Application of Statistical Methods in the Post-Hoc Analysis of Bankruptcy Risk Prediction Models

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Abstract: **The main objective of this study is to predict bankruptcy risk using statistical methods. The risks generated by the activities of any entity, as well as their mismanagement, can lead to the instability of the company or, in the worst case, to its bankruptcy. To forecast this type of risk, we will use statistical techniques, which can provide concrete financial information that helps both internal decision-makers within the company in implementing the best financial strategies, as well as external parties: clients, investors, etc.**

The post-hoc analysis is based on a sample of 30 Romanian companies, using the previously developed D model. The study covers a period of 3 consecutive years, from 2021 to 2023, and employs a total of 9 economic and financial indicators that most accurately reflect the probability of bankruptcy. The statistical methodology used is discriminant analysis. The financial variables identified as likely to differentiate between bankrupt and non-bankrupt companies are organized into four groups: activity ratios, liquidity and solvency ratios, debt ratios, and profitability ratios. Throughout the study, based on the results obtained for each company individually, the hypothesis that the D score is effective and applicable to Romanian companies is confirmed.

Keywords: *Bankruptcy Risk; Liquidity; Solvency; Profitability; Indebtedness.*

I. INTRODUCTION

The necessity of predicting bankruptcy risk for a company is of utmost importance within the firm's operations. Risk forecasting has been and continues to be the primary subject of many research studies aimed at identifying the probability of bankruptcy occurrence, the factors leading to this state, as well as methods for minimizing these risks.

Accurate assessment and management of risks are crucial for the development of businesses. On one hand, they allow for the maximization of the chances of survival for the entity in the context of financial crises, while on the other hand, they increase the opportunities for a company to access external sources of financing. This study focuses on *bankruptcy risk* at the level of Romanian companies, describing the most relevant ratios for detecting financial issues, as well as *methods for preventing this type of risk*. The analysis of the ability to remain solvent and manage bankruptcy risk holds a central position within any entity.

II. OBJECTIVES

The main objective of the study is to estimate bankruptcy risk for small and medium-sized enterprises (SMEs) in Romania using the most relevant financial indicators. A few secondary objectives will also be considered, such as:

- *Objective 1*: The methodology applied in the analysis of bankruptcy risk;
- *Objective 2*: Description of financial variables on the basis of which bankruptcy/non-bankruptcy discrimination can be made.

In achieving the objectives, a working hypothesis is proposed within the study, such as:

- Hypothesis H_1: The accuracy of the prediction through post-hoc analysis of the success rate is likely to be effective for Romanian companies.

The technique used in this study is the statistical method. The score function is a method based on discriminant analysis, which involves a combination of the

most discriminatory ratios, specifically those that best separate financially healthy companies from those with problems (i.e., bankrupt companies). The variables considered in the study are: receivables recovery; payment of obligations; asset solvency; equity indebtedness; gross profit margin rate; economic profitability rate. These ratios reflect the performance level of an entity and allow for the comparison of risk and stability.

III. SPECIALIZED LITERATURE

Bankruptcy prediction plays a fundamental role both for individual companies and for the national economic environment. It helps firms identify financial difficulties before their situation worsens, allowing them to take timely corrective measures. Moreover, the development of risk management methods and the implementation of bankruptcy prevention policies become more effective.

The term "risk" can be viewed in various ways by theorists and practitioners. In this regard, in his work, author Teodorescu C.D. [1] states that "risk can be defined as the threat whereby an event or action negatively affects an organization's ability to achieve its objectives."

According to author Corduneanu I. [2], "risk represents the potential for deterioration, loss, or destruction of a resource as a result of the materialization of a threat that exploits a vulnerability."

Author Mocanu M. [3] argues in his study that "risk is the probability or threat of damage (...) a loss or any other negative occurrence caused by internal or external vulnerabilities, which can be avoided through preemptive action."

The general definitions presented above largely cover the same aspects: probability, negative effect, with different connotations (loss, damage). Certainly, *all these definitions* are *valuable* in exploring the *factors* that determine the undesired event and, subsequently*, important in managing these risks,* in management, in general.

According to authors Bătrâncea I., Bătrâncea L.M., Borlea S.N. [4], *the concept of risk* "only has significance when the future is presented and when an attempt is made to estimate the possible fluctuations of the profitability rate in forecasting analyses."

During the operation of a business, various financial problems may arise that affect normal activities, thus endangering the continuity of the business. These difficulties can become increasingly severe, taking the form of insolvency. However, as a rule, there are warning signals indicating increased financial risks. Early awareness of these issues can help in managing crisis situations.

According to Law No. 85/2014 (Art. 5, Paragraph 29) [5] – "insolvency represents the state of the debtor's assets characterized by the insufficiency of available financial resources to settle certain, liquid, and due debts."

The issue of insolvency and bankruptcy has been extensively studied over the years and remains an important concern for the academic environment, managers, and investors.

As authors Stan M. and Turcu I. [6] state: "Currently, insolvency is a matter of global interest everywhere in the world."

"If insolvency does not always lead to bankruptcy, bankruptcy implies that the company is in a state of insolvency" (Căruntu Constantin, Lăpăduși Mihaela L.) [7].

There are factors such as economic systems, financing possibilities, fiscal policies, working conditions, market competition, or the prevailing legislation that influence business development and the associated risks.

Authors Stan M. and Turcu I. [6] believe that: "Bankruptcy is never limited to an isolated enterprise, as the consequences are felt throughout the entire community."

Therefore, the activities of enterprises and the risks they are exposed to require careful and in-depth analysis.

In her research, author Taran A. [8] conducted a study focused on small and medium-sized enterprises in the United Kingdom and demonstrated that non-financial information and compliance-related data can significantly contribute to measuring insolvency risk. Furthermore, the results highlighted that the main causes of unexpected financial problems in enterprises are insufficient capitalization and lack of planning.

An empirical study conducted by Fisher T.C.G. and Martel J. [9] on 810 Canadian enterprises at high risk of bankruptcy tested certain theoretical models regarding the factors that influence a firm's bankruptcy decision, focusing on restructuring initiatives and managing conflicts with creditors. The relevance of this study lies in identifying the factors that influence the condition of distressed enterprises and the success of restructuring attempts (such as asset structure and volume, type of business, legal form of the firm, debt repayment term—an important aspect in influencing financial stability).

Existing research on bankruptcy risk evaluation demonstrates that it is essential to use both financial and non-financial information. Although many studies have reported the high predictability of certain financial indicators, financial distress prediction models lose their predictive power over time if they are not updated according to economic, market, and other changes.

Bankruptcy risk "represents the possibility of the inability to meet all due obligations as a result of closing previous periods with losses that were not covered and have completely depleted the company's equity" (Holt Gheorghe) [10].

This type of risk can be assessed from essential aspects for the decision-making process (Nagy C., Ghica E.D., Tipărescu C.A.) [11]:

➢ Static analysis based on the study of the financial balance sheet;
➢ Dynamic analysis from the perspective of studying cash flows;
➢ Functional analysis based on the functional balance sheet;
➢ Analysis through the scoring method, techniques that are increasingly necessary in a business.

The specialized literature identifies many factors that can influence the bankruptcy risk of Romanian companies, among which we can highlight:

➢ *Economic and Financial Factors:*
• High level of borrowing;
• Insufficient liquidity to pay financial debts;
• Repeated losses leading to decreased profitability;

➢ *Internal Factors:*
• Lack of implementation of financial strategies; poor management;
• Inadequate planned investments;
• Inefficient management of costs and inventories;

➢ *External Factors*:
• Instability of the exchange rate, inflation;
• Market competition;
• Changes in the prevailing legislation.

Economic studies show that bankruptcy affects not only the company itself, but also employees, investors, clients, suppliers, and the entire national economy.

Considering the extensive studies in recent years on this topic, there are numerous *methods for preventing bankruptcy risk*, such as:

➢ *Monitoring the most relevant economic and financial indicators,* namely liquidity and solvency, indebtedness, and profitability;
➢ *Diversifying income sources* to avoid excessive dependence on a very small number of clients;
➢ Streamlining costs and *implementing stricter financial controls*;
➢ Enhancing market competitiveness by *constantly adapting to new technologies*;

Therefore, in light of these considerations, it is essential to develop measures for preventing or combating this type of risk and, at the same time, to ensure the sustainability of the manufacturing industry.

Through a review of the specialized literature and the implementation of a relevant case study, this article emphasizes the usefulness of applying the Z-score in forecasting bankruptcy risk, recommending its application in financial analysis for Romanian companies.

Bankruptcy risk assessment tools include: "score functions, decision trees, neural networks, expert systems" (Cîrciumaru D.) [12] .

The score function, being the most well-known, was developed by Altman Ed. I. and is used to estimate a company's bankruptcy risk.

According to the opinion expressed by Siminică M. [13], scoring methods are composed of two main categories: *empirical methods* and *statistical methods*.

Statistical methods are based on a combination of several financial indicators, namely: indebtedness, liquidity, solvency, and profitability, to obtain a numerical score, providing an overview of the company's financial situation.

In addition to the Altman model (Z-score, 1968), other models are used in Romania for estimating bankruptcy risk, including: the Springate Model (1978), the Fulmer Model (1984), the Koh Model (1992), the Conan & Holder Model, the Mânecuță & Nicolae Model (1996), the Ion Anghel Model (2002), etc.

IV. METHODOLOGY

By using discriminant analysis, the Z-score is calculated for each company under analysis, indicating whether the entity is likely to go bankrupt or not. To determine the score function, several steps must be followed, namely:

➢ Selecting a sample of companies from the same industry, some of which are financially stable while others are facing financial difficulties;
➢ Choosing financial indicators that accurately reflect the company's situation;
➢ Selecting variables that have a discriminatory capacity between distressed companies and healthy ones;
➢ Determining the Z-score values and establishing specific inflection points for interpreting the score function, which reflects the bankruptcy risk. The general calculation of this function is as follows:

$Z = V_1 X_1 + V_2 X_2 + \cdots + V_n X_n$; Where:
V_1 – represents the discriminant coefficients;
X_1 – represents the financial variables.

In conducting the **post-hoc analysis** of the D Model, the information was collected from the financial statements of 30 small and medium-sized enterprises, with the companies belonging to the manufacturing industry.

In designing the study, the following hypothesis is considered relevant:

• If the accuracy of the prediction through post-hoc analysis of the success rate is likely to be effective for Romanian companies? The hypothesis is confirmed through testing a different sample of companies than those used in the construction of the D Model.

For the development of this analysis, it is necessary for the companies on which the study is based to be divided into two groups:

• Group F: bankrupt companies, with financial problems;
• Group NF: non-bankrupt companies, financially healthy.

- Thus, the 30 companies included in the sample are divided as follows:
- **12 companies** are insolvent, specifically those falling under the provisions of Law 85/2014;
- **18 companies** are non-bankrupt (with a favourable situation).

The financial ratios considered likely to discriminate between bankrupt and non-bankrupt companies in this analysis are classified into 4 groups:

- Activity ratios (turnover ratios);
- Liquidity and solvency ratios;
- Profitability ratios;
- Debt ratios.

To illustrate the significant differences, two companies are randomly selected: VRANLACT SRL, which belongs to the group characterizing failure, and MIFADO PRODCOM SRL, which belongs to the group characterizing a favourable situation.

Table 1 Comparative Analysis of the Variables in the Test Sample (Bankrupt company)

VRANLACT SRL	Tax identification number 1445546	2021	2022	2023	Z -TOTAL
Indicator	Calculation formula				
Activity ratios (turnover ratios):					
Receivables recovery	X1 = Receivables / Revenue*360	114,21	28,48	33,79	
Payment of obligations	X2 = Liabilities / Revenue *360	2148,58	1372,10	1807,64	
Liquidity and solvency ratios:					
Asset solvency	X3 = Equity / Total assets	-0,46	-0,82	-1,09	
Profitability ratios:					
Gross profit margin rate	X4 = Gross profit / Revenue*100	-151,72	-65,47	-54,98	
Economic profitability rate	X5 = Gross profit / Total assets *100	-37,13	-31,28	-22,89	
Debt ratios					
Equity indebtedness	X6 = Total liabilities / Equity	-3,17	-2,22	-1,92	
Z = -0.249X1 + 0.101X2 + 17.230X3 + 0.508X4 - 0.156X5- 0.156X6		-7822,04	-14017,79	-18635,66	-40475,5

Source: Own interpretation based on the information found in the author's work

Table 2: Comparative analysis of the variables in the test sample (Non-bankrupt company)

MIFADO PRODCOM SRL	Tax identification number 2690357	2021	2022	2023	Z -TOTAL
Indicator	Calculation formula				
Activity ratios (turnover ratios):					
Receivables recovery	X1 = Receivables / Revenue*360	20,96	9,41	29,32	
Payment of obligations	X2 = Liabilities / Revenue *360	29,18	69,17	67,07	
Liquidity and solvency ratios:					
Asset solvency	X3 = Equity / Total assets	0,82	0,47	0,69	
Profitability ratios:					
Gross profit margin rate	X4 = Gross profit / Revenue*100	7,31	7,95	17,52	
Economic profitability rate	X5 = Gross profit / Total assets *100	16,12	21,99	29,34	
Debt ratios					
Equity indebtedness	X6 = Total liabilities / Equity	0,22	1,13	0,45	
Z = -0.249X1 + 0.101X2 + 17.230X3 + 0.508X4 - 0.156X5- 0.156X6		14148,15	8074,374	11859,374	34082,08

Source: Own interpretation based on the information found in the author's work

Changes in the global economy, shifts in the national economic environment, new legislative approaches, as well as the existence of different types of enterprises with specific characteristics, highlight the need to reconsider the indicators used to measure the bankruptcy risk of companies.

➤ *Activity Ratios*

The financial indicators analysed highlighted certain aspects, namely:

The receivables *recovery period* for the bankrupt company, VRANLACT SRL, showed a very high value in 2021, specifically 114.21 days, reflecting the fact that the company had accumulated receivables from previous financial years. On the other hand, the non-bankrupt company, MIFADO PRODCOM SRL, recorded a value of 20.96 days in 2021, indicating that companies without financial problems recover their receivables much faster.

The payment period *for liabilities* showed a very high level for the bankrupt company, 2148.58 days in 2021, which may indicate the company's inability to pay its suppliers. This poses significant risks in maintaining long-term contractual relationships, as well as the possibility of entering insolvency. Meanwhile, the non-bankrupt company indicates that it has no problems paying its obligations, as the values for this ratio were 29.18 days in 2021, increasing later but not significantly to 69.17 days in 2022 and 67.07 days in 2023.

It is thus recommended, prudently, to maintain financial stability by positively modifying the turnover through: identifying new markets; increasing sales volume; reducing the number of poorly trained employees; etc.

➤ *Liquidity and Solvency Ratios*

According to author Teodorescu A. [14], "liquidity refers to one of the company's abilities, namely the transformation of assets into cash, the transfer costs of which are at a low level."

A critical moment in the life of a company is represented by the deterioration of its financial situation and the emergence of a liquidity crisis, which can lead to the inability to meet obligations.

Solvency represents "the company's ability to meet due obligations resulting either from previous commitments or from current operations whose completion is essential for continuing business activities, or from mandatory withdrawals" (Popa I.L., Miculeac M.) [15].

Regarding liquidity, *it is recommended t*hat companies apply, in future periods, measures to reduce obligations as much as possible by refraining from taking new loans, alongside attracting capital from the financial market to increase equity. From the perspective of loans, it is advised that these be reduced until the interest rate falls below the level of economic profitability.

➤ *Profitability Ratios*

For a company to enjoy long-term economic performance, it must ensure that the balance between profitability, liquidity, solvency, and indebtedness is maintained.

Referring to the profitability ratio, it indicates that the company with financial difficulties is incurring losses, as the *gross profit margin rate* is negative each year (-151.72 in 2021; -65.47 in 2022; -54.98 in 2023), which shows that it is recording losses. In contrast, the company without financial difficulties maintains a positive level each year analyzed (7.31 in 2021; 7.95 in 2022; 17.52 in 2023).

The economic profitability ratio also remains negative year after year for the financially troubled company (-37.13 in 2021; -31.28 in 2022; -22.89 in 2023), compared to the non-bankrupt company where a positive variation can be observed year after year (16.21 in 2021; 21.99 in 2022; 29.34 in 2023).

Since this indicator is below the indebtedness ratio each year, it can be concluded that the loans granted to the bankrupt company, VRANLACT SRL, led to its bankruptcy.

Regarding profitability ratios, it is recommended to reduce costs and review technologies; analyse market competition; increase sales while also reducing expenses.

➤ *Debt Ratios*

In order to make the best possible decisions regarding the financing of operations, decision-makers will analyse, in addition to the evolution of liquidity, solvency, or profitability ratios, the ability to incur debt, financing needs, and the order in which these should be prioritized. At the same time, economic changes at the national level must also be considered, such as exchange rate fluctuations, interest rates, and the evolution of gross domestic product, alongside prevailing legislation.

Given that the values remain negative for the bankrupt company (-3.17 in 2021; -2.22 in 2022; -1.92 in 2023) compared to the non-bankrupt company, where the values are positive each year, this indicates the high level of borrowing, which is generally more pronounced in bankrupt companies than in financially healthy ones. Consequently, the risk will be proportional to the level of indebtedness, meaning a higher risk of bankruptcy.

Indebtedness represents for a company both *the obligation to periodically pay interest*, which essentially translates into financial expenses that reduce results, as well as *a way to achieve profitability by resorting to loans*. This profitability represents a benefit for the company if it exceeds the cost of the borrowed capital.

The borrowing activity primarily focuses on the sustainability of a business, so that the ability to repay the loans taken by borrowers can be assessed based on the income and liquidity generated from the operations of the business (Mărginean M.) [16].

The economic activity of a company can be profitable or not, depending on the global financial policy it adopts,

namely self-financing from its own capital or financing through bank loans.

Clearly, no investor would risk placing their capital in a company with a high level of indebtedness, considering the investment risk would be very high. It is preferable to have a balance between the two forms of financing rather than relying exclusively on one of them.

As stated by authors Grițco D. and Dumbravanu L. [17], using only equity capital, a company has the highest financial stability, "but it limits the pace of its development." At the same time, using borrowed capital leads to a risk of decreasing financial stability and a risk of losing solvency. It is very important to mention one aspect, namely that the development of the financing structure is a central element in a company's management activities, as both equity and borrowed capital involve costs, which, in turn, reduce the financial result.

Building an optimal financing structure is very useful, as the ratio between the two forms of capital significantly influences the level of profitability achieved by the company. Depending on the financial structure, the necessary capital for the company's operations can be attracted. The attraction of borrowed resources allows decision-makers to implement certain investment plans; however, these resources can have negative effects on the financial position of the entity, which may ultimately lead to bankruptcy.

Analysing the obtained data, it can be noted that for the company facing financial problems, the score obtained using the D model corresponds to the real situation it is in. The result highlights and confirms that the bankrupt company is facing financial difficulties, most likely having issues with paying debts, recovering receivables, low economic profitability, etc.

At the same time, for the financially healthy company MIFADO PRODCOM SRL, the D model establishes that the score obtained, with a value of 34,082.08, corresponds to the real situation in which the company finds itself, namely in a relatively good financial position, with a low risk of bankruptcy. It can be said that the company is capable of generating profit, considering the level of the economic profitability ratio. However, it is advisable for the management team to continue monitoring the financial indicators and implement effective risk management measures to ensure long-term sustainability.

Thus, the need to evaluate the company's risks with the help of the most relevant economic and financial indicators becomes apparent.

Following the processing of data from the financial statements of the selected companies in the manufacturing industry and the use of financial variables to determine the Z-score for each company, the results obtained are shown in Table 1.4. These results are ranked in ascending order for both groups of companies (F/N-F), thus resulting in a specific situation for each company.

Table 3: Prediction of the situation of companies in the test sample (the 30 companies)

No.	COMPANY	SITUATION	D SCORE	CLASIFICARE	CORRECT POINTS = 1
1	FILIP D IMPEX SRL	F	-946446	F	1
2	COSNA SA	F	-646650	F	1
3	EOLA MARK SRL	F	-92111,3	F	1
4	ANTOP PROD IMPEX SRL	N-F	-69172	F	0
5	COVABEL SRL	N-F	-63202,2	F	0
6	VRANLACT SRL	F	-40475,5	F	1
7	PATISIMO SRL	F	-26827,2	F	1
8	SMS ROMANIA SRL	F	-25551,8	F	1
9	BANINI IMPEX SRL	N-F	-22552,6	F	0
10	ALFADEL SRL	F	-21866,6	F	1
11	A.C.K. FLUID SRL	F	-20362	F	1
12	NEW ADYTEX SRL	N-F	-7652,07	F	0
13	EVEREST PRODSERV SRL	F	-6715,79	F	1
14	ZOLI & EDITH SRL	F	-2901,45	F	1
15	C.M.C SRL	F	4105,509	F	1
16	EXPLOIT SRL	F	13906,95	F	1
17	EDILTEX 55 SRL	N-F	21995,77	N-F	1
18	KNITWEAR SRL	N-F	25419,03	N-F	1
19	TEXTILE GEL & CO ROM SA	N-F	31193,06	N-F	1
20	MODIN SA	N-F	32959,79	N-F	1
21	MATO SRL	N-F	33952,75	N-F	1
22	MIFADO PRODCOM SRL	N-F	34082,08	N-F	1
23	GNOATO EST SRL	N-F	34455,91	N-F	1
24	TEO & ALEX CONFEX SRL	N-F	36485,11	N-F	1

25	MLH CREATION FACTORY SRL	N-F	36900,84	N-F	1
26	SMIRODAVA SA	N-F	38926,18	N-F	1
27	FACTORY BELT SRL	N-F	43244,88	N-F	1
28	MOTOC NIL INDUSTRIAL SRL	N-F	43951,04	N-F	1
29	SUBLY4U SRL	N-F	44880,04	N-F	1
30	PRODUCTIV SRL	N-F	45893,89	N-F	1
MEDIAN			9006,228		26
Success rate without uncertainty zone					87%

Source: Own interpretation based on the information found in the author's work

The results show that the use of the Score function in bankruptcy risk prediction models can significantly improve the accuracy of financial forecasts for companies in the manufacturing industry.

In the total verification sample, the success rate is 87%. This allows the assessment that the D score is effective and can be applied to Romanian companies. Thus, the hypothesis H_1 is also confirmed: *The accuracy of the prediction through post-hoc analysis of the success rate is likely to be effective for Romanian companies.*

This function can be useful for investors in identifying early signs of financial difficulties and allows for early intervention, through restructuring obligations or optimizing costs. Furthermore, the use of this function can contribute to increased transparency, facilitating access to financing through risk analysis by banks, financial institutions, etc.

V. CONCLUSIONS

In general, it can be said that risk expresses the possibility that a future action may result in losses that will affect the economic results, performance of a company, and the entire activity of entrepreneurs. Every business is exposed to risk, but to varying degrees. The higher the risk, the greater the expectation of investors that the return on the capital they invest will match the level of the assumed risk.

The evaluation of an entity's profitability is incomplete if the associated risk in achieving that profitability is not considered.

Particular importance must be given to the **methods of preventing and mitigating** the most significant risks, measures that help both in increasing the profitability of an entity and in enabling any manager to make the best possible decisions under conditions of risk.

The way in which risks are managed differs from one company to another, leading to different profit outcomes, and determining the success or failure of the business.

There are numerous studies on the bankruptcy risk of companies at the national level, highlighting the importance and necessity of rigorous financial analyses and efficient risk management planning. The diversity of prediction models, alongside a solid financial strategy, can help companies prevent this type of risk.

The predictability of risks using the scoring method is essential for managing the company, as the economic entity could implement recovery strategies long before bankruptcy occurs. Evaluating and interpreting this type of risk is important because it has major implications for business partners, shareholders, investors, and even the company's staff.

Thus, considering the existence of a multitude of bankruptcy forecasting models in Romania, inspired by international literature and adapted to local economic realities, numerous **methods for preventing bankruptcy** risk can be determined, aimed at improving long-term stability, among which we can propose:

➢ *Financial Methods*:
- Rapid collection of receivables;
- Negotiating longer payment terms with suppliers;
- Avoiding excessive borrowing;
- Using bank loans with favourable interest rates;
- *Operational methods:*
- Optimizing the supply chain;
- Increasing sales;
- Ensuring a business continuity plan in situations such as a pandemic or economic crisis;

➢ *Development Methods:*
- Negotiating favourable contracts with suppliers;
- Innovations based on consumer demand;
- Developing marketing strategies based on customer loyalty;
- Expansion into external markets to avoid relying solely on the local economy;

Thus, in conclusion of the study conducted, **a first conclusion** may refer to the dual role of management, which must apply both measures for identifying, evaluating, and managing specific risks, as well as a business plan that is profitable (also for shareholders and investors), all while complying with the prevailing legislation.

A second conclusion can be formulated as the need for adequate systems to detect events that generate risk; the need for comprehensive models that can process large volumes of information and that are constantly updated with the multitude of risk factors.

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