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RISK MANAGEMENT IN THE COMPANY USING „SEPTRI“ METHOD

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Abstract

Risk is absolute and always present. All spheres of human life contain some form of risk. Given that risk cannot be eliminated, it is very important to manage risk properly to reduce the likelihood of negative events or the negative consequences of such events. For a business system, this means integrating the risk management function into the entire management system at all relevant levels. The aim of this paper is to identify risks and assess their impact using appropriate techniques and methods, as well as to influence the reduction of these impacts on the company's operations through the application of suitable control techniques. For this purpose, the statistical method for risk assessment and management called „SEPTRI“ (Risk Assessment and Proposed Risk Treatment System) will be used in this paper. This method transforms a large number of factors that affect a company's operations into exact data, providing clear information about the analyzed risk and guidelines for further risk treatment as a result of its application.

Keywords: *risk, risk assessment, SEPTRI, risk identification*

1. INTRODUCTION

Throughout their life cycle, technological systems and processes are subject to various destructive influences that can significantly reduce the quality of their performance. The possibility of unwanted events and the expected consequences of such events are considered risks within a system. Risk management involves the systematic identification, assessment, and prioritization of risks, followed by coordinated efforts to minimize, monitor, and control the probability or impact of unwanted events. Companies that fail to manage risks effectively may face significant financial losses, damage to their reputation, and operational disruptions. With the globalization of the world economy, the importance of risk management has increased to unprecedented levels over the past decade. Some authors go so far as to compare risk management to warfare: „what war is to generals, risk management is to managers“ (Crouhy et al., 2006). As a result, there is growing interest in adopting structured methodologies, such as the „SEPTRI“ method, which this paper will focus on, for systematically addressing and mitigating risks.

The „SEPTRI“ method (*Risk Assessment and Proposed Risk Treatment System*), an acronym for screening, evaluation, prioritization, treatment, reporting, and improvement, provides a comprehensive framework for risk management across various organizational contexts. By integrating both qualitative and quantitative techniques, the "SEPTRI" method allows companies to make informed decisions, efficiently allocate resources, and improve their ability to withstand potential disruptions.

Risk is a concept that involves the probability of specific undesirable outcomes or losses. The presence of a certain hazard, under specific circumstances (reduced to probability), can result in a particular loss. There are many definitions of risk, which vary depending on the context or circumstances of occurrence. Risk is described using two parameters:

- Probability, and
- Outcome (effect of the risk).

Business risk is the exposure of a company to threatening influences that can impair its ability to meet its strategic, financial, and/or operational goals. Therefore, it must be countered on both a strategic and operational level (Panić & Živković, 2024).

Risk management involves the management of purposeful activities that enable the elimination, at least partially, of an uncertain and unpredictable future, as well as the modification and redistribution of risks and opportunities along with their probabilities of occurrence, thereby making the future more certain and predictable. In its simplest form, risk management consists of four phases (Wideman, 1992):

1. Risk identification,
2. Risk assessment,
3. Risk response,
4. Documentation.

Although, in its simplest form, the risk management process includes all essential phases and the core of the management process itself, as companies and the external conditions in which they operate (market, competition, etc.) evolved, so did the risk management process through different frameworks. The most well-known frameworks include COSO 2004 and ISO 31000.

2. "SEPTRI" METHODOLOGY IMPLEMENTATION

The "SEPTRI" method, or the Risk Assessment and Proposed Risk Treatment System, is a method that enables quantitative risk assessment and provides guidelines on how to manage risk (Mapfre, 2008). The method is universal and applicable to all business activities, allowing quantitative comparison and hierarchical classification of different types of hazards. The general equation for risk, when applying this method, is modified by adding a factor that corresponds to the level of security present in a given company. The new equation is as follows:

$$\boldsymbol{R} = \frac{\boldsymbol{P\ x\ E\ x\ I}}{\boldsymbol{S}} \tag{1}$$

Where:

- **R** (Risk) – the value of the risk
- **P** (Probability) – the probability coefficient
- **E** (Exposure) – the exposure coefficient
- **I** (Intensity) – the consequence coefficient
- **S** (Security) – the security coefficient

The probability coefficient **P** is derived from data the company has from its own records or from national statistics for a given area. The Table 1 used for quantification is provided below (Vujović, 2009):

Table 1. Probability Coefficient P (Vujović, 2009)

Recurrence Period	**Coefficient P**
Less than a day	10
Less than a week	9
Less than a month	8
Less than a year	7
Less than 5 years	6
Less than 10 years	5
Less than 25 years	4
Less than 50 years	3
Less than 100 years	2
Less than 500 years	1
Less than 1000 years	0.5
More than 1000 years	0.1

The exposure coefficient **E** represents the frequency of performing a hazardous activity or operation. One activity may contain several operations or functions that can lead to a harmful event. The exposure coefficient is quantified by focusing on the operation that most frequently generates risk. The Table 2 for determining the exposure coefficient.

Table 2. Exposure Coefficient E (Vujović, 2009)

Operation Frequency	**Coefficient E**
Constant	10
1 hour	9
1 daily	8
1 weekly	7
1 monthly	6
Every 6 months	5
Annually	4
Every 10 years	3
Every 50 years	2
Every 100 years	1
Period longer than 100 years	0.5

The values for the intensity coefficient **I** are derived as the arithmetic mean of the Maximum Foreseeable Loss (MFL) and the Maximum Probable Loss (PML) (Table 4). The consequence coefficient is derived according to the Table 3 and Table 4.

- **Maximum Foreseeable Loss (***Impact Risk - Ir*) is the value exposed to danger under the most unfavorable conditions and the most negative environmental impacts.
- **Maximum Probable Loss (***Impact Probability - Ip***)** is the value exposed to destruction from a harmful influence under conditions where the company's internal and external protective systems function normally.

Table 3. Maximum Foreseeable Loss MFL (Vujović, 2009)

MFL in euros	**MFL in %**	**Coefficient Ir**
Less than 100e	0.05	1
101 - 1000	0.1	2
1001 – 10,000	1	3

10,000-100,000	5	4
100,000-1,000,000	10	5
1,000,000-10,000,000	40	6
10,000,000-100,000,000	60	7
100,000,000 - 200,000,000	80	8
200,000,000-500,000,000	90	9
More than the net worth of the company	100	10

Table 4. Maximum Probable Loss PML (Vujović, 2009)

PML in euros	**PML in %**	**Coefficient Ip**
Less than 50e	0.01	1
50-100	0.05	2
100-1000	0.1	3
1000-10,000	1	4
10,000-100,000	5	5
100,000-500,000	7	6
500,000-1,000,000	10	7
1,000,000-10,000,000	30	8
10,000,000-50,000,000	35	9
More than 50,000,000	Over 40	10

The security coefficient **S** is derived by weighting the factors that determine the level of security in a company in relation to each type of risk. The security factor is common to all risks, so increasing its value significantly impacts the final risk value. The security coefficient is derived from the following table (Vujović, 2009):

Table 5. Security Coefficient S (Vujović, 2009)

Factor	**Coefficient S**
Security policy	0-1
Security system: Responsibilities, structure, and functions: safety manager, prevention representatives, safety department	0-0.6
Prevention program	0-0.6
Compliance with norms and regulations	0-0.4
Technical measures: active and passive	0-0.6
Human resources	0-0.4
Assessment, supervision, and control	0-0.4
Training and communication plans	0-0.4
Accident and contingency plans	0-0.4
Research, analysis, and accident records	0-0.2
Risk management program	0-1
Integration and prevention already provided by methods, processes, and procedures	0-1
Quality control program	0-1
Periodic external audits	0-1
External assistance services: police, fire department, medical services, etc.	0-1

Once the risk values are obtained using the given formula (1), risks are categorized into groups, and an appropriate approach is proposed for each:

- **Intolerable risks** with values greater than 300 – Risk must be removed or the operation generating the risk must be eliminated.
- **Extreme risks** with values between 200 and 300 – Permanent measures should be improved to reduce or eliminate the risk; methods for financing the risk should be established.
- **Serious risks** with values between 100 and 200 – Essential risk mitigation measures should be applied; partial financial retention may be established.
- **Moderate risks** with values between 30 and 100 – Usual risk reduction measures should be improved; risk retention is acceptable.
- **Minor risks** with values between 0 and 30 – No additional risk mitigation measures are needed.

3. APPLICATION OF THE METHOD AND DISCUSION

We will apply the method in a leading company specializing in the production and sale of industrial, medical, and specialty gases, as well as related equipment, including cutting and welding equipment. The focus will be on one of its production unit in Bor.

At the specific location, the following facilities and resources exist:

- Production of technical gases (oxygen, nitrogen, argon),
- Equipment for storing and vaporizing technical gases,
- Equipment for compressing and distributing gaseous oxygen to ZiJin Copper Bor,
- Operational buildings for housing control systems and compressors,
- Auxiliary services.

The air separation plant operates purely on thermodynamic principles, involving changes in pressure and temperature. Thanks to the different boiling points of the components in the gaseous mixture (air), they are separated and decomposed. No chemical reactions or changes in the chemical composition of raw materials or final products occur in the plant.

Most of the production output is transported by pipeline to the final consumer - ZiJin Copper Serbia's new plant. A smaller portion (the liquid phase) is stored in tanks for backup supply needs of ZiJin’s technical gases and for commercial sale.

To apply the SEPTRI method, we first need to determine the coefficients for probability, exposure, consequence, and safety to calculate the risk value using the formula (1).

When we look at the fire risk, it is the most prevalent risk in enterprises. Almost all companies in the industry face the risk of fire. The fire load of the factory in Bor is classified as high due to the type of plant (pressurized vessels and installations) and the characteristics of the hazardous substance oxygen, which does not burn but significantly enhances combustion.

There are several facilities critical in terms of exposure to this risk (compressor hall, storage tanks, cylinder filling station, bottle storage). Historical company data shows that in the past 25 years, there hasn't been a fire at any of these facilities, so the probability coefficient (P) is 4.

There are many causes that could contribute to the realization of the fire risk. Static electricity is a common phenomenon that occurs when gases flow through pipelines, on people's bodies, or on moving liquid or solid containers, so exposure to risk is constantly present. Therefore, the exposure coefficient (E) is 10.

Since the facilities are linked in the technological process, the maximum foreseeable loss in the event of this risk event would amount to up to 100,000,000 euros, as this event would affect all facilities, so Ir is 7.

The maximum probable loss, on the other hand, is related to a specific facility. If the risk event were to occur, the safety systems would localize it to just that facility, so the Ip coefficient is 5.

The consequence coefficient I represent the arithmetic mean of the previous two values (Ir and Ip) and amounts to 6.

The safety coefficient (S) is common to all risks and is derived by weighting the safety factors in the company. The safety coefficient is presented in Table 6.

Table 6. Safety Coefficient for the Company

Factor	**Coefficient S**
Security policy	1
Security system: Responsibilities, structure, and functions: safety manager, prevention representatives, safety department	0,6
Prevention program	0,6
Compliance with norms and regulations	0,4
Technical measures: active and passive	0,6
Human resources	0,4
Assessment, supervision, and control	0,4
Training and communication plans	0,4
Accident and contingency plans	0,4
Research, analysis, and accident records	0,2
Risk management program	0,9
Integration and prevention already provided by methods, processes, and procedures	1
Quality control program	1
Periodic external audits	1
External assistance services: police, fire department, medical services, etc.	1
SUM	9,9

Safety and protection in this company are considered from two aspects:

- **Macro aspect –** relating to risk and safety management at the company level,

- **Micro aspect –** relating to risk and safety management at the Bor plant level.

At the company level, in line with QMS, FSSC, and EMS policies, the company has adopted a Guide to the Requirements of SRPS ISO 9001:2015 standards. The manual covers the declared policy for product quality, safety, and environmental protection, integrating the requirements of ISO 9001:2015, FSSC 22000, and ISO 14001:2015.

The manual includes the following elements:

- Quality Management System (QMS),
- Certification standard for food safety systems, FSSC 22000, and
- Environmental Management System (EMS).

The manual describes the functioning of the quality and environmental management system in the company, following the requirements of the SRPS ISO 9001:2008 Quality Management System and SRPS ISO 14001:2005 Environmental Management System. The company is the first and only one in Serbia to hold EU GMP certificates for the entire production processes of liquid oxygen and nitrous oxide.

The plant in Bor is classified as a SEVESSO plant. A Sevesso plant is a technical unit within a complex where hazardous substances are produced, used, stored, or handled. The plant includes all equipment, buildings, pipelines, machines, tools, internal railways, depots, docks, and similar facilities required for the plant's functioning (Službeni glasnik, RS). As a Seveso plant of the lower order, the company is required to prepare a “Major Accident Prevention Policy” document.

Internally, the plant has clearly defined responsibilities, structures, and functions within the safety system. Employee training, including for new hires, is conducted regularly and documented appropriately.

The plant is fully automated, and its operations are controlled from a central control room via a Distributed Control System (DCS), which includes sensors and actuators for monitoring and controlling operations without local supervision, except during the loading of liquid products, when two operators are present. The DCS not only visualizes operating parameters and controls actuators but also implements control and shutdown logic, automatically switching equipment to a safe position in case of deviations. The plant is equipped with real-time surveillance cameras, and in case of a remote access failure, the system will continue to operate in its last position and enter a safe phase.

For security, the plant is protected from unauthorized access by 24-hour security monitoring and an electronic barrier system with alarms. It is also equipped with fire detection sensors and an early lightning detection system, while electrical devices are protected against surges. In the event of a fire, the alarm is forwarded to the guardhouse, where personnel can call the fire brigade if needed.

Inspection and audits, both external and internal, are conducted according to a prescribed schedule and documented accordingly.

General preventive measures include (Accident Prevention Policy, 2020):

- **Design and construction measures –** These measures include actions during the selection of technology, project preparation, construction of technological plants and buildings.
- **Technical and technological measures –** To prevent incidents in technological processes, preventive measures have been implemented, including proper process control with automation and supervision, professional maintenance, regular inspections of installations, and the use of work instructions and safety procedures. Technical protective measures include protection against injuries, proper insulation, and the prohibition of activities that can generate sparks or fires in hazardous material storage areas.
- **Fire protection measures –** The organization of fire protection encompasses measures related to occupational safety, fire protection, and environmental protection. The factory relies on the local fire brigade in Bor, which can reach the location within about 5 minutes. Technical preventive measures include an appropriate transport infrastructure, lightning protection systems, fire hydrant networks, fire alarm systems, and regular maintenance of firefighting equipment.
- **Organizational measures –** Organizational measures include training workers for safe operations, developing fire protection and recovery plans, regular equipment checks, and preparing employees for initial fire suppression and evacuation. Responsible individuals must pass professional exams, and those handling hazardous materials must be trained in proper procedures.

The safety factor S for the observed company is 9.9 (Table 6). All identified risks and their values, derived through the application of the SEPTRI method, are presented in Table 7.

Table 7. Results of "SEPTRI" method implementation

Risk	Probability Coefficient (P)	Exposure Coefficient (E)	Ir	Ip	Consequence Coefficient (I)	Safety Factor (S)	Risk Value (R)	Risk Categorization	Rank
Fire risk	4	10	7	5	6	9.9	24.24	Low risk (0-30)	2
Gas leakage risk	4	10	7	6	6.5	9.9	26.27	Low risk (0-30)	1
Natural disaster risk	2	10	7	6	6.5	9.9	13.13	Low risk (0-30)	4
Mechanical failure risk	6	10	5	4	4.5	9.9	22.73	Low risk (0-30)	3
Human error incident risk	5	10	5	4	4.5	9.9	22.73	Low risk (0-30)	3
Unauthorized access risk	4	10	3	1	2	9.9	8.08	Low risk (0-30)	5
Fire risk	4	10	7	5	6	9.9	24.24	Low risk (0-30)	2
Gas leakage risk	4	10	7	6	6.5	9.9	26.27	Low risk (0-30)	1
Natural disaster risk	2	10	7	6	6.5	9.9	13.13	Low risk (0-30)	4
Mechanical failure risk	6	10	5	4	4.5	9.9	22.73	Low risk (0-30)	3
Human error incident risk	5	10	5	4	4.5	9.9	22.73	Low risk (0-30)	3
Unauthorized access risk	4	10	3	1	2	9.9	8.08	Low risk (0-30)	5
Fire risk	4	10	7	5	6	9.9	24.24	Low risk (0-30)	2
Gas leakage risk	4	10	7	6	6.5	9.9	26.27	Low risk (0-30)	1

As shown in Table 7, all risks that could lead to significant accidents and losses in the company fall within the category of low risk, meaning no additional preventive measures are required.

The gas leakage risk has the highest value and priority according to the results. Even though it remains low, it demands constant attention due to its high exposure and potentially catastrophic consequences. Effective prevention measures keep this risk at an acceptable level, but it remains present because of the nature of operations involving pressurized vessels and continuous exposure.

Fire risk is one of the most prevalent risks in industrial plants, and this one is no exception given its operations. Although no major incidents have occurred in the past 25 years, the company remains vigilant, continuously monitoring and improving its fire prevention and protection systems.

Human error risks, though mitigated through process automation, remote control systems, regular training, and strict safety protocols, still pose a potential risk, especially in operations involving hazardous materials.

Mechanical failures, particularly in critical systems, are addressed through preventive maintenance, regular inspections, and detection systems. Additionally, maintaining supplies and collaborating with other plants ensures that production continues uninterrupted, even in the event of mechanical failures.

Natural disasters also represent relatively low risk, given the location and historical lack of occurrences. However, unpredictable events with high exposure and potentially devastating consequences, such as earthquakes, require ongoing preparedness and control measures.

Although incidents related to unauthorized access has not occurred, and the value of this risk is relatively low, the company remains on high alert to protect its property and personnel from third-party intrusions.

Despite the existence of risks that could severely jeopardize the company's operations and lead to significant material and non-material losses, effective prevention measures keep most of these risks under control and at an acceptable level. All prevention and reduction measures implemented by the company, both at the corporate level and within the production unit, have contributed to a high safety factor, which further reduces the risk values. Without these measures, considering the exposure factors and potential consequences, controlling these risks would be difficult, if not impossible.

4. CONCLUSION

Risk management plays a key role in ensuring safe operations in industrial plants, especially in high-risk facilities like the one described in this paper.

Through consultation with management and a review of historical data, risks that could lead to accidents and major incidents with serious losses have been identified. By applying the “SEPTRI” method, these risks have been thoroughly assessed. Each category of risk has been analyzed by evaluating the probability, exposure, consequences, and safety factors, resulting in values for critical events. This approach enables the company to understand, prioritize, and implement necessary control measures for these risks.

As demonstrated, the company shows a strong commitment to risk management by integrating safety protocols, technology, and continuous employee training. The combination of a proactive approach to risks, prevention, and mitigation strategies ensures operational continuity, promotes a safe working environment, and minimizes potential losses. By continuously improving these practices, the company not only meets regulatory standards but also fosters a culture of safety and operational excellence.

The method applied in this paper is universal and can be implemented in organizations of any type, size, and industry for the purpose of risk management.

UPRAVLJANJE RIZICIMA U KOMPANIJI PRIMENOM "SEPTRI" METODE

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Abstract

Rizik je apsolutan i uvek prisutan. Sve sfere ljudskog života sadrže neki oblik rizika. S obzirom na to da rizik ne može biti eliminisan, veoma je važno pravilno upravljati rizikom kako bi se smanjila verovatnoća negativnih događaja ili negativne posledice takvih događaja. Za poslovni sistem, ovo znači integraciju funkcije upravljanja rizicima u celokupan sistem menadžmenta na svim relevantnim nivoima. Cilj ovog rada je identifikacija rizika i procena njihovog uticaja korišćenjem odgovarajućih tehnika i metoda, kao i uticanje na smanjenje tih uticaja na poslovanje kompanije primenom odgovarajućih tehnika kontrole. U tu svrhu, u ovom radu će biti korišćena statistička metoda za procenu i upravljanje rizikom nazvana „SEPTRI" (Sistem procene rizika i predloženo tretiranje rizika). Ova metoda transformiše veliki broj faktora koji utiču na poslovanje kompanije u egzaktne podatke, pružajući jasne informacije o analiziranom riziku i smernice za dalji tretman rizika kao rezultat njene primene.

Ključne reči: *rizik, procena rizika, SEPTRI, identifikacija rizika*

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