Risk management in the context of sustainability in business – case study

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Abstract

The national and international macroeconomic and financial context has remained steady in recent years, contributing to some protection for organizations. However, we cannot say that organizations are not subject to risks, which means that risk management is considered a component of management that can be found at any organizational level.

Managers manage the organization's revenue and costs through a performance system. They manage risks at the economic entity level, be they financial, economic, strategic, or operational, using quantitative instruments or with professional experience and reasoning.

Addressing risk as a whole has become much more important with globalization. Thus, mathematical modeling of risk became important, and companies allocated much more time to this aspect. The potential exposure of organizations to internal and external risks determines that each legal entity has a proactive approach from the point of view of risks.

This paper aims to analyze the methods of identifying and assessing economic risks, mainly in the context of company sustainability, using qualitative tools for risk measurement. The case study is carried out on a construction company.

Keywords: risk management, qualitative indicators, quantitative indicators, sustainability of companies

1. Introduction

Risk is an uncertain but possible event that originates in uncertainty. It arises in any economic, social, or political activity. The idea of risk implies the notion of possible loss, loss caused by the evolution of internal or external risk factors.

The problem of risk involves solving decision problems that minimize the risk and losses associated with the different decisions taken and the actions applied. All this is in the context of the sustainability of companies. The need for activities leading companies to sustainable development has increased in recent years, due to globalization. In terms of sustainability, the focus is on three dimensions: environmental sustainability, social sustainability, and economic sustainability. Ecological sustainability refers to the ability of companies to use and protect natural resources; social sustainability considers social interactions, relationships, behavioral patterns of people, and the values of humanity, and economic sustainability requires the organization's ability to make a profit.

In the case of an organization, sustainability means that all its management processes are interrelated to survive in a constantly changing economic market.

Thus, economic sustainability and risk management are closely related, and both ensure the functionality of companies within optimal parameters.

In recent decades, the notion of risk, uncertainty, and sustainability of companies has constantly evolved, manifesting three main trends:

- increasing at a steady rate of risk and uncertainty;
- the constant use of scientific research resources in the field of risk, uncertainty, and sustainability of companies;
- enhancing and diversifying risk and uncertainty analysis techniques in the context of corporate sustainability.

In the process of evolving risk identification and classification, we have moved from classifying risk as a standard management method to the need to treat risk in an integrated manner. [1] This led to the need for risk management to be the responsibility taken over by senior management. The current approach relates to risk management as a whole, which involves integrating all categories of risks to achieve a sustainable company and optimize economic processes. [1]

Risk management in the context of the sustainable development of a company is a complex approach. The sustainable development of an organization is based on three dimensions: economic, ecological, and social, in full inter-conditioning, and such aspects have been included in sustainable management of companies and reflected in corresponding research with a wide range of approaches (e.g.[1], [2], [3] [4]).

Thus, to construct a strategy from the point of view of a company's sustainability, it is necessary to approach the three dimensions in the context of influence and external factors: legislation, technological developments, the specific context of a particular market, socio-cultural conditions, and environmental factors. Internal factors are those of economic, managerial, and human nature.

This paper aims to integrate risk management analysis in the context of the sustainability of a construction company. The construction field was chosen because it constantly changes due to permanent legislative changes and the need for personnel. However, the approach presented in the proposed article can apply to any company in any field of activity. The starting point of the analysis was the need to analyze the main risks that influenced the company's financial indicators. Subsequently, in the second phase of the study, three economic and financial indicators are presented that are directly influenced by the identified risks, which are indicators that significantly impact the company's financial sustainability.

The paper presented does not take a new approach from the literature. The research methodology of this article is based on the standard ISO 31000:2018—Risk Management Principles and Guidelines [5], while aware of the advantages and limitations [6]. The element of originality is, in particular, the analysis of the problem described by the context of the chosen field of application.

The work is structured as follows: 1. Study of knowledge in the field of work, including studies and analyses in the field; 2. Methodology, which presents the architecture of the analyzed analysis; 3. Data analysis and Conclusions, which present future approaches and directions.

2. Knowledge study in the field

Regardless of their size, organizations constantly interact with internal and external factors that generate possible uncertainties about their ability to achieve their goals. The effect of uncertainty is a risk that is inherent in all activities [7].

Ever since the ’70s and’80s, George L. Head emphasized that risk management within companies contributes to achieving the goals effectively set by the organization. This began to focus more and more on risk management, which led to the establishment of the Washington Society for Risk Analysis (The Society for Risk Analysis - in 1980 SRA) to present the concept of risk management at the academic and business levels. Six years later, in 1986, the Institute of MR (The Institute for Risk Management – IRM) began its activity in London. This institute will develop the first risk management educational program to discuss the many factors that influence it. [8]

In the years that followed, risk management became of global importance, so the first standard for risk management was published in 1995 by Standards Australia/Standards New Zealand and revised in 1999.

The International Organization for Standardization (ISO) has developed the ISO 31000:2018—Risk Management Principles and Guidelines. It provides guidelines for risk management faced by organizations and a common approach to managing risk within each industry [9].

According to the previously-mentioned standard, we can say that the principles of risk management apply within the organization at any level:

a. Risk management creates and protects value;
b. Risk management is an integral part of all processes of an entity/organization;
c. Risk management is part of the decision-making process;
d. Risk management explicitly addresses uncertainty;
e. Risk management is systematic, structured, and timely;
f. Risk management is based on the best available information;
g. Risk management is customized at the level of each entity/organization;
h. Risk management takes into account human and cultural factors;
i. Risk management is a participatory and transparent process;
j. Risk management is dynamic, iterative, and responsive to change;
k. Risk management leads to continuous improvement and development of the organization entity.

In the above-mentioned context, risk management has developed as a complex field focusing on the functional ensemble within an organization: policies, methodologies, data, and technological infrastructure.

In terms of sustainability, this has long been synonymous with environmental sustainability. The evolution of sustainable development in recent decades has also developed at the level of organizations, targeting the three types of capital relevant to sustainability: economic, natural, and social. From this point of view, the six criteria have been developed that managers aiming at corporate sustainability must satisfy: eco-efficiency, socio-efficiency, eco-efficiency, socio-efficacy, socio-efficacy, and environmental adequacy and equity [10].

From a risk point of view, a company voluntarily accepts certain risks to generate superior returns related to its strategy in the context of the organization's sustainability. Strategic risks are different from preventable risks, as they are external to management's will. A high-yielding strategy causes the company to take significant risks, and managing these risks is a critical factor in capturing potential earnings.

In this context, the focus is on social, environmental, and financial performance in the sustainability of companies that use risk management as a tool. Thus, economic and socio-human performance leads to financial

performance, and financial performance leads to ecological and social performance. It follows that both financial performance and environmental and social performance are synergistic.

In the above-mentioned context, risk analysis in economic sustainability for a Romanian company turns into an approach of practical interest.

3. Methodology

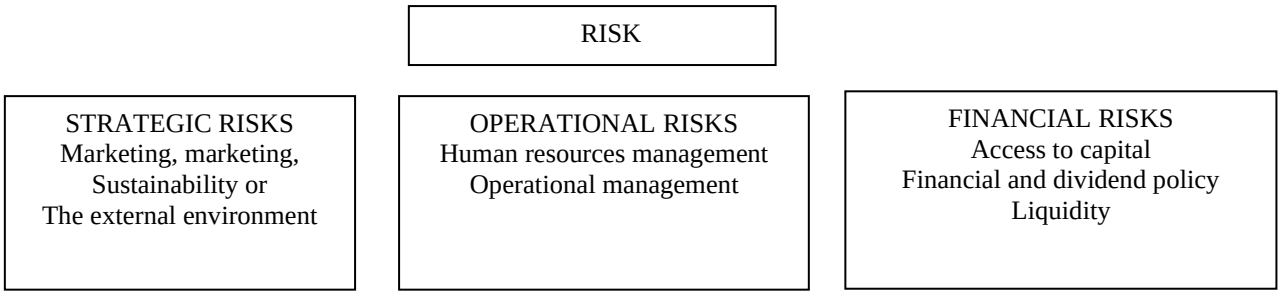
The specific activities of the risk management process must be carried out coherently and consistently to achieve relevant results in the context of organizational sustainability. The risk management process refers to the external and internal environment within the organization. The external context refers, without limitation, to the economic, social, cultural, political, legal, regulatory, environmental, competitive, international/national/local environment, and the internal context refers to the economy and organizational culture developed at an entity's level.

Risks cannot be managed through a rule-based control model. Instead, they can be assessed and controlled by a management system designed to reduce the likelihood that the risks incurred will materialize. This would improve the company's ability to manage or minimize risk events if they occur. Such a system would not prevent companies from taking risks; on the contrary, it would allow companies to take higher risk and reward actions than competitors with less effective risk management.

It should be considered that organizations invest capital initially and then develop projects. Today, we are talking about capital and development; if you do not have them, you disappear from the market.

Thus, the identified risks that may be subject to the management process to reduce them are described in Figure 1, by three categories, by their mode of occurrence:

Figure no. 1: Risk typology



Source: Own contribution

Types of risks identified:

a1.Strategic risks include the risk of business failure, the risk of financial loss of the project, the occurrence of major construction accidents, implicitly by business partners and disputes, and organizational risks.

a2. Operational Risks: These occur during the enterprise's current activity and are medium—and short-term (short-term risk has an immediate impact, such as changing requirements for a deliverable). They are hard to accept and more unacceptable but manageable.

a3. Financial risks: they are usually unacceptable and difficult to control by their own company if they do not have provisions and if they allow them. This includes access to capital, financial and dividend policy, and liquidity.

In determining its risks and opportunities, the organization may consider using output elements of techniques such as questionnaires, Brainstorming, SWOT, Probability Matrix –Impact, AMDE-failure tree Analysis, and Decision trees.

From the point of view of qualitative indicators, risk management can be analyzed using the following tools: brainstorming, structural or semi-structured interviews, AMDE-Failure Tree Analysis, Decision trees, Cause-effect diagrams etc., Markov's Analysis, and the Monte Carlo Simulation.

Because AMDE-Failure Tree Analysis and decision trees are found as techniques used in the risk analysis process and the ISO 31000:2018 standard, these tools will also be used in developing the methodology proposed in this research.

The central assumption that started in developing this process is that a company's risk management and sustainability must be the basis of the development process of those organizations in the context of globalization.

The basis of operational risk consists of the activities carried out by the company, and the likelihood of operational losses increases with the volume and complexity of activities. Errors involve both a cause and an effect of process performance.

This methodology emphasized the associated risks in the context of economic, social, and natural environmental sustainability in light of the analysis of operational risks.

The objective of the methodology is to achieve the correlation between operational risks and company sustainability according to the identified errors.

Process errors are defined as deviations from the quality standards of operational processes. In this context, the following financial indicators were analyzed: immediate liquidity, payment capacity rate, and overall solvency ratio. The company whose indicators have been examined is in the construction field (for confidentiality reasons, we can not use the actual name). The analyzed indicators were chosen precisely because of what they represent: Immediate liquidity measures the company's ability to repay its short-term debts from the existing available instantly, the company said; the rate of payment capacity shows the possibility of paying off short-term debts with bank availabilities, cash in the house and short-term placements and the general solvency ratio show to what extent the firm can cover its total liabilities with total assets. The results of these indicators practically show the functionality of operational management.

Thus, within the proposed methodology, the following steps will be taken:

- Achieving agreement on the Defective Tree for the operational management level
- Making the decision tree also for the operational management level
- Analysis of the results of the indicators obtained for the last four years and their analysis in the context of those studied in the previous points

AMDE-Failure Tree Analysis involves identifying potential fault modes and hazards associated with process detailing. AMDE can be achieved with decision trees, tools that describe fundamental interactions between decisions and random events as perceived by decision-makers.

By applying the methods presented above, the tools for responding to the identified risks—risks that may affect the company's sustainability—can be used.

3. Data analysis

As previously presented, the analyzed company is active in the construction field. The field was chosen because it faces numerous risks that can cause companies to become unsustainable. In the context of the above, the company had numerous obstacles at the operational level. Even in this context, the company's turnover and profit constantly grew.

From an operational point of view, the organization must maintain a flexible and performant system. Thus, the operational management of the company acts on:

- structural components (development of the production program, control of the production program)
- input system variables (technical preparation of works, maintenance, repair of machinery, supply), output (delivery terms, deviations from quality), provider (modification of deadlines, waivers, lack of personnel)
- the objectives of the production system (quality, quantity, terms and costs)
- production system variants (depending on the size and periodicity of the objectives, variability of products and technologies)
- functions of the production system (supply, storage, delivery)

To develop the AMDE, an impact level will be established as follows:

1=very strong

2=strong

3=medium

4=skinny

The impact level will be used in the AMDE to describe the frequency of occurrence of a defect (F), the severity of this defect (G), and the detection of the defect (D). All this to get the criticism (C = F x G x D).

In the context of those described from the point of view of the actions of the operational management AMDE-Agreement on the Defective Tree related to the significant effects that may lead to the interruption of activities and implicitly to the achievement of delays in the production process are presented in table no. 1.

Tabel no. 1: AMDE-Authorization of the Defective Tree related to significant effects that may lead to disruption of activities and implicitly to delays in the production process

Current no.	The mode of failure	Potential effects of failure	F	Potential causes of failure	G	Checks to detect failure	D	C	Recommended measures
1	Malfunctions of equipment in the equipment	Business interruption	1	Long service life of the equipment	2	Permanent monitoring of equipment	2	4	Preventive maintenance activities
2	Personal lack	Business interruption	1	Large fluctuations in the labour market	1	Continuous monitoring of staff needs	3	3	Periodically conducting a staff needs analysis

3	Products received in the supply process do not comply with the standards in force	Business interruption	1	Changing the products delivered by the supplier	2	Continuous monitoring of the delivered products	1	2	Carrying out procedures for the permanent monitoring of suppliers

Source: Own contribution

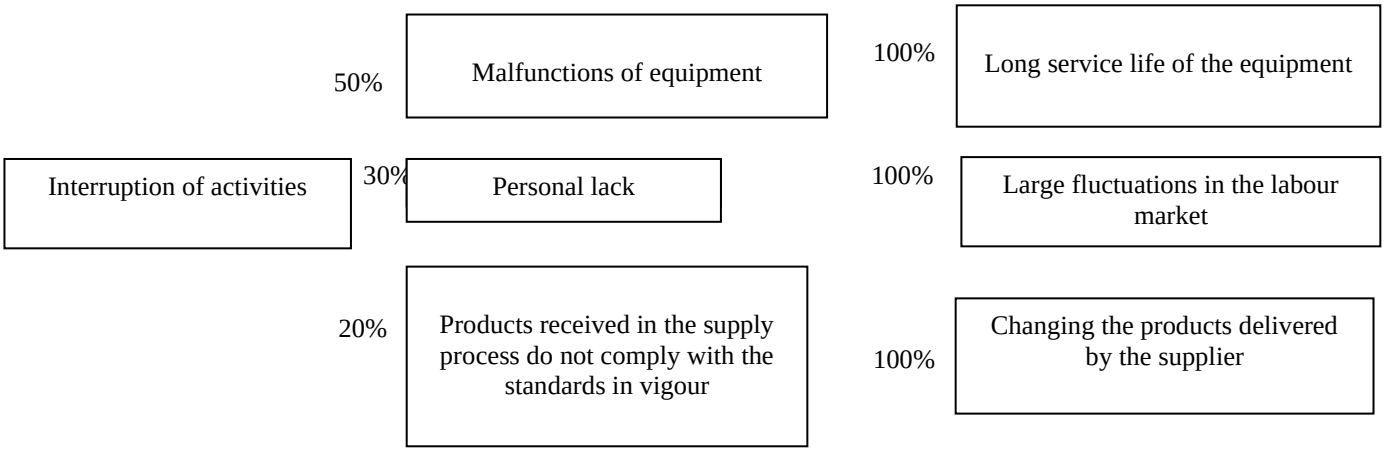
Table no. 2: Criticism level

Level of criticism	Criteria for Defining Criticism
4	Any event that may result in the loss of one or more of the essential functions of the system, significant damage to the system and the environment
3	Any event which may result in the loss of one or more essential functions of the system, material damage to the system and the environment but which is of negligible risk
2	Any event that damages the proper functioning of the system without causing significant damage
1	Any event liable to impair the proper functioning of the system, causing negligible damage to the system and the environment

Source: [7]

Figure 2 describes the decision tree for activities that may delay production.

Figure no. 2: Decision tree related to activities that may lead to the process of delay in the production process



Source: Own contribution

Following the calculations, it can be seen that the highest probability of activity interruption in the analyzed company is given by the malfunctioning of the equipment in the endowment, 50%, followed by a 30% staff shortage and products received in the supply process that does not comply with the standards in force, for which the probability is 20%.

As I said, the identified risks can affect the organization's financial sustainability. The following indicators were analyzed to assess the organization's ability to adapt to market requirements: immediate liquidity, payment capacity rate, and overall solvency ratio.

The indicators obtained for the last four years are shown in Table No. 3.

Table no. 3: Evolution of the indicators analyzed

	N-3	**N-2**	**N-1**	**N**
Immediate liquidity	0.55	1.05	0.74	1.02
Payment capacity rate	0.06	0.26	0.25	0.27

Overall solvency ratio	1.17	1.55	1.13	1.44

Source: Own contribution

The evolution of the three indicators analyzed over the last four years shows the company's adaptation capacity. The risks identified by the company do not affect the analyzed indicators because the organization has always had a risk response plan.

To analyze the evolution of the analyzed indicators, the following algorithm is used:

a) A, the analyzed population whose characteristic X is normal distribution shall be considered $N(\mu,\sigma^2)$.
b) A sample of volume n shall be extracted from this population. Estimate the mean with a 95% confidence interval for bilateral symmetric risk. The level of significance is 0.05.
c) It is known as the sample average and has a normal distribution $N(\mu, \sigma^2/n)$.
d) Unknown Parameter: A confidence interval for this size with the limits (-z, z) established with the Laplace distribution is to be built.
e) It is known as the random variable: $z = \frac{\mu - \bar{x}}{\sigma/\sqrt{n}}$ it has an average distribution N(0,1).
f) According to the distribution table, the probability of 95% is defined as being in the range (1.96;+1.96).
g) This results in the confidence interval with probability $P(-1.96 < z < 1.96) = 0.95$.

From this relationship can be written double inequality: $-1.96 < \frac{\mu - \bar{x}}{\sigma/\sqrt{n}} < 1.96$

$$\bar{x} - 1.96\frac{\sigma}{\sqrt{n}} < \mu < \bar{x} + 1.96\frac{\sigma}{\sqrt{n}}$$

Where to get the limits of the interval:

h) It was built this way for the confidence interval of 95%. The result can also be put in the form:

$$\mu = \bar{x} \pm 1.96\frac{\sigma}{\sqrt{n}}$$

The interval is symmetrical about the value $\bar{x}$.

Applying the methodology described above, the results of the mean and dispersion related to the values of the three analyzed indicators are presented in Table No. 4:

Table no. 4: Mean and dispersion values

Indicators analyzed	$\bar{x}$	σ
Immediate liquidity	0,84	0,24
Payment capacity rate	0,21	0,10
Overall solvency ratio	1,32	0,20

Source: Own contribution

The above fundamental values can be calculated for confidence interval (see table no. 5).

Table no. 5: Confidence intervals

Indicators analyzed	$\bar{x} - 1{,}96\frac{\sigma}{\sqrt{n}} < \mu < \bar{x} + 1{,}96\frac{\sigma}{\sqrt{n}}$
Immediate liquidity	$0{,}61 < \mu < 1{,}07$
Payment capacity rate	$0{,}11 < \mu < 0{,}31$
Overall solvency ratio	$1{,}12 < \mu < 1{,}52$

Source: Own contribution

Thus, the calculated indicators will keep their positive evolution without the identified risks being able to determine a significant impact on these indicators. In this context, the decision can be made to reduce risks by making investments, particularly by purchasing new equipment, and in the context in which the leading cause of interruption of work is precisely this.

Due to the evolution of these indicators, we can say that the organization is economically sustainable.

Reducing risks—here, we can talk about the risk related to personnel fluctuation. We can also discuss social sustainability because the procedures that will develop in terms of elements to combat these risks will focus on social interactions, relationships, behavioral patterns, and the values of humanity.

By purchasing new, much more efficient machines, the organization can be said to be environmentally friendly because the latest equipment is much more efficient and meets the requirements regarding pollution.

4. Conclusion

The model presented can be further developed to predict the likelihood that a risk with a significant impact on the company can be combated without influencing financial sustainability indicators. As mentioned, the model can be extended to other areas of activity without being restrictive. Also, different economic and financial indicators can be used to analyze a company's economic context in the context of effective risk management that can lead to a sustainable company.

The advantages and benefits of such a model include reducing the subsequent costs for corrective actions that may occur and optimizing processes within the organization. Thus, the system must be standardized and consistent for identification, data registration for quantification, qualification, control and measurement, and analysis and management of operational risk based on clearly defined requirements by the organization's management.

The paper presented offers a new perspective on risk management and sustainability. It also integrates techniques from reliability, statistics, and management to create a unified approach to risk.

Extending research to other organizations in other fields of activity can continue this article's results. Different techniques and tools used to identify risks will also be integrated into the process, as will other economic and financial indicators that can emphasize the importance of risk management in the context of sustainable organizations.

5. Bibliography

[1] Terje Aven (2016). „Risk assessment and risk management: Review of recent advances on their foundation", European Journal of Operational Research, Vol. 253 (1), pp. 1-13, https://doi.org/10.1016/j.ejor.2015.12.023

[2] Wenderson dos Santos Alvarenga, Sérgio Luiz Braga França, Luis Perez Zotes. (2024). "Collaborative projects: sustainable development and risk management in the corrugated cardboard industry", Procedia Computer Science, Vol. 237, pp 36-42, https://doi.org/10.1016/j.procs.2024.05.077

[3] Muhammad Kashif Shad, Fong-Woon Lai, Chuah Lai Fatt, Jiří Jaromír Klemeš, Awais Bokhari (2019). "Integrating sustainability reporting into enterprise risk management and its relationship with business performance: A conceptual framework", Journal of Cleaner Production, Vol. 208, pp. 415-425, https://doi.org/10.1016/j.jclepro.2018.10.120

[4] Anni-Kaisa Kähkönen, Kati Marttinen, Antti Kontio, Katrina Lintukangas (2023), "Practices and strategies for sustainability-related risk management in multi-tier supply chains", Journal of Purchasing and Supply Management, Vol. 29 (3), https://doi.org/10.1016/j.pursup.2023.100848

[5] https://www.iso.org/publication/PUB100464.html, ISO 31000:2018 - Risk management. A practical guide

[6] Lalonde, C., Boiral, O. (2012). „Managing risks through ISO 31000: A critical analysis". Risk Management, 14, 272–300, https://doi.org/10.1057/rm.2012.9

[7] Panait V., Popescu M. O. (2003)."Calitatea produselor și fiabilitate", Editura Matrix Rom

[8] H. Felix Kioman (1992), "Rethinking Risk Management", The Geneva Papers on Risk and Insurance, Vol. 17 (64), pp.299-313, https://link.springer.com/content/pdf/10.1057/gpp.1992.19.pdf

[9] Baumgartner, R. J. and Ebner, D., 2010. Corporate sustainability strategies: sustainability profiles and maturity levels. Sustainable Development, 18(2), pp. 76-89.

[10] Thomas Dyllick and Kai Hockerts, 2002 Beyond the business case for corporate sustainability, Business Strategy and the Environment Bus. Strat. Env. 11, 130– 141