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The method of soft computing risks in matrices of complex events

Abstract: The existing normative definition of risk is based on probability theory, is a particular definition of risks and does not correspond to the variety of measures for calculating life risks. The purpose of risk matrices is to make it possible to assign numerical values to the properties of evaluated objects through expert subjective judgments. The method is aimed at direct application of expert assessments of any objects and their components.

Keywords: soft computing, estimation, matrix, risk, emergency, event

Introduction. Event management is dominated with approaches to measuring, calculating risks, developing national and global security programs and managing risks in emergency situations. There are three approaches to study the subject of risk: the measurement of risk, the sociocultural evaluation and the psychometric evaluation. Risk measurement focuses on how to transform data on damage, casualties, financial losses, and how risk is influenced. The sociocultural evaluation looks at the impact of group and cultural variables on risk. Risk psychometry establishes the emotive responses of people to risk situations that form risk judgments [1]. The risk assessment approach focuses on matrix risk estimation. out of all the diversity of studying the risks of life activity, this work considers two most important aspects of the problem: (1) identification and the validity of calculating risks, (2) the validity of the approach to assessing risk matrices in the instrumentation. Author presents a method of design and soft computing (SC) in risk matrices. The problems of subject risk are as follows: a) unclear origin of the term "risk", b) numerous incompatible classifications and definitions of risks, c) groundlessness of the concept of risk measurement, d) groundlessness of risk identification through uncertainty, e) groundlessness of risk identification as a negative consequence through a combination probability and damage.

Identification and **calculating risk.** Concept of risk measurement and the regulatory standards [2] risk is defined as follows: risk (a) is the

product of multiplication (b) the probability and (c) the consequences (impact, damage) of an event (1): $[\overleftrightarrow{\boldsymbol{R}} = \mathbf{P} \cdot \mathbf{D}]$

[Risk = Probability x Damage]. (1)

The scientific basis for the risk formula remains debatable and controversial. The consequence of these problems is the fact that in practice the calculation of risks by the ratio of probability and consequences becomes uncertain. If there are a number of consequences and the probabilities for different outcomes differ, then the total risk is determined by the sum of the mathematical multiplication (2):

$$R = \sum_{i=1}^{n} P_i \cdot D_i \quad (2)$$

Problems of assessing risk in matrices are discussed for long time in scientific literature [3-5]. When compiling risk matrices, a fundamental mistake is made when assigning linear numerical values for the rows and columns of the matrix. Multidimensional assessments in weak scales are the reason for the long-debated problem of "weak consistency" in strict risk matrix assessment. Therefore, the vast majority of practiced risk management methods cannot be recognized as scientifically justified.

Method. This paper presents the development of a new matrix method for event risk soft assessment. The basis of the method is the concept of the richness of natural language (NL) in comparison with any formal models used for calculating the risks of complex events. The development of a new approach of soft computing (SC) in this paper is considered as original. Soft computing (SC) defines as a set: hard estimation (HE), soft measurement (SM), soft estimation (SE) in metric and non-metric scales with the ability to simultaneously process quantitative numerical and qualitative linguistic data. The aim of the research is to present a new method of design and soft computing in risk matrices.

Method Development. In this paper, it is proposed to use the following tools that lead to the estimation of the risk value to create event estimation matrix content: RISK MATRIX: [word, color, letter, digit, interval, bit depth] = risk value. It is presented the development of a risk matrix design template. The event is observed in the randomness of the outcome and in the measure of the magnitude of the outcome. The purpose of risk matrices is to make it possible to assign numerical values to the properties of the evaluated objects through expert subjective

judgments. In the method of this work, the randomness measure absorbs a wide class of soft measures – likelihood, necessity, confidence, conviction, possibility, probability. The measure of the magnitude of the outcome combines the concepts of severity, impact, damages, losses, victims.

Estimations of values can be performed on the data of the numerical domain for determining pairs of fuzzy qualifiers [0, 1]. Such calculus is called HE. The regions can be expanded on sets of semantic series by a sequence of NL words, which are a chain of increasing and decreasing properties of an object. To solve the tasks of the SE, it is used the nominal scales of fuzzy qualifiers. To build scales, it is suggested compiling semantic rows of words that set the values of event parameters. Each word is assigned a numerical value of the chosen heuristic school.

Establishment of the Parameters Quantification. The solution to the problem of calculating risks is to establish a method of quantification of the parameters. The cell displays one value of the estimated value of risks in natural numbers or in the names of the NL. The method prescribes a sequence in the concepts of NL: a) the search and establishment of an acceptable parameter, b) the establishment of the concept of the domain of definition (estimation), c) the expansion of the domain into a semantic series of words of increasing-decreasing of the estimated properties, d) assigning a numerical value to each of the words. It is possible to set various quantification parameters.

Complex Matrices Design Development. The soft risk assessment matrix is designed for managing complex events. The number of subsets of fuzzy spaces in the set of fuzzy measures is six. This makes up a numerical scale [1 – the greatest fuzziness, 6 – the least fuzziness]. Weights of estimates are indicated by a double digit, separated by a hyphen, the first digit has an estimate of the structural properties of the object, the second digit evaluates the measures of clarity. The presented matrix has a bit size (6x10) and is intended for expert assessment of risks of any events. The matrix is intended for evaluating events in terms of duration randomness [exs, fev] and fuzziness of the plausibility-conviction measures [pl, con]. The resulting score is a measure of the of the outcome, denoted as a fuzzy measure of the first kind, and written (3):

$$R: <\mu\_[exs, fev], \mu\_[pl, con]>. \quad (3)$$

Risk assessment using this profile is an alternative probability measure compared to the accepted metric. Unlike analogs, the advantage of the matrix is the resolution of the problem of "weak consistency": the exclusion of mismatch of color and numeric values of risks.

Event Risk Soft Assessment Example. Let's create a scenario of practical soft assessment method (SAM) application of the risks of the complex event "Readiness of the Olympiad". Choose a three-color matrix metric: the lower-right cells are red, the upper-left cells are green, and the intermediate cells are yellow. The duration qualifiers are reasonably reduced to six, excluding the top two and bottom two. The extreme right and extreme left measures can be excluded from fuzzy measures. As a result, a reduced 4x6 matrix is used for this practical task. This reduction of the matrix is caused by our common sense judgments that extreme estimates are improbable, since they correspond to the failure of the Olympiad project. Let's assume that after the calculation, a total expert assessment of the event's risks is obtained (4):

RISK: <(prob – soon), (6-3) [yellow]> ≡ {plausible – realistic}, (4)

where (prob – soon) is the measure of event randomness of expert values in terms of NL, (6-3) is weight values in duration qualifiers, [yellow] is a color estimation of the event according to the heat map method.

Results, A formal definition of the concept of soft computing is presented. Method of design and soft computing of event management in risk matrices is proposed. Risk matrix design template is proposed. Risk matrix, risk indicator, risk value definitions are developed. Definitions allow to formulate the concepts of normal activity in numerical, non-numeric and color indicators. Examples of evaluating various event parameters are presented: distances, frequency, duration, value, impact, speed. The complex matrix is to be used for expert assessment of risks of any events. Complex event risk soft assessment experiment indicates that SAM is available for use by experts of any qualification. Risk assessment using this profile is an alternative to the accepted probability measure metric. In contrast to the analogs, the advantage of the proposed matrix is the resolution of the problem of "weak consistency" of the matrices: the elimination of mismatch of color and numeric values.

Conclusion. The purpose of risk matrices soft computing is to make it possible to assign numerical values to the properties of evaluated objects through expert subjective judgments. The randomness measure

absorbs a wide class of soft measures. The measure of the magnitude of the outcome combines the concepts of severity, damages, losses, and victims. The method is aimed at direct application of expert assessments of any objects and their components.

This practice is used by insurance corporations to evaluate very complex and large events of great value. They use commercial databases of damage values without calculating the randomness of events in any fuzzy measures, probabilistic or possible due to the high complexity of calculations. To evaluate the measure of the outcome value, in accordance with the method, it is necessary to create a number of semantic qualifiers of the value and perform an evaluation similar to the previous one.

Symbols proposed and used are normative guidelines for practical application. The template allows to select a set of tools to indicate the randomness and magnitude of risks. The content provides a sample design of risk assessment matrices using the developed template using the soft computing method.

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