enterprises and is viewed as an organizational management system.

The subject of the study is the models, criteria, and procedures for the quantitative assessment of organizational risks that are taken into account when making management decisions in the ISS.

The purpose of the article is to develop a model-based approach for the quantitative assessment of organizational risks in the ISS of explosion and fire-hazardous enterprises, with the aim of supporting management decisions to reduce these risks.

The scientific novelty of the study is characterized by the development of an approach to the quantitative evaluation of organizational risks within the integrated safety system of explosion and fire-hazardous enterprises, based on a normalized conditional information measure. This approach enables the allocation of the contribution of multiple organizational causes within a single actual hazardous event and the creation of a ranked list of risks to support managerial decision-making.

II. FORMULATING THE OBJECTIVE OF THE ASSESSMENT OF ORGANIZATIONAL RISKS IN THE INTEGRATED SAFETY SYSTEM AT EXPLOSION AND FIRE-HAZARDOUS ENTERPRISES

Organizational risks will be considered as a distinct category of risks associated with insufficient management effectiveness in the ISS or with violations of rules and procedures by the staff responsible for its operations. Within the category of organizational risks R_{OR} , the following new groups are identified:

1. the group considered as insufficient personnel actions (IPAs) in all safety areas (industrial safety (IS), fire safety (FS), occupational health and safety (OHS), and the management body of production structural units (MB of PSU)) while exercising control over personnel of production structural units (PSUs), denoted by R_{IPAs} ;
2. the group considered as deficiencies (Ds) in the implementation of the requirements of regulatory legal acts (RLAs) and normative documents (NDs) by personnel in all areas of safety (IS, FS, OHS, and PSU), denoted by R_{Ds} [2].

There is no universally accepted metric that allows organizational risk to be represented as a quantitative measure of its negative impact on an outcome, such as an accident or fire, in classical information theory and risk theory. However, if information with a qualitative description is generally associated with a bit (the amount of information represented by a binary digit that takes one of two values, “0” or “1”), then it becomes possible to link an information bit to a conditional bit (a measure of the negative impact of organizational risk on an outcome such as an accident or fire). Unlike a classical bit (a value indicating one of two equally probable outcomes), a conditional bit will be represented by a quantitative indicator linked to a qualitative description for each assessed organizational risk. This will reduce the uncertainty of risk groups R_{OR} for given dependency conditions (“Risk” $\rightarrow$ “Accident and Fire”). Such a dependency justifies the use of a conditional bit when describing the connection between organizational risks R_{IPAs} and R_{Ds} and the hazardous events occurring after the realization of these risks (Table 1).

Table 1: Justification for using a conditional bit as a measure of the negative impact of organizational risks on a hazardous event

The connection between organizational risks R_{IPAs} and R_{Ds}	Mathematical interpretation	Benefits
- knowledge of the outcomes of one group of risks with a measure of the uncertainty of its impact on another group of risks; - the ability to consider specific characteristics at EFH enterprises which affect the probability and consequences of risks appearing in HEs; - the ability to measure the severity of negative risk outcomes in HEs.	The ability to relate a conditional bit to entropy in information theory: $1 \text{ cond. bit} = H(R_{OR} C),$ where $H(R_{OR} C)$ is the conditional entropy of risk R_{OR} under condition C; R_{OR} is a qualitative description of the cause of HEs that requires conversion into a quantitative value; C represents conditions taking into account the connections throughout the occurrence and manifestation of R_{OR} in HEs. $H(R_{OR} C) = - \sum_{c \in C} \sum_{r \in R} p(r, c) \log_2 p(r c),$ where $p(r, c)$ is the joint probability of obtaining value r for R_{OR} and value c for condition C; $p(r c)$ is the conditional probability of obtaining value r for R_{OR}, given $C = c$.	- the ability to assess R_{OR} taking into account conditions as they appear and manifest in HEs; - the ability of R_{OR} to obtain a quantitative value that provides a numerical representation of residual uncertainty; - the ability to use methods from information theory to assess R_{OR}, since their compatibility is established.

A mathematical formulation of a scientific problem for converting groups of organizational risks R_{OR} , described qualitatively, into an interval measure (weight), with the possibility of creating a list of risks ranked by level of negative impact, is presented below.

Given:

1. The list of conditions $C = \{c_1, c_2, \dots, c_n\}$, where $n \in \{3, 4\}$ (here and below denotes the set of possible ranks), presented in the accident and fire investigation reports on the Rostekhnadzor website.¹
2. The organizational risk rank $R_{OR} \in \{1, 2, \dots, n\}$ that corresponds to c_n in the report containing the accident and fire investigation materials.

Required:

1. To explain the rationale for using a new metric called the conditional bit to assess organizational risks $R_{OR} \in \{R_{IPAs}, R_{Ds}\}$.
2. To justify the possibility of performing calculations while using organizational risk assessment models in the ISS with $f : R_{OR} \rightarrow w_{R_{OR}}$ that satisfies the condition

$$\sum_{R_{OR}=1}^n w_{R_{OR}} = 1, \quad w_1 > w_2 > \dots > w_n.$$

3. To provide an example that demonstrates the possibility of defining the boundaries of intervals for assessing organizational risks.

¹Open data available at <https://www.gosnadzor.ru/industrial/oil/lessons/index.php>. Information current as of June 8, 2026.

All the results will be used by the management body of the ISS to develop a set of preventive measures.

III. EXPLANATION OF THE EXPEDIENCY OF USING A TIERED MEASURE CALLED CONDITIONAL BIT TO ASSESS ORGANIZATIONAL RISKS

It is proposed to use a level-based measure U_R , referred to as a conditional bit (cond. bit), for all groups of organizational risks as a standardized conditional measure of the contribution of organizational risk to a realized HE. This dimensionless quantity reflects the proportion of the informational-organizational contribution of a specific cause to the resulting negative outcome in the form of cooperative HEs (accidents and fires). The total contribution of all organizational risks listed in the report for a single hazardous event is taken to be equal to 1 cond. bit. Suppose there is a simple event with probabilities for two outcomes P and $q = 1 - P$. It is possible to construct the graph (Figure 1) characterizing the level of uncertainty for emerging ORs represented by U_R , based on the assumption that the maximum value will be directly determined by the weighting factor of the negative impact of the OR itself, as well as its connection with group factors of the OR. Then, the rationale for selecting the level of manifestation of the OR in the HE will be represented by the formula

$$U_R = -\frac{1}{2} \log_2 \left(\frac{1}{2} \right) - \frac{1}{2} \log_2 \left(\frac{1}{2} \right) = 1 \text{ cond. bit.} \quad (1)$$

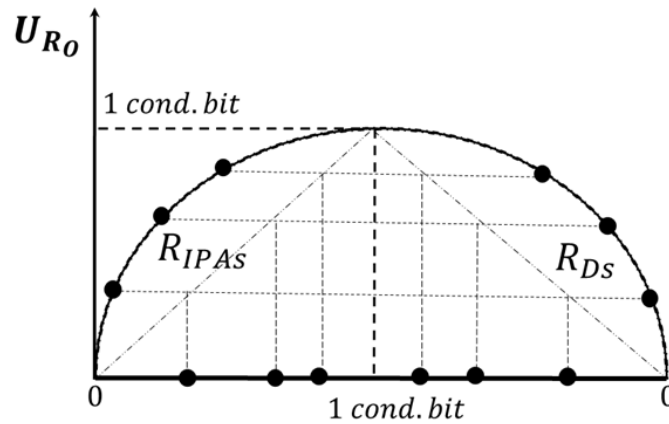


Figure 1: Explanation of the measure in the case of the negative impact of ORs on the outcome expressed as an HE

The graph illustrates a case where, for an event with n discrete outcomes, the value U_R will be maximized when $P_i = 1/n$ and $U_{R_{OR}} = \log_2 n$. Here, it becomes possible to link the level of uncertainty regarding HE information to the presence of organizational risks described in accident reports with qualitative descriptions. In this case, we are interested in information from accident reports, obtained during investigations involving expert consultation.² The level of uncertainty U_x for data taken from accident reports at the Russian oil and gas complex can be calculated using Formula (1), where U_{x1} is the initial information about the OR with a qualitative description and U_{x2} is the final information about the actual HE (accident and fire) [4, 5]. Formally, the sequence of equations justifying the expediency of using a new measure to assess the OR will be as follows:

$$U_R = -1 \log_2(1) - 0 \log_2(0) = 0 \text{ cond. bit,}$$

$$U_{x1} = -\frac{1}{2} \log_2 \left(\frac{1}{2} \right) - \frac{1}{2} \log_2 \left(\frac{1}{2} \right) = 1 \text{ cond. bit.}$$

²The source is the same as in the preceding footnote.

New information about the sequence of ORs in HEs (accident and fire) is

$$U_{x1} - U_R = 1 - 0 = 1 \text{ cond. bit},$$

while missing information about the HE that has already occurred (accident and fire) is

$$U_{x2} - U_R = 0 - 0 = 0 \text{ cond. bit}.$$

However, when using accident reports at enterprises of the Russian oil and gas complex, the “organizational causes” (organizational risks) section may present not a single cause but several $(2, 3, \dots, n)$ values for ORs. Then there emerges a need to develop models for determining an interval value for each OR listed in the accident report [6]. An example illustrates the possibility of using the new measure (cond. bit) to assess ORs. If P_i is the probability that one of several ORs is the sole cause of an outcome in the form of an HE (accident or fire), then the contribution of the ORs to the HE can be expressed as

$$\sum_{i=1}^n P_i \log_2 \frac{1}{P_i}.$$

Therefore, in the presence of mutually exclusive outcomes, the information associated with classifying the outcome variable for the final HE as risk R_{IPAs} will be $\log_2(1/0.9) = 0.15$ cond. bit, and as risk R_{Ds} will be $\log_2(1/0.1) = 3.32$ cond. bit. The average value confirming the reliability of the results under uncertainty will be $0.9 \cdot 0.15 + 0.1 \cdot 3.32 = 0.47$ cond. bit. Taking permissible errors into account, this indicator is approximated to 0.5 cond. bit, used to assess the two risk components. This result is a reliable weighted average value.

IV. JUSTIFICATION OF A MODEL FOR ASSESSING ORGANIZATIONAL RISKS BASED ON WEIGHTED VALUES ON AN INTERVAL SCALE

In the model for assessing ORs at EFH enterprises in the ISS for the period τ (year), a general, systematic, and comprehensive criterion for the assessment of OR R_{OR}^τ is established. It is an indicator in the form of the HE (accident or fire) which has already occurred, and it is assigned a quantitative value equal to 1 cond. bit. Accordingly, the task consists of determining indicators of the negative impact of ORs (R_{IPAs} and R_{Ds}) presented in open data in the form of accident reports. At the beginning of the study, it was necessary to test various models. The multiplicative model [7] was tested; it is represented by the equation

$$R_{OR}^\tau = \frac{\prod_{i=1}^p (f_i)^{w_i}}{\prod_{j=1}^{n-p} (f_j)^{w_j}} = 1 \text{ cond. bit}, \quad (2)$$

where n is the number of causal factors leading to the occurrence of OR (units); p is the number of ranks connected with the causal factors leading to the occurrence of OR (units); w_i and w_j are the weighted estimates of the causal factors leading to the occurrence of individual ORs (conditional bits); f_i and f_j are value measures of the assessments of causal factors leading to the occurrence of OR (cond. bits); $(f_i)^{w_i}$ belongs to the group of OR assessments with indicators of OR causes equal to 0 cond. bit; and $(f_j)^{w_j}$ belongs to the group of OR assessments with indicators of OR causes equal to 1 cond. bit. However, when using a comprehensive OR assessment criterion of this type, the values of causal factors may exceed one (> 1 cond. bit) because zero values may be considered within the group with acceptable indicators of OR causes. Then R_{OR}^τ will tend toward either infinity or zero, which prevents the condition in Formula (2) from being satisfied. Such a model is not suitable for obtaining individual OR indicators (R_{IPAs} and R_{Ds}).

Next, mixed models [8–10] were selected for testing, for example,

$$R_{OR}^{\tau} = \sum_{i=1}^p w_i f_i - \sum_{j=1}^{n-p} w_j f_j = 1 \text{ cond. bit}, \quad (3)$$

and also

$$R_{OR}^{\tau} = \sum_{i=1}^p w_i f_i + \sum_{j=1}^{n-p} w_j f_j = 1 \text{ cond. bit}. \quad (4)$$

If any assessed causal risk factor (OR) has a value of zero when using these models, it will not be included in the sample since it does not affect the estimates of the remaining ORs. Such models became preferable to the multiplicative model in Formula (2). They made it possible to obtain weighted coefficients reflecting the negative manifestations of ORs in HEs (accidents and fires). However, these models required refinement for the assessment of ORs, since the overall systemic comprehensive OR assessment criterion R_{OR}^{τ} took negative values in some cases, which prevents the condition in Formula (4) from being satisfied. It was considered appropriate to use the model presented as an additive weighted assessment [11]:

$$R_{OR}^{\tau} = \sum_{i=1}^n w_i f_i, \quad \sum_{i=1}^n w_i = 1 \text{ cond. bit}. \quad (5)$$

Here f_j is adjusted according to f_i by normalization of values for the assessed ORs when selecting the maximum value for each of them. If a single OR was specified in an accident report, a measure of 1 cond. bit was assigned to it. Different accident reports typically specify the number of ORs (2, 3, or 4). It was necessary to use specific values to aggregate ORs so that the total additive sample index would be 1 cond. bit (Formula (5)). For accident and fire reports involving two, three, or four organizational risks, it is necessary to determine the order in which weights are assigned, as these weights must differ based on the sequence in which the risks are presented in the general list. The following explanations apply to the first organizational risks:

- based on their contribution to the occurrence of an accident or fire, the first risk in the list is considered the primary risk, and the subsequent risks are considered secondary;
- based on probability, the first risk in the list is the most likely;
- based on the severity of the consequences, the first risk in the list is considered to be the one that caused the most severe consequences in terms of damage;
- based on the time when it occurs, the first risk in the list is the triggering risk, which sets off a chain of subsequent events;
- based on manageability, the first risk in the list is the least controllable.

To justify the choice of an organizational risk assessment model based on weight values on an interval scale with the number of ranks (2–4 units), let us consider risk groups $G_{R_{IPAs}}$ and $G_{R_{Ds}}$ under the condition $R_{OR} \in \{G_{R_{IPAs}}, G_{R_{Ds}}\}$, described by a set of influencing causal risk factors $F = \{f_1, f_2, \dots, f_n\}$, where $n \in \{2, 3, 4\}$. Each causal risk factor f_i has a qualitative description and requires conversion to a quantitative form using an indicator x_i belonging to an interval scale $X \subset \mathbb{R}$ with fixed boundaries of the space $[L, U]$, with selected values $[0, 1]$. To determine the threshold values $\{T_0, T_1, \dots, T_k\}$ that will divide the space $[L, U]$ into non-overlapping intervals, it is proposed to use an aggregated measure for the hazardous-event report $B_{R_{OR}}$. It was necessary to determine weight values $\mathbf{w} = (\omega_1, \omega_2, \dots, \omega_n)$ that will represent the level of negative impact for each causal risk factor. Here, it is necessary to assume the condition $\omega_i > 0$, $\sum_{i=1}^n \omega_i = 1$, where ω_i represents the negative impact indicator for each causal risk factor f_i in the HE report (accidents and fires). Then the aggregated measure will be expressed as

$$B_{R_{OR}} = \sum_{i=1}^n \omega_i x_i, \quad (6)$$

which ensures that the properties of an interval scale are preserved (invariance under linear shifts and additivity of increments).

The selection of interval threshold ranges $\{T_0, T_1, \dots, T_k\}$ under the conditions $L = T_0 < T_1 < \dots < T_k = U$ will correspond to the risk negative-impact level (e.g., “requiring immediate action,”

“manageable over a period of time,” or “negligible”). A methodological approach for justifying the organizational risk assessment model is presented in Table 2.

Table 2: Comparison of models for assessing organizational risks on an interval scale

Approach to risk assessment	Mathematical justification	Expediency of use
Entropic (informational)	$H_j = -\sum_{i=1}^m P_{ij} \log P_{ij}$, where $P_{ij} = x_{ij} / \sum_i x_{ij}$ and $\omega_j = (1 - H_j) / \sum_k (1 - H_k)$	To assess risk factors whose qualitative characteristics are not homogeneous
Pairwise comparisons (expert)	The matrix $A = [a_{ij}]$, $a_{ij} \in [1/9, 9]$; the weight vector $\mathbf{w}$ is the normalized eigenvector of matrix A ; consistency ratio < 0.1	To assess the dominant risk factors that require calibration of indicators to interval values
Regression identification	$\min_{\mathbf{w}} \sum_{k=1}^m (y_k - \sum_{i=1}^n \omega_i x_{ki})^2$, subject to $\sum_i \omega_i = 1$, $\omega_i > 0$; y_k is an integral event-realization coefficient	To assess risk factors based on empirically derived weights
Bayesian belief networks	The initial weights $\mathbf{w}^{(0)}$ are received from experts and then updated according to $\mathbf{w}^{(t)} \propto \mathbf{w}^{(t-1)} L(X_t \mathbf{w})$	To adjust a ranked list of heterogeneous risk factors that have identical weight values

V. AN EXAMPLE ILLUSTRATING THE PRACTICAL APPLICABILITY OF A NEW MODEL FOR ASSESSING ORGANIZATIONAL RISKS

Academician N.N. Moiseev proposed the following definition of a model as a means of cognition [12, p. 166]. He suggested a new model be understood as simplified or “packaged” knowledge that conveyed quite specific, limited information about an object (phenomenon) and reflected certain properties of that object. It is proposed that a new model be regarded as a special form of information encoding. Unlike conventional encoding, where all the source information is known and is translated into another language using established methods, a new model, regardless of the language it employs, encodes information that people have not previously known. In this case, the new model contains potential knowledge that a researcher can acquire, make tangible, and apply in practice. To achieve the objective of this article—to develop a model-based approach to the quantitative assessment of organizational risks in ISS departments at EFH enterprises—it is advisable to use an example to demonstrate the possibility of gaining new knowledge through the results of a risk assessment.

Input data: an expert team consisting of six members had to process the reported results, including an analysis of accident and fire statistics, which were used to assess ORs using a new model. For each accident and fire report, a questionnaire was provided in which respondents were required to answer questions by selecting a specific safety category (IS, FS, OHS, or MB of PSU) that:

1. is directly related to the occurrence and manifestation of ORs in HEs (accidents and fires), and damage was consequently caused to the ISS;
2. is immediately related;
3. is intermediately related;
4. is indirectly related.

Each expert assigned the selected area of safety to the appropriate rank $r \in \{1, 2, 3, 4, 5\}$ according to the established scale. The results of the analysis of individual questionnaire data are presented in a group sample (Table 3).

Table 3: Results of expert data analysis with statistics

Group reports	IS	FS	OHS	MB of PSU
No. 1	5	5	5	1
No. 2	3	4	5	2
No. 3	3	4	6	2
No. 4	5	5	5	1
No. 5	3	5	4	1
No. 6	3	4	5	2
No. 7	3	5	5	1
Total	25	32	33	10
Overall priority	2	4	3	1

Expert concurrence was assessed using Kendall's coefficient of concordance [13, 14], W , by the formula

$$W = \frac{12S}{m^2(n^3 - n)}, \quad (7)$$

where $m = 6$ is the number of experts, $n = 5$ is the number of ranks, and S is the sum of the squares of rank deviations, calculated using the formula

$$S = \sum_{k=1}^j (r_k - \bar{r})^2, \quad (8)$$

where r_k is the sum of the ranks assigned to safety category k , and $\bar{r}$ is the normalized rank index calculated using $\bar{r} = \sum_{k=1}^j r_k / 4$. The calculated data are presented in Table 4.

Table 4: Rank correlation of OR assessment indicators

Safety category	Sum of ranks r_k	$(r_k - \bar{r})^2$
IS	25	$(25 - 25)^2 = 0$
FS	32	$(32 - 25)^2 = 49$
OHS	33	$(33 - 25)^2 = 64$
MB of PSU	10	$(10 - 25)^2 = 225$
Total	100	$S = 338$

Kendall's coefficient of concordance was calculated using Formula (7):

$$W = \frac{12 \cdot 338}{6^2(125 - 5)} = \frac{4056}{4320} \approx 0.93.$$

The resulting figure is considered acceptable, as $W \approx 0.93 > 0.7$.

Since the experts' task focused on assessing the effectiveness of the safety contribution (IS, FS, OHS, and MB of PSU) to the overall condition of the ISS, it was necessary to take into account the following condition: "The higher the risk on the Harrington desirability scale, the smaller the safety function's contribution to the effective functioning of the ISS." A template table was used to assess the effectiveness of the safety contribution (Table 5).

Table 5: *Assessment of the safety contribution to the overall condition of the ISS*

Range d_z	Qualitative assessment of the safety contribution
[0, 2]	unacceptable (critical) contribution
[3, 4]	unsatisfactory contribution
[5, 6]	satisfactory contribution
[7, 8]	good contribution
[9, 10]	excellent contribution

The resulting metrics are inversely proportional to the ranks of organizational risks (r_k). The invertible normalization mapping is

$$\begin{cases} z_k = 0 \text{ (negative)} & \longrightarrow z_k^* = +3 \text{ (maximum negative),} \\ z_k = 10 \text{ (positive)} & \longrightarrow z_k^* = -3 \text{ (minimum negative).} \end{cases} \quad (9)$$

To determine z_k^* , it was necessary to assess the effectiveness of each safety contribution (IS, FS, OHS, and MB of PSU), i.e., to rate them on a 10-point scale $z \in [0, 10]$, where [0, 2] indicates an unacceptable (critical) contribution; [3, 4] indicates an unsatisfactory contribution; [5, 6] indicates a satisfactory contribution; [7, 8] indicates a good contribution; and [9, 10] indicates an excellent contribution.

To normalize the data with an inversion of the level attribute z_k^* , a calculation was performed using the formula

$$z_k^* = 3 - \frac{z_k}{5} \cdot 3. \quad (10)$$

The Harrington function was used to determine the indicators of the negative impact of each safety contribution (IS, FS, OHS, and MB of PSU):

$$x_k = \exp[-\exp(-z_k^*)]. \quad (11)$$

Calculations were performed, and contribution-effectiveness indicators were presented for each safety contribution (IS, FS, OHS, and MB of PSU) (Table 6).

Table 6: *Results of the effectiveness of the safety contribution in the overall condition of the ISS*

Group reports / indicator	IS	FS	OHS	MB of PSU
No. 1	7	9	9	1
No. 2	5	7	9	3
No. 3	3	9	7	1
No. 4	7	9	9	1
No. 5	3	9	7	1
No. 6	2	7	9	3
No. 7	3	9	9	3
Weighted average z_k	4.29	8.43	8.43	1.86
Normalized z_k^*	0.43	-2.06	-2.06	1.89
Safety contribution indicator x_k	0.22	0.88	0.88	0.00
Negative-impact indicator $1 - x_k$	0.78	0.12	0.12	1.00

A mechanism for assessing expert uncertainty through a derivative of the desirability function is presented. It allows the correct use of a level-based criterion z_k while ensuring compatibility with the derivation of indicators x_k (the effectiveness of the safety contribution to the quality of the ISS) and indicators of the negative impact of the safety contribution on the ISS condition, calculated as $(1 - x_k)$.

VI. CONCLUSION

This article proposes a model-based approach to the quantitative assessment of organizational risks within the integrated safety system of explosion and fire-hazardous enterprises. It is shown that organizational risks associated with inadequate personnel actions and deficiencies in compliance with regulatory documents can be considered as factors influencing the occurrence of hazardous events. To assess these risks, a normalized conditional measure (conditional bit) is proposed, which allows for the allocation of the contribution of multiple organizational causes within a single actual hazardous event. Various assessment model options are considered, and the expediency of using an additive weighted model is justified, as it ensures the receipt of comparable indicators of the negative impact of organizational risks. The practical significance of the results lies in the ability to create a ranked list of organizational risks and to determine priorities for management actions within the integrated safety system. The results can be used by the management bodies of integrated safety systems at explosion and fire-hazardous enterprises when developing measures aimed at reducing organizational risks and the probability of accidents and fires.

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