

## INDICATORS IN RISK MANAGEMENT

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### Abstract

The article describes the approach to risk management at an early stage of the identification. The approach is based on the use of risk indicators for the preliminary risk assessment for subsequent in-depth analysis or study discontinuation. Risk management methods are based on international standards ISO 31000:2009 and ISO/IEC 31010:2011. Risk-Indicators methods are suggested by the authors on the base of method of Fine-Kinney.

**Key words:** risk management, identification, indicators, ISO 31000:2009, ISO/IEC 31010:2011

### WSKAŹNIKI W ZARZĄDZANIU RYZYKIEM

#### Streszczenie

Opisano podejście do zarządzania ryzykiem w początkowym stadium identyfikacji. Podejście oparto na zastosowaniu wskaźników ryzyka do wstępnej oceny ryzyka dla kolejnej, dogłębnej analizy lub przerwania badań. Metody zarządzania ryzykiem oparto na międzynarodowych standardach ISO 31000:2009 i ISO/IEC 31010:2011. Autorzy sugerują stosowanie metody Wskaźników Ryzyka opracowanych na podstawie metody Fine-Kinney.

**Słowa kluczowe:** zarządzanie ryzykiem, identyfikacja, wskaźniki, ISO 31000:2009, ISO/IEC 31010:2011

### Introduction

A risk is present in activities of any organization. This corresponds to the essence of human existence as a living being who studies the world around under uncertainty. Risk management helps in making the most correct decisions in these circumstances and opportunities prediction of adverse events or circumstances that may affect the achievement of the goals of the organization and security personnel.

Risk Management uses logical and systematic methods applied for information sharing and consultation about of the risks. Therefore, there is a need to make the identification, analysis, evaluation and treatment of risk, accor-

ding to any activity, process, function or product; monitoring and analysis of changing risk; check the results and prepare to report [*Hazardous*. 1976].

Risk assessment is part of the risk management. This is a structured process in which ways of achieving goals, analyzes of consequences and likelihood of hazardous events for a decision on the need for handling risk is identified. Risk management is based on the International Standard ISO / IEC 31010-2011 [*Risk management...* 2015a]. This standard presents methods of risk assessment and data for links to other international standards where more details of risk assessment methods are described. Risk assessment that is in this standard, the structure and process of risk management were established by ISO 31000 [*Risk management...*2015b] and ISO Guide 73:2009 [*Risk management...* 2015c]. The structure of risk management involves establishing policies, procedures and organizational measures for the implementation of risk management in all parts of the organization [*ISO. Standards 2015*].

Risk assessment is a process that combines the **identification**, **analysis** and **comparative assessment** of risks. The risk can be estimated for the entire organization and its divisions, individual projects, activities or particular hazardous event. Therefore, in different situations can be applied different methods of risk assessment [*Risk management...*2015b].

Risk identification is the process of determining the elements of risk, preparation of a report and description of each element of risk. The purpose of risk identification is the inventory of risk sources and events that may affect the achievement of the stated objectives of each organization or make it impossible to meet these goals. After identification of risk the organization should identify the essential features of the project, staff, processes, systems and controls. Risk identification process includes identification of the causes and sources of dangerous events, situations, circumstances or risks that may have a significant impact on the achievements of the organization and nature of these impacts. Methods for identifying of risk can include [*Risk management...*2015a]:

- Methods risk assessment based on documentary evidence, examples of which is the analysis of checklists, analysis of experimental data as well as data and events that occurred in the past;
- The approach, according to which should be established the group for risk identification process that will be using a structured set of tips or questions;
- Inductive methods such as HAZOP.

To improve the accuracy and completeness of risk identification various methods can be used such as brainstorming method and the Delphi method.

It is important to identify the risk to consider the human and organizational factors. Deviations caused by the influence of human and organizational

factors and dangerous events related to information technology too must be taken into account in the identification of risk [Berezutskyi 1999; Berezutskyi, Berezutskaya 2013].

### Preliminary hazard analysis

PHA (Preliminary Hazard Analysis) is a simple inductive method of aiming to identify hazards, hazardous situations and events that may disrupt or harm this type of activity, equipment or system [Risk management...2015a and b]. PHA is usually performed in the early stages of project development in a lack of information about the project details or workflows. This action is often preceded or followed by research aimed at obtaining information to develop requirements for the projected system. PHA also is useful when analyzing existing systems aimed on to do ranking of hazards and risk for further risk analysis. Input data include

- information on the estimated system;
- project details of the systems that is available and necessary.

The lists of hazards and hazardous situations have based in common form on:

- data of materials used and produced, chemical or other activity their;
- list of equipment used;
- information about the work environment;
- location of equipment;
- information about the interaction of system components, and etc.

Qualitative analysis of the consequences of unwanted events and their probability can be performed to identify the risk and for further its evaluation.

PHA should be repeated in progress through the stages of design, development and testing to detect new threats and making the necessary changes. The results can be presented in tabular form or as a „tree” [Risk management...2015a; Berezutskyi 1999]. Imprints include list of hazards and appropriate risk, and also recommendations on risk-taking, recommended methods of controls, requirements to design or request on perform more detailed assessment. Advantages and disadvantages of the method are presented in table 1. Anyway, adding the indicators of risk to the PHA method makes it more effective [Berezutskyi, Dreval 1997].

Hazard indicators are located around us and it is only necessary to learn how to identify them and apply in practice. Hazard indicators are distinguished by the nature of their origin, in the physical and chemical properties, form a signaling and other. Indicators are also divided into natural and artificial ones, created by man.

Table 1

Advantages and disadvantages of Preliminary Hazard Analysis method

Advantages of the method	Disadvantages of the method
PHA method can be used in a situation of limited information	PHA method provides only preliminary information
PHA method allows you to explore the risk at the earliest stages of the life cycle of the system	Method PHA is not a comprehensive method and cannot provide detailed information about dangerous events and ways to prevent them

The indicators, which are specially made technical devices, can be subdivided into electronic circuits with light panel which is designed for visual status messages of object, electrical measuring instruments, with which you can distinguish phase from zero conductor and others. Technical aids or substance intended to establish the presence or certain quantity substance and determining its threshold. This threshold shows the limits of hazards and risks and affordability for man and nature. Indicators are used as indicators pointers of well-being of society, the economy and finance. A feature of these indicators is that they are used for systems which are very difficult to study and there are no special technical devices to accurately determine the status of the object of study. The indicators used in the analysis of the states of the natural and working environments. Tables of indicators for gas and liquids have the same place in various chemical labs. For example: many reactions occur only at certain pH values, and the color changes of the indicator just tell you approximate the pH of the solution [Indicator PH... 2015]. For reference: the acidic environment – pH <7; alkaline – pH > 7; neutral medium of pH = 7. Note only that phenolphthalein has the same color in acidic and neutral media and methyl orange should be added in a small amount because at a high concentration it will be difficult to grasp border color transitions. Paper strips and sheets impregnated with special solutions can be used like indicators.

Indicators must have high selectivity capacity which determines their effectiveness and reliability of use. Therefore, indicators should be developed for each specific case on the basis of the dangers and hazards that are specific to a particular domain of research. For example, the risk of carbon monoxide poisoning is determined by selective sensor which can emit an audio signal after detecting an excessive doses or receive information from recording device. So, there are indicators developed for the chemical, physical and other parameters of the environment. But indicators of danger it is the specific field in which there are not only material and energy but also psycho-physiological factors. Their main distinguishing feature is the complexity and unpredictability of their effects.

## The fine-kinney method

The method of **Fine-Kinney** is widely used for professional risk assessment widely. Approach at this method is based on hazards assessment in the workplace of worker by susceptibility the potential threats in the workplace and the consequences for health and /or safety of workers in the event that the threat is realized. This method is also based on the indication of danger [*Risk management...* 2015a; Berezutskiy, Dreval 1997].

This method is expressed by the equation (1):

$$R = \text{Tendency} \times \text{Probability} \times \text{Consequences} \quad (1)$$

In the method of Fine-Kinney (table 2) degree (level) varies for Tendency from 0 (had no tendency) to 10 (permanent), the Probability ranges from 0 (absolutely impossible) to 10 (expectations that happens), the Consequences range from 1 (minimum enough first aid) to 100 (catastrophe).

Table 2

Principles of Fine-Kinney's method

Tendency		Probability		Consequences	
10	Permanent	10	Expectations that happens	100	Catastrophe, many victims
6	Regular (daily)	6	Very likely	40	Alarm few victims
3	Occasionally (weekly)	3	Unusual, but possible	15	Very heavy, 1 person killed (immediately or over time)
2	Sometimes (monthly)	1	Unbelievable	7	Heavy, disability
1	Sometimes (annually)	0.5	One can imagine but incredibly	3	Serious injury and absenteeism
0.5	Very rare	0.2	Almost impossible	1	Minimum, enough first aid
0	Never	0.1	Unable		
		0	Absolutely impossible		

Analysis of risk should lead to risk classification on the degree of seriousness (table 3).

Table 3

Risk classification on the degree of seriousness

Risk	The degree of seriousness
> 400	Extremely high risk immediate termination of
200 – 400	High risk, immediate improvements are needed
70 – 200	Severe risk of needed improvement
20 – 70	Possible risk should pay attention
0 – 20	Small possibly acceptable risk

Method of Fine-Kinney had classified risks at five professional groups (table 4).

Table 4

Classifies risks in five professional groups

Probability	Severity of harm		
	moderate	average	bad
It is incredible	Very easy 1	Little 2	Average 3
Probably	Little 2	Average 3	High 4
Highly likely	Average 3	High 4	Very high 5

Thus, the method of determining the indicator for each object, time and place will be determined by the combined effect of the impact on living organisms, humans and the environment. Proceeding from the above mentioned, for the identification of hazardous and harmful factors of the environment, one must first define them (visually, devices, technical description of the device, the smell, color, etc.). The results that were obtained need to compare with the databases. It is preferable that this work had done by professionally trained experts with experience in such work. This is a very important stage in the development of use of indicators of danger (risk). Next you need to determine the extent of the danger posed by these hazards. Different approaches can be used but the most preferable in our opinion is to determine the magnitude of the danger on the number of people who can (or are) in danger. Comparison of the magnitude of risk for assessing how people might be affected and in what form is not entirely correct. But an existing reality which is based on the probability of events can be translated to the existing category for comparison.

## The risk-indicator method

Method of Fine-Kinney does not consider the physic-chemical and other properties of the materials but mainly relies on the personal perception of dangerous and harmful factors of the working area. It is not always correctly identified those workers who interrogated. To reduce the risk assessment to a more objective, the Risk Indicator method developed by the National Technical University „Kharkov Polytechnic Institute” has been proposed [Berezutskyi, Berezutskaya 2013; Berezutskyi, Dreval 1997].

Analyzing the above we propose indicators of danger (symbol – **RI - Risk - Indicators**) which can be defined by the following expression:

$$RI = \text{Workpeople} \times \text{Factors} \times \text{Probability} \quad (2)$$

Where:

**Workpeople** – number of personnel that can be exposed to this factor;

**Factors** – number of hazardous factors (the factors which influence the result of a person leads to serious injury or death);

**Probability** – the Probability ranges from 0 (Absolutely impossible) to 10 (Expectations that happens). It's like at method **Fine-Kinney** about it mentioned above.

### **Workpeople:**

**8** – More 1000 people (working teams), and/or plus passengers and other people present;

**7** – 100-1000 people (working teams), and/or plus passengers and other people present;

**6** – 10-100 people (working teams), and/or plus passengers and other people present;

**5** – 5-10 people (working teams);

**4** – 1-5 people working teams;

**3** – One man at workplace;

**2** – Service (workplace impermanent);

**1** – Control (some time).

### **Factors:**

**10** – More 1 chemical agents (substances), and/or radioactive, and/or explosive fire risk material (gas state);

**9** – More 1 chemical agents (substances) 1 class, and/or more 1 pathogenic component Biological, and/or explosive fire risk material (liquid state);

**8** – 1 chemical agents (substances) 1 class, and/or 1 pathogenic component Biological, and/or explosive fire risk material (solid state);

**7** – More than 1 chemical agents (substances) 2 class, and/or Fire-risk substance (gas state);

- 6** – 1 chemical agents (substances) 2 class, and/or more 1 non-pathogenic component Biological, and/or Fire-risk material (liquid state);
- 5** – 2 chemical agents (substances) 4 and 3 classes of danger and/or 1 Biological nonpathogenic component, and/or Fire-risk material (solid state);
- 4** – More 5 physical factors and / or 1 chemical (Hazard class 3 – low hazard);
- 3** – 2-5 Factors of physical and/or 1 chemical (Hazard Class 4 – innocuous);
- 2** – Two factors (physical).
- 1** – Only one factor (physical)

Neuropsychiatric and other human factors are qualified to the physical exposure levels.

**Probability:**

- 10 – Expectations that happens
- 6 – Very likely
- 3 – Unusual, but possible
- 1 – Unbelievable
- 0.5 – One can imagine but incredibly
- 0.2 – Almost impossible
- 0.1 – Unable
- 0 – Absolutely impossible

Analysis of Risk-Indicator should show to the threshold degree of seriousness (table 5).

Table 5

**Risk-Indicator** classification on the degree of seriousness

RI	The degree of seriousness
More 480	Extremely high risk immediate termination of
240 – 480	High risk, immediate improvements are needed
80 – 240	Severe risk of needed improvement
20 – 80	Possible risk should pay attention
0-20	Small possibly acceptable risk

Determine value of risk with the help of Table 4.

## Conclusion

Thus improving the risk management mechanism, we are able to promptly identify thresholds of dangerous and harmful environmental factors. Each of the methods offered by the risk assessment in the international standard ISO 31010 is necessary to learn and improve.

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