Applicable eventology of safety: inconclusive totals

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Abstract. Totals of the eventological [1] safety system modeling [2, 3, 4] is considered for examples and illustrations, which are intended to demonstrate the main features of the algorithm for calculating the risk of a dangerous event at the company under established the event-related circumstances based on the portfolio of identification indicators of company safety; interalia the examples and illustrations show the role and functions (in calculating the risk) of the three main event-based figurants in the safety eventological system: the total subject, the total object and the total barrier; and most importantly they reveal the key of eventological approach applicability for the field of safety in the methods for selecting the optimal portfolio of identification indicators of safety providing specified accuracy of estimating risk of the dangerous event for this company by minimal expert costs.

Keywords. Eventology, applicable eventology, probability theory, event, probability, set of events, algebra of events, mean probable event, value of an event, Gibbsean event-based model, event identification, total subject, total object, total barrier, portfolio of identification indicators, accuracy of estimating risk, minimum cost of expert.

In this paper I intend to very briefly summarize two years of eventological [1] research in the field of safety, which have been published in my works [2, 3, 4, 5, 6, 7, 8], stopping only at the nodal eventological concepts and models to provide a compact and transparent picture again eventological prevailing approach in the development of practical methods in the field of safety and insurance, which led eventually to the establishment of a new eventological safety system of enterprise.

Among other things I'm going to sum up the work of this still new and unfamiliar to most researchers field in the examples that illustrate the characteristics of eventological safety system of enterprise, for if you want to clarify something new, then to make it clearer in the examples, ruthlessly eliminating unnecessary parts and sending them to the original sources.

The nature of this final work forces me to engage in no small measure self-citations. Some short but important sections cited are unchanged as they appear in the original. In the other - I have made minor editorial changes.

In addition, this review includes some illustrations of my previous works, equipped with self-contained full captions that are not duplicated in the text. However, this work, along with the inevitable new synergies for the first time gathered together the results also contains some new ideas, has never been published, and therefore, I hope, is an independent scientific value for the applicable eventology safety and insurance.

Finally, the pattern of recent eventological research in the field of safety would be far from complete without the results of Arcady Novosyolov [9, 10] for controlling and optimizing the risk of dangerous events, references to which I am pleased to be included in these totals.

1 Eventology of safety

Recently, the paper [2] proposes a new eventological world in the field of safety, which is relative to the subject, event, probability and value.

1.1 Safety: subject, event, probability, value [2, pp. 92-93]

The meaning of the concept of danger\(^1\) is investing only a subject (or a set of subjects), which defines and describes the danger. No subject is devoid of any concept of danger, it would not make sense. Danger is always a danger for the subject, the subject danger. As well as a

\(^1\) Or it is safe as there is no danger.
Safety is always a subject safety. Thus, the danger and the safety are subject categories.

It has long been noted more than once stated [1] that a subject does not exist without the event. The event is a being of the subject, a subject being, a co-being, and only in the event subject realizes its existence.

In eventology [1] every event has a probability, and the concept of probability does not make sense as long as the event is defined, the probability of which is at stake. Thus, events do not happen without a probability as the probability does not happen without the event. The second essential characteristic of subject events in eventology is its value. Just as in the case of probability, the eventological concept of value is meaningless as long as the event is not specified, the value of which is pointed: event is not without value, as the value does not exist without the event.

Eventological theory characterizes the subject by this or that set of events that are directly or indirectly connected with the subject, reflecting either side of his being. Each such set of events occurs in the form of a situation of an set of circumstances, of a combinations of occurrence or non-occurrence of events from this set of a terraced events generated by this set. And each such terraced event occurs with appropriate probability. A set of probabilities of all the events terraced generated by a given set of events is called the probability distribution of a given set of events, and a set of values of all the terraced events is called its value distribution 2.

Here we are interested in those aspects of a subject being, those sets of events, along with their E-distributions that give rise to its danger or its safety. It goes without saying that the subject danger and the subject safety is relative categories defined as to the set of events that each time selects the subject himself.

Conclusions of the subject of a danger or safety at the current juncture is always preceded by a conscious or unconscious estimating by subject to the probability and value of a causing or not causing damage to the subject by a coincidence, estimating by subject the probability and value of the terraced event. Thus, both the danger and the safety are not only subject and relative, but also probabilistic and value-categories.

***

It is appropriate to once again after [2] and [3] emphasize the important idea of revealing insight eventological safety and insurance:

• and safety, and insurance is always subject safety and subject insurance, as measured mathematically based on eventological model of the subject and of subject methods of accounting and control probabilistic and value eventological distribution of sets of events in the field of safety and insurance.

***

In [3] it has a method of eventological simulation of safety systems within eventological system analysis, the result of which is the eventological safety model of subjects at the enterprise.

1.2 Eventological system of safety

In [3] it presents mathematical models safety 3 that are based on the eventological system theory [1] and the latest developments in the field of eventology safety [2]. Systems of (fire) safety exist in every corner of the world, in every industry and in every enterprise. Current approaches to the development of (fire) safety systems [11, 12, 13] regardless of the specific country, sector and individual features of the system have a common event-based system basis. Eventological systems theory allows the development of a mathematical model which makes it possible not only to express in a unit eventological safety system and system basis, and the system shell, but also to explain and to measure the structure of the system event-related interactions between them.

To express, to explain and to measure eventologically safety systems as systems of events we must first agree that in eventological theory it means by a system of events, and, in particular, than the notion of a system of events must be different from still central to this theory the concept of the set of events.

In eventology mathematical models of safety systems are considered as a part of eventological system theory (eventological system analysis) [1]. Since our work [5], a eventological system (system of events) proposed a set of events, which is composed of free set of events (system basis), and events operationally related to events from the basis (system shell).

The main landmarks in the development of safety systems, we selected from a rather impressive list of two works. The one [12] can rightly be considered the most famous domestic achievement in the field of fire safety, and the other [13] — exemplary performance of an international project of safety system.

The first work [12] allowed a useful comparative analysis. The second [13], in which the concepts of preventive and reactive barriers, prompted by the thought put into the eventological system safety analysis new concepts and terms: events that are related to the activities of providing safety, called barrier event, and the eventological model of a set of barrier events — the

2The probability and value distributions of events together determine the Gibbs characterization of eventological distribution (E-distribution) of the set of events.

3including fire safety systems.
total barrier, which, together with the total subject and total object is one of the three main event-figurants in the eventological model of safety system of subjects at the enterprise proposed.

2 Glossary of terms and problems of the applicable eventology of safety

1. Gibbs model of eventological system of safety is an eventological model describing the event-based behavior of three total figurants of safety: the subject, barrier and the object, and assessing the risk (the probability of a danger event) in the enterprise as a result of expert review of event state of enterprise safety, carried out within the expert portfolio of I-signs.

2. Identification of regulatory parameters of Gibbs event model — maximum, medium and minimum risk (the probability of a danger event) — for this enterprise together historical, expert and model statistics (see Section 4.3).

3. “I-sign” is an identification sign of safety of the enterprise, the values of which are assess by the expert and define execution/non-execution of regulatory safety requirements; synonym for “I-event”, identification event of safety of this enterprise, the occurrence of which characterizes the performance of the regulatory requirements for safety and is assessed by expert.

4. “Portfolio of I-signs” is a set of I-signs \( \mathcal{A} \), used in eventological safety model to assess the risk (probability) of the dangerous event in the field of safety.

5. Figurant portfolio of “I-signs” is one of the three subsets of I-signs that characterize each of the three figurants individually: total subject, the total barrier and total object, and used in the eventological safety model for risk (probability) assessment of a dangerous event in the enterprise for the appropriate figurants (subject: \( \mathcal{A}_1 \), barrier: \( \mathcal{A}_2 \), object: \( \mathcal{A}_3 \)).

6. Internal figurant subportfolio of “I-signs” is one of two subsets of I-signs that characterize the two-set state of each of the three figurants: total subject, total barrier and total object, and used in eventological safety model to assess the risk (probability) of a dangerous event in the enterprise for the appropriate figurants (internal subject: \( \mathcal{A}_1 \), internal barrier: \( \mathcal{A}_2 \), internal object: \( \mathcal{A}_3 \)).

7. Mean probable portfolio of “I-signs” is the portfolio \( \text{weakidat} \mathcal{A} \), which approximates the portfolio of I-signs \( \text{frakA} \) in the mean probable, composed of mean probable I-signs, each of which approximates in the mean probable to one subportfolio of portfolio \( \mathcal{A} \) respectively.

8. Expert portfolio of “I-signs” is a set of I-signs \( \mathcal{A}^{(e)} \), selected from a total portfolio of I-signs \( \mathcal{A} \) and the proposed for expert review the safety of the enterprise; and similarly defined expert figurant portfolios and internal subportfolios.

9. Minimum expert portfolio of “I-signs” is an expert portfolio in which each I-sign belongs to the only one of the six subportfolios and each of the six subportfolios contains the only one I-sign.

10. Weighted minimum expert portfolio of “I-signs” is an expert portfolio in which each I-sign belongs to the only one of the six subportfolios, and each of the six subportfolios contains not less than one I-sign.

11. Assessment of portfolio weights of I-sign (based on statistical surveys of experts and based on the Gibbs model, from which the log-dependence of portfolio weight of I-sign of the probability of its value), which is characterized by its effect on the risk (probability) of a dangerous event among other I-signs of the portfolio (see Section 4.5).

12. Assessment of information capacity of I-sign in the portfolio (based on statistical surveys of experts and evaluation of information obtained during testing of its value), which characterizes the importance of expert review information value of this I-sign.

13. Assessment of accuracy of the calculation of risk (the probability of a dangerous event) in the enterprise and its dependence on the number of I-signs in the expert portfolio (see Section 4.6).

14. The optimal expert portfolio of I-signs for the enterprise is a portfolio of I-signs \( \mathcal{A}^{(o)} \), provides a given degree of accuracy of risk assessment (the probability of a dangerous event) at the minimum cost of expert (see section 4.5).

3 An event hierarchy of eventological safety system in pictures

Fig. 1: An event hierarchy of eventological system of safety consists of three levels — Left: the set of subjects \( \mathcal{M} \), the set of barriers \( \mathcal{B} \) and the set of objects \( \mathcal{X} \). Center: three system figurants; Right: three figurants eventological system of safety.

Fig. 2: Trajectory of safety. Schedule of probability of safety \( 0 < \mu < 1 \) (vertical axis in the nonlinear scale) for a 50-year sequence of 13 hyper-scenario cycles of safety system. The frequency of fire dangerous events is 0.04 (2 events in 50 years). Safe levels: \( l_1 < l < l_2 \) allowed dangerous levels: \( l_2 < l < l_3 \); dangerous levels of \( 0 < l < l_1 \).

Fig. 3: Many events cycle. Venn diagram illustrating many events cycle of safety system, characterized by a succession of mean probable states of its total figurants: \( \rightarrow \) Norm (N) \( \rightarrow \) Threat (T) \( \rightarrow \) Danger (D) \( \rightarrow \) Restoring (R) \( \rightarrow \) Norm (N) \( \rightarrow \) ...
Fig. 4: Many events cycle in time. Eventological expert events model of the main cycle (Norm, Threat, Danger, Restore) of safety system of subjects in the enterprise. Venn diagram of a succession (left to right) of confluence of mean probable states of system figurants: the total subjects, barriers and objects. Against the background of mean probable state of the total object, the total subject implemented barrier event: warning (in safe state: NORM (N)), eliminating (in permissible dangerous state: TREAT (T)), liquidating (in dangerous state: DANGER (D)) and restoring (in permissible dangerous state: RESTORE (R)). The vertical axis — safety (0 ≤ l ≤ 1 in nonlinear scale) of the subjects, the horizontal axis is the time sequence (left to right) of terraced events.

Fig. 5: The identification of a state of one of the three figurants $A = A_1 \cup A_2$, $N = N_1 \cup N_2$, $B = B_1 \cup B_2$, $X = X_1 \cup X_2$ of safety system of the enterprise based on expert review, which identifies (*) mean probable state TREAT, DANGER, RESTORE or NORM for the figurant $A = A_1 \cup A_2$.

4 Four stages of the assessment of risk of a dangerous event by eventological safety system

The procedure for assessment of the current risk of a dangerous event by eventological safety system of the enterprise consists of four stages.

I Preparation of the portfolio of I-signs (identification
signs) of safety optimal for the enterprise (see Section 4.1).

II Expertise of I-signs of optimally prepared the portfolio (see Section 4.2).

III Identification of the current state of safety on the results of this expertise of I-signs (see Section 4.3).

IV The calculation of the risk of a dangerous event at the enterprise under the current state of its safety ter(A/Λ) using the following formula for conditional probability:

\[
P(s|\text{ter}(A/\Lambda)) = \gamma(\emptyset) \exp \left( \frac{|A|}{|\Lambda|} \ln \frac{\gamma(\Lambda)}{\gamma(\emptyset)} \right),
\]

where \( \gamma(\emptyset) \) is the worst risk, \( \gamma(\Lambda) \) is the best risk, \( \gamma_0 = P(s) \) is the average risk of dangerous event (see Fig. 6 in Section 3).

4.4 Calculation of the risk of a dangerous event

On the basis of the Gibbs event model [3, 4] it is offered to calculate the risk of a dangerous event \( s \) at the enterprise under the current state of its safety \( \text{ter}(A/\Lambda) \) using the following formula for conditional probability:

\[
P(s|\text{ter}(A/\Lambda)) = \gamma(\emptyset) \exp \left( \frac{|A|}{|\Lambda|} \ln \frac{\gamma(\Lambda)}{\gamma(\emptyset)} \right),
\]

where \( \gamma(\emptyset) \) is the worst risk, \( \gamma(\Lambda) \) is the best risk, \( \gamma_0 = P(s) \) is the average risk of dangerous event (see Fig. 6 in Section 3).

4.5 Optimizing the expert costs for expert review of portfolio of I-signs

To solve the problem of optimizing the costs of expert for checking the portfolio of I-signs it is required the notions of a portfolio weight and an information capacity of the I-signs.

The portfolio weight \( w_a = V(a) \) of I-sign/i-event \( a \in \mathfrak{A} \) is based on the Gibbs model which connects it with the probability of \( p_a = P(a) \) of occurrence of the I-event \( a \in \mathfrak{A} \) by known formula [1]

\[
p_a = \frac{1}{\mathcal{Z}} \exp \{ \alpha w_a \},
\]

where \( \alpha \) and \( \mathcal{Z} \) are Gibbs model parameters of portfolio of I-signs.

The formula (4.5.1) can solve two mutually inverse probability problems:

- from known portfolio weight \( w_a \) of I-event \( a \in \mathfrak{A} \) to seek the probability \( p_a \):
- from known probability \( p_a \) of I-event \( a \in \mathfrak{A} \) to seek its portfolio weight

\[
w_a = \frac{1}{\alpha} \ln(p_a \mathcal{Z}).
\]

as well as the control problems for the risk of a dangerous event under various restrictions on expert costs [9, 10].

The information capacity of I-sign/i-event is measured by entropy of I-event \( a \in \mathfrak{A} \) by the known formula [1] (see Fig. 8)

\[
\mathcal{I}_a = -p_a \ln p_a - (1 - p_a) \ln(1 - p_a),
\]

where \( p_a = P(a) \) is the probability of I-event \( a \in \mathfrak{A} \).

The interpretation of this information specifications of I-event lies in the fact that if the probability of I-event is close to 0 or 1, the expert review of its occurrence provides little additional information and its inclusion in the expert portfolio is not too justified. The criteria for selection of I-sign \( a \in \mathfrak{A} \) of the portfolio \( \mathfrak{A} \) in optimal expert portfolio

\[
\mathfrak{A}^{(c)}(\delta) = \{ a \in \mathfrak{A} : \mathcal{I}_a \geq \delta \} \subseteq \mathfrak{A},
\]
is a significant amount of its information capacity $I_a$ surpassing the threshold $\delta \in [0, \ln 2]$ which depends on the desired accuracy of the risk assessment of a dangerous event.

4.6 Optimizing the accuracy of assessment of the risk of a dangerous event

Error $\varepsilon$ of the assess $\hat{P}(s)$ of the risk $P(s|\text{ter}(A/\Xi))$ of dangerous event $s$ based on the selected expert portfolio $\mathcal{X}^{(e)}(\delta)$ can be computed using the formula:

$$\varepsilon = t_{(1-\alpha)/2,N-1} \frac{\sigma}{\sqrt{N}},$$

where $t_{(1-\alpha)/2,N-1}$ is the $(1-\alpha)/2$-quantile of the Student $t$-distribution with $N-1$ degrees of freedom, $\sigma$ is a standard deviation, $\alpha$ is the required level of confidence usually taken equal 0.95, and $N = |\mathcal{X}^{(e)}(\delta)|$ is the power of expert portfolio, i.e. amount of I-signs including in $\mathcal{X}^{(e)}(\delta)$. Thus the error $\varepsilon$, which is the smaller, more square root of its power $N$, determines the confidence interval

$$\hat{P}(s) - \varepsilon \leq P(s|\text{ter}(A/\Xi)) \leq \hat{P}(s) + \varepsilon,$$

where the value of risk of a dangerous event falls with the probability which is not less than $\alpha$.

In addition to the power of expert portfolio $N$, the error $\varepsilon$ of risk assessment greatly depends also on how the relationship between the I-signs characterized by the portfolio of selected I-signs. To control interdependence between I-signs in the portfolio may be, controlling its probability-event structure. Control principles of probability-event structure of the expert portfolio that lead to a reduction of error set out in section 5.

5 Help: eventological model of expert portfolio of I-signs of safety

The key to the applicability of eventological approach in safety is the eventological model of the structure of expert answers to a set of normative questions about the safety of the enterprise, in other words, the structure of expert portfolio of identifying signs/events (I-signs/I-events) of enterprise safety$^4$.

Such an event-probability structure of I-signs of safety should be organized optimally so that at minimum expert cost to provide the required accuracy of risk assessment (probability) of a dangerous event. In theory, it is clear that a large body of regulatory questions is due to the greater accuracy of risk assessment. However, with the increase of the totality of questions, first, rising costs of obtaining expert responses, and secondly, the information capacity of each answer added decreases. The proposed optimally organized structure of expert portfolio of I-signs solves this dilemma by providing the required accuracy by the minimum cost.

5.1 Eventological model of the portfolio of I-signs

Eventological safety model proposed in [2, 3, 4, 5, 6, 7, 8], is an event-probability model of the safety enterprise system, which is formed by event-driven reaction of three system total figurants, each of whom is responsible for the event-behavior of the corresponding set of: $\mathcal{M} —$ subjects, $\mathcal{B}$ — barriers and $\mathcal{X} —$ objects of the enterprise, joint event-state of which form the safety state of the enterprise as a whole.

Eventological risk (probability) of a dangerous event at the enterprise depends on the event-state in which there is an enterprise safety. This event-state is characterized by portfolio of I-signs of safety of this enterprise, which is usually a set of answers to the specially selected regulatory questions. The composition of the portfolio of I-signs and organization structure of these I-signs in the portfolio largely determine the accuracy of the expert assessment of risk and the amount of the cost of the expertise of state of enterprise safety.

The general structure of the portfolio of I-signs is defined by the hierarchical structure three-figurants eventological safety model, where each of the three total figurants has its own two-set-structure. This hierarchical

$^4$The definitions of the basic concepts and concise formulations of the problems (usually highlighted in italics) associated with the optimal choice of the expert portfolio of I-signs of enterprise safety listed in the reference section 2 on page 106.
structure is formed by three figurant portfolios $I$-signs

$$M, B, X,$$

each of which is formed by the union of two inner figurant subportfolios of $I$-signs$^6$.

$$M = M_1 \cup M_2, \ B = B_1 \cup B_2, \ X = X_1 \cup X_2. \quad (5.1.1)$$

As a result, the structure of portfolio of $I$-signs of enterprise safety is characterized by the totality

$$A = M_1 \cup M_2 \cup B_1 \cup B_2 \cup X_1 \cup X_2, \quad (5.1.2)$$

which is formed by the union$^6$ of six figurant subportfolios of $I$-signs.

The problem of choosing the optimal structure of the expert portfolio is to choose six $I$-signs of the enterprise $A^{(c)} \subseteq A$, which provides the required accuracy of the risk assessment by minimal expert costs.

5.2 Full expert portfolio of $I$-signs

The Table 1 illustrates the minimum full expert portfolio of $I$-signs

$$A = M_1 \cup M_2 \cup B_1 \cup B_2 \cup X_1 \cup X_2 \subset A, \quad (5.2.1)$$

compiled by combining six subportfolios, each of which is defined by the relevant subset of $I$-events

$$M_1, M_2, B_1, B_2, X_1 \cup X_2 \subset A. \quad (5.2.2)$$

This full expert portfolio $\frac{frak}{\cal A}$ is an interesting event-based interpretation, perhaps the only correct only when using the concept of a kind of mean event-based characteristics of subsets of $I$-events. The role of the mean characteristics can be successfully implemented, for example, recently introduced to eventology the concept of the mean probable event$^7[7, 8]$. In this interpretation, the entire expert portfolio is approximated by a set of just six mean probable $I$-events

$$M_1, M_2, B_1, B_2, X_1 \cup X_2 \in A, \quad (5.2.3)$$

each of which approximates one of the six subsets of $I$-events (5.2.2), which, for example, for subset of $I$-events $M_1 \subset A$ is interpreted as follows:

$$M_1 = \mathcal{E}(\mu / M_1) = \mu_{M_1}, \in A.$$

$^5$Not necessarily disjoint.

$^6$Each pair of inner figurant subportfolios of $I$-signs is required mainly in order to assess the condition of the 4 states of the safety cycle (norm, threat, danger, restore) is one of three figurants involved and, consequently, in which condition of 64 is the whole safety system of the enterprise. In addition, inner figurant subportfolios of $I$-signs can be used to estimate the private risks of dangerous events for each figurant involved in isolation, or for each of a pair of sides$^7$ of the figurant separately.
I will outline
\[ \hat{A} = \{ \hat{M}_1, \hat{M}_2, \hat{B}_1, \hat{B}_2, \hat{X}_1, \hat{X}_2 \} \subset A \]  
the set made as of the elements of the six mean probable events (5.2.3), and approximating in the mean probable a whole expert portfolio \(\hat{A}\) and \(A \subseteq \hat{A}\) generated by 64 = \(2^6\) terraced I-events of the second kind
\[ \text{ter}_{A/\hat{A}} = \bigcap_{a \in A} a \in \hat{A}, \]
the probability of which form probability distribution of II-type
\[ \{p_{A/\hat{A}}, A \subseteq \hat{A} \} \]
of sextet of I-events \(\hat{A}\), where
\[ p_{A/\hat{A}} = P \left( \text{ter}_{A/\hat{A}} \right). \]

Remark 1. All I-events from the full portfolio \(\hat{A}\) are joint and are generated by six mean probable I-events of the sextet \(\hat{A}\) as the different results of terraced\(^8\) operation of the II-kind over sextet \(\hat{A}\), indexed by its different subsets\(^9\) \(A \subseteq \hat{A}\).

Remark 2. In Table 1 abbreviation used to denote subsets of the sextet \(A \subseteq \hat{A}\) refers to the states of Norm (N), Threats (T), Restore (R) and Danger (D) of each of the three total figurants of safety system as follows. For any total figurant involved \(\hat{A} = \hat{M}, \hat{B}, \hat{X}\), approximated by doublet of mean probable events (\(\hat{M}_1, \hat{M}_2\)), its empty subset \(\emptyset \subseteq \{\hat{M}_1, \hat{M}_2\}\) corresponds to the mean probable state of Danger (D), the subset \(\{\hat{M}_1\} = \) mean probable state of Threat (T), the subset \(\{\hat{M}_2\} = \) mean probable state of Restore (R), and the subset \(\{\hat{M}_1, \hat{M}_2\} = \) mean probable state of Norm (N). So, for example, the abbreviation “-TN” corresponds to mean probable state of safety when the total subject \(\hat{M}\) is in an arbitrary mean probable state, the total barrier \(\hat{B}\) is in the mean probable state of Threat (T), and the total object \(\hat{X}\) is in the mean probable state of Norm (N).

Examples of the use of abbreviations are:
\[ \text{ter}_{- - TN} = \text{ter}_{\emptyset/\hat{A}}, \quad \text{ter}_{- T} = \text{ter}_{\{\hat{M}_2\}/\hat{A}}, \quad \text{ter}_{- T N} = \text{ter}_{\{\hat{M}_1, \hat{X}_1, \hat{X}_2\}/\hat{A}} \]
\[ \text{ter}_{RN} = \text{ter}_{\{\hat{B}_1, \hat{X}_1, \hat{X}_2\}/\hat{A}}, \quad \text{ter}_{T T} = \text{ter}_{\{\hat{B}_2, \hat{X}_2\}/\hat{A}}, \quad \text{ter}_{NNN} = \text{ter}_{\emptyset/\hat{A}}. \]

\(^8\)Terraced called such a set-theoretic operations on sets of events which resulted in the terraced event of one of six standard kinds [1], generated by this set of events.

\(^9\)The results of terraced operations of II-kind on the events of \(\hat{A}\) are terraced events of II-kind \(\text{ter}(A/\hat{A}) = \bigcap_{a \in A} a \subseteq \Omega\), indexed by subsets of \(A \subseteq \hat{A}\).

5.3 Minimum expert portfolio of I-signs

Minimum expert portfolio of I-signs (see Tab. 2), though allowing to solve all the problems facing the eventological safety system, but does not guarantee the accuracy required for risk assessment.

<table>
<thead>
<tr>
<th>I-signs</th>
<th>***</th>
<th>Filling subportfolios</th>
</tr>
</thead>
<tbody>
<tr>
<td>M</td>
<td>M</td>
<td>M</td>
</tr>
<tr>
<td>B</td>
<td>B</td>
<td>B</td>
</tr>
<tr>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
</tbody>
</table>

Tab. 2: Example of filling figurant subportfolios of I-signs in the minimum expert portfolio, which consists of six I-signs with weights: 1,1,1,1,1,1 (top-down). In the column *** subsets of the abbreviation (see Remark 2 on page 112), by which the corresponding I-event (terraced event of II-kind) are numbered.

5.4 Minimum weighted expert portfolio of I-signs

Minimum weighted expert portfolio of I-signs (see Tab. 3) also solves all the problems facing the safety system, can provide the required accuracy of the risk assessment by varying the weights of I-signs in the portfolio, but unable to consider interconnections between I-signs in the portfolio.

<table>
<thead>
<tr>
<th>I-signs</th>
<th>***</th>
<th>Filling subportfolios</th>
</tr>
</thead>
<tbody>
<tr>
<td>M</td>
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<td>M</td>
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<tr>
<td>B</td>
<td>B</td>
<td>B</td>
</tr>
<tr>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
</tbody>
</table>

Tab. 3: Example of filling figurant subportfolios by I-signs in the minimum weighted expert portfolio, which consists of 38 I-signs corresponding to 6 terraced I-events of the II-kind with weights: 12,16,3,5,3,1,1 (top-down). In the column *** the abbreviation of subsets shown (see Remark 2 on page 112), by which the corresponding I-event of II-kind are numbered. SS — safety standards, D — dangerous.

5.5 Arbitrary expert portfolio of I-signs

The arbitrary expert portfolio of I-signs (see Tab. 2), containing a minimum weighted portfolio, allows us to
solve all the problems facing the eventological safety system that can provide the required accuracy of the risk assessment, and has the option to account for the relationship of I-signs in portfolio with the help of I-signs contained in more than one of the six subportfolios.

<table>
<thead>
<tr>
<th>I-signs</th>
<th>Filling subportfolios</th>
<th>B</th>
<th>C</th>
<th>D</th>
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<td>3</td>
<td>4</td>
<td>1</td>
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<tr>
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Tab. 4: Example of filling figurant subportfolios by I-signs in the incomplete expert portfolio, which contains a minimal portfolio (see Tab. 2) and the minimum weighted portfolio (see Tab. 3) consists of 69 I-signs corresponding 13 (instead possible 63) terraced I-events of II-kind with weights: 12,16,3,5,4,1,10,1, 2,1,11,2,1 () (top-down). In the column the abbreviation of the subsets shown (see Remark 2 on page 112), by which the corresponding I-event of II-kind is numbered. SS — safety standards, D — dangerous; ETW — engineers and technical workers.

To match all kinds of relationships between I-signs in the portfolio can be using the expert portfolio, including the weighted full portfolio of I-signs of safety, that includes I-signs corresponding to all possible terraced events of II-kind generated by the corresponding mean probable expert portfolio.

6 Totals

The proposed succinct statement of the results of eventological studies on the safety turned out, though far from exhaustive, but rewarding venture, during which opened stripped of unnecessary details, the overall design of eventological safety system that produced new ideas related to key safety procedure of applicable eventology — the preparation of optimal portfolio of I-signs. Detailed research and development of these eventological ideas will be discussed in subsequent papers.

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Thank to Arcady Novosyolov for reliable resistance, which allowed sharpen almost axiomatic rigor to new theoretical ideas in eventology safety, and Sergey Amelchugov for constant advancement of new fire safety problems and their useful discussion, which invariably led to new approaches in eventological modeling and safety control.

**References**


