



Leveraging Z-Score and Financial Ratio as Early Warning System to Mitigate Supply Chain Disruption at PT Gunung Raja Paksi TBK

Nazla Sagita Maharani^{1*}, Raden Aswin Rahadi²

^{1,2} School of Business Management, Bandung Institute of Technology, Bandung, Indonesia

ABSTRACT: PT Gunung Raja Paksi faces significant challenges in maintaining profitability, which impacts its overall financial health. Key risk factors include the volatility of raw material prices, intense competition within the steel industry, and economic downturns. Fluctuations in raw material prices affect production costs and profit margins. Rising raw material costs can squeeze margins unless passed on to customers, which is challenging in a competitive market. The competitive landscape requires the company to balance competitive pricing with quality, leading to potential price wars and further margin erosion. Additionally, economic downturns reduce demand for steel products, impacting sales volumes and revenues. This study comprises four key components: risk assessment, Z-score model analysis, financial ratio analysis, and risk prevention formulation. The risk assessment, covering both internal and external factors, identifies major risks including supply chain disruptions, financing challenges, weather-related issues, major accidents, and steel market volatility. Analysis using the Z-score model, based on data from the past five years, reveals significant profitability risks for the company. Further examination of financial ratios shows that the company's profitability ratios are generally below the industry average. Integrating these qualitative and quantitative findings indicates that the company should prioritize addressing supply chain disruption risks. Consequently, an early warning system has been developed, and risk prevention strategies have been established.

KEYWORDS: risk assessment, Z-score model, early warning system, supply chain disruptions

1. INTRODUCTION

PT Gunung Raja Paksi operates within the volatile steel manufacturing industry, which is heavily influenced by global economic trends, fluctuating demand, and raw material prices. This industry is known for its susceptibility to market volatility, which poses significant challenges for companies like PT Gunung Raja Paksi. The company must navigate these market dynamics while striving for sustainable growth and profitability. The steel industry, characterized by its strategic importance and complex external influences, faces constant transformation driven by economic, political, and technological factors.

In recent years, the steel market has experienced heightened volatility due to trade disputes, geopolitical tensions, and shifts in consumer preferences. These factors contribute to financial instability, supply chain disruptions, and increased competitive pressures for PT Gunung Raja Paksi. Managing these risks effectively is crucial for the company to safeguard against adverse outcomes and ensure operational stability. Traditional risk management approaches, which often rely on reactive measures, may not be sufficient in today's rapidly changing business environment, necessitating the adoption of proactive strategies.

Financial ratio analysis emerges as a vital tool for PT Gunung Raja Paksi to manage these risks. By consistently evaluating key financial indicators such as liquidity, solvency, profitability, and efficiency, the company can gain insights into its financial health and potential weaknesses. Liquidity ratios, like the current and quick ratios, provide an understanding of the company's ability to meet short-term obligations, while solvency ratios assess its capacity to handle long-term debt. These analyses serve as early warning indicators, alerting PT Gunung Raja Paksi to potential financial hazards before they escalate into critical situations.

Identifying financial risks early is especially important in the steel industry due to significant fluctuations in raw material costs caused by global economic shifts and geopolitical events. Through financial ratio analysis, PT Gunung Raja Paksi can predict potential increases in raw material costs, allowing it to adjust pricing strategies, hedge against price fluctuations, and seek alternative supply sources. This proactive approach helps the company mitigate financial burdens, maintain competitive pricing, and protect profit margins amid market volatility.



Moreover, maintaining operational stability and effective cash flow management is essential for PT Gunung Raja Paksi’s daily operations and long-term viability. Financial ratio analysis aids in optimizing working capital, controlling inventory levels, and accurately forecasting cash flow requirements. Timely knowledge of cash flow gaps or liquidity concerns enables the company to address these issues proactively, such as by renegotiating payment terms with suppliers or obtaining additional financing. This ensures continuous operations and reduces the risk of disruptions, thereby enhancing the company’s resilience and operational efficiency.

2. LITERATURE REVIEW

2.1 Enterprise Risk Management (ERM)

Enterprise Risk Management (ERM) is a comprehensive and methodical strategy for managing all business risks, aimed at optimizing a firm's value by integrating credit risk, market risk, economic capital, and risk transfer (Dickinson, 2001; Lam, 2003). ERM helps identify, evaluate, and mitigate risks threatening an organization's strategic goals while also identifying opportunities for competitive advantage (Miccolis and Shah, 2000). Unlike conventional risk management, which isolates risk management within specific departments, ERM promotes an enterprise-wide approach by removing departmental and functional barriers to manage risk holistically (Loghry and Veach, 2009; Anderson, 2000). This integrated methodology is essential for large businesses operating in complex ecosystems with interorganizational interactions, such as supply chains, requiring internal competence to manage external partners and ensure supply chain flexibility (Dionne, 2013; Abrams et al., 2007; Ivan and Henry, 2012).

2.2 Financial Risk Early Warning

The technologies, guidelines, and procedures used to anticipate and address a potentially catastrophic event are referred to as "early warning systems." By definition, early warning systems have the ability to use both quantitative and qualitative data (Lin, 2021). The single factor that determines a reliable financial crisis forecast is the ability of early warning systems to identify early indicators of financial instability.

According to Padhan and Prabheesh (2019), early warning systems are necessary to predict vulnerability events and can be helpful in framing alerts effectively to determine if an incident will escalate into a crisis or to lessen the effects if it cannot be completely prevented. When a business is exposed to financial risk, it increases the likelihood that it may experience significant financial losses, disrupt its capital chain, and face bankruptcy. Enhancing early detection of corporate financial risk is therefore essential. The stability and growth of the securities market are linked to the caliber of businesses. To help businesses correctly detect financial risks and prevent losses, it is becoming more and more important to comprehend how to build an effective early warning system for financial crises for a variety of corporate interest groups (Tong and Tong, 2022).

Different early warning systems are required for different threats. To enhance control warnings, a range of modern technology models and applications are showcased (Klopotan et al., 2018). Early warning indicators give authorities sufficient time to draft the necessary policies.

2.3 Previous related literature

Numerous researchers have conducted extensive studies on risk early warning across various fields, as illustrated in Table 1. While the concept of early warning for financial risk has seen substantial progress, there is a notable scarcity of published research on early warning of financial risk specifically in the steel sector.

Table 1: Previous related studies on financial risk early warning system

No	Research Title and Author	Applied sector	Method	Objectives	Factors
1	Financial Risk Evaluation Z-score Model for Intelligent IoT-	IoT-based enterprise	Z-Score model	Reducing the likelihood of catastrophe and expanding	<ul style="list-style-type: none"> • Liquidity • Solvency • Operational



	based enterprises (Zhu et al., 2021)			businesses in healthy and orderly manner	
2	A Novel Financial Risk Early Warning Strategy Based on Decision Tree Algorithm (Tong & Tong., 2022)	Financial sector	Decision tree algorithm to establish a financial early warning system based on big data analysis	<ul style="list-style-type: none"> • Predicting financial operations • Preventing financial crises • Guiding modern enterprise management 	Liquidity
3	Developing The Strategy for Steel Sales by Scenario Planning Approach	Steel industry (Manufacturing)	<ul style="list-style-type: none"> • Content analysis • Semi-structured interviews • Secondary data collection 	Identifying driving forces, uncertainties, and future trends for scenario planning in the steel industry	<ul style="list-style-type: none"> • Profitability • Liquidity • Solvency



4	Financial Risk Early Warning System for Coal Mining Company in Facing Disruption of Supply Chain	Mining company	<ul style="list-style-type: none"> • ERM • Z-Score model • Financial ratio analysis 	Early warning system and risk prevention formulation to avoid supply chain disruption	<ul style="list-style-type: none"> • Profitability • Liquidity • Solvency • Cash flow
5	Forecasting corporate financial distress in the Southeast Asian countries: A market-based approach (Dung V. et al)	Listed company in Southeast Asia	<ul style="list-style-type: none"> • Distance to Default (DD) mode • Interest Coverage Ratio (ICR) 	Early warning distress indicators that signal distress well before bankruptcy	<ul style="list-style-type: none"> • Profitability • Solvency • Cash flow
6	Measuring the financial effects of mitigating commodity price volatility in supply chains (Gaudenzi et al., 2020)	Commodity market	<ul style="list-style-type: none"> • Total cost ownership (TOC) • Real option valuation (ROV) 	Estimating the financial effects of mitigating commodity price risk volatility (CPV) in supply chain management decisions.	<ul style="list-style-type: none"> • Profitability • Cash flow
7	Analyzing impact of financial information sharing on supply chain performance and stability: system dynamics approach (Lee et al., 2010)	Manufacturing	System Dynamics methodology.	Simulation regarding the impact of financial information flow on supply chain performance and stability based on the system dynamics methodology and analyzed the performance.	<ul style="list-style-type: none"> • Liquidity • Cash flow
8	Financial Risk Analysis of Steel Enterprises Based on Z-score Model-	Manufacturing	Z-Score model	The view of the cause of Jiugang Hongxing financial risk	<ul style="list-style-type: none"> • Profitability • Solvency • Liquidity



	Taking Gansu Jiugang Hongxing as an Example (Xie, 2024)			problems, put forward the strategy to deal with financial risk	
9	Bankruptcy prediction for steel industry in India using Altman Z Score model (Gopalakrishnan, 2019)	Steel industry	Z-Score model	To predict the bankruptcy for the Indian Steel Industry by considering two objectives. They are to identify the company's degree of closeness to bankruptcy and to deduce the various parameters involved in influencing the inferred values to a large extent	<ul style="list-style-type: none"> ● Profitability ● Solvency ● Liquidity
10	The relevance of Altman Z-Score analysis (C.S, 2018)	Steel industry	Z-score model	This paper analyses the viability and accuracy of the tool "Z-Score Analysis" for the Indian Steel sector by using various ratios to know about each aspect of the companies of this sector	<ul style="list-style-type: none"> ● Profitability ● Solvency ● Liquidity

3. RESEARCH METHODOLOGY

3.1 Research Design

Numerous researchers have conducted extensive studies on risk early warning across various fields, as illustrated in Table 3.1. While the concept of early warning for financial risk has seen substantial progress, there is a notable scarcity of published research on early warning of financial risk specifically in the steel sector.

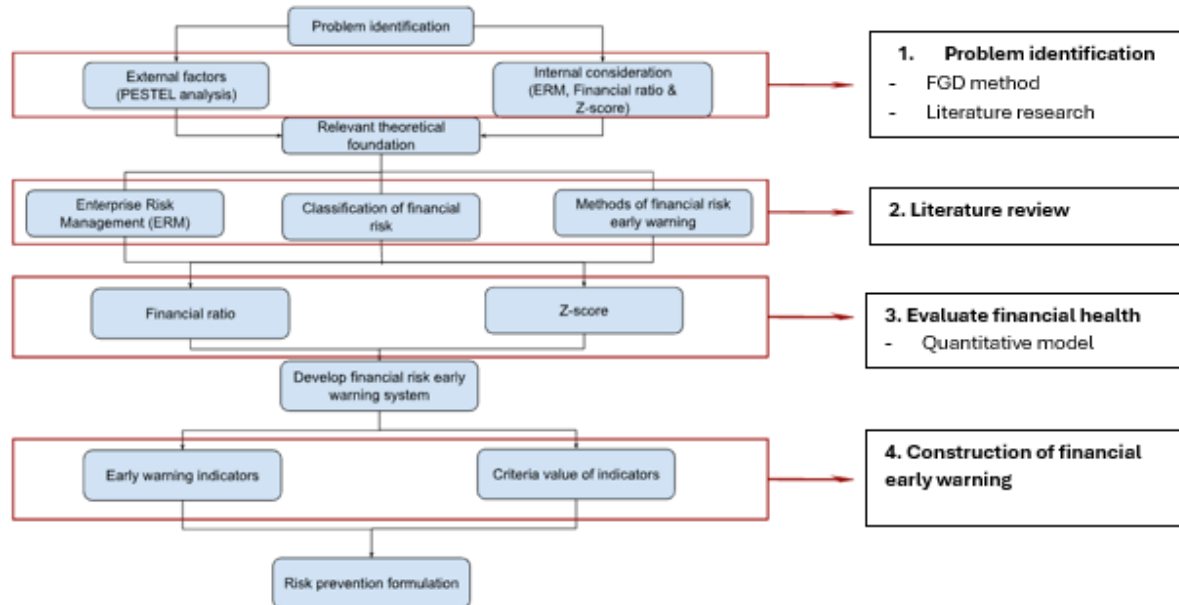


Figure 1: Research design diagram

The early warning system of financial threats is thoroughly examined using a combination of theoretical studies and specific case studies of firms. Figure 3.1 illustrates the analytical framework for this investigation, dividing the methodology and the entire process into five main sections.

First, the problem is identified by combining an industry report with financial reports available on the IDX to analyze risks from various sources. This analysis helps discern which firm is currently facing the most substantial risk factors. Secondly, literature research methods are employed to uncover significant theoretical foundations from previous journals and publications, including the categorization of financial risk and methodologies for establishing early warning systems for financial risks.

Thirdly, research on the Z-score model for the firm begins by utilizing financial data from the company's financial and/or annual reports. Among the various early warning models discussed in the literature, the framework proposed by Xie, Minhe (2023) is deemed most suitable for PT Gunung Raja Paksi Tbk. This model provides a comprehensive assessment of a company's financial status using multiple inputs from corporate income statements and balance sheets.

The steel manufacturing industry, characterized by its capital-intensive nature, cyclical revenue, and exposure to commodity price fluctuations, presents unique financial challenges. Companies like PT Gunung Raja Paksi Tbk can significantly benefit from employing the Z-score model as an early warning system due to its ability to identify early signs of financial distress, assess debt management and asset utilization, and analyze financial performance across economic cycles. By benchmarking against peers, companies can gauge their financial position relative to the competition.

To optimize the Z-score model for PT Gunung Raja Paksi Tbk, financial ratios such as profitability, solvency, and liquidity should be incorporated. Additionally, the model can be enhanced by considering the impact of commodity prices and environmental factors on the company's financial health. By tailoring the Z-score model to the specific characteristics of PT Gunung Raja Paksi Tbk and the steel industry, the company can gain valuable insights to mitigate risks and optimize performance.

CS et al. (2018) demonstrated the Z-Score model's effectiveness as an early warning system by analyzing its application to Essar Steel and Electro Steel. Their study revealed consistent negative Z-Scores for both companies, accurately forecasting their financial instability and leading to insolvency and bankruptcy proceedings. This case study highlights the Z-Score model's value as a tool for early intervention and risk management. Studies show that Altman's Z-score model has a 72% accuracy in forecasting bankruptcy



two years in advance with a 6% false positive rate (Amadeo et al., 2016). This model's accuracy is particularly relevant for steel manufacturing firms. The Z-score model study yields two results: indicating whether the company is at risk of bankruptcy or in stable financial condition, and identifying the financial aspects posing the greatest risks for further in-depth examination.

Finally, the construction of a financial risk early warning system for the company involves determining early warning indicators and their corresponding criteria values. This step uses the final analysis results as a reference to develop an effective early warning system.

3.2 Data Collection

The data collection method for this study involves using secondary data gathered from journals, publications, official websites, reliable online sources, and annual reports of PT Gunung Raja Paksi Tbk and its competitors. Secondary data are used to conduct a literature review on relevant theoretical frameworks, understand the business characteristics and external risks, and analyze financial indicators.

Selecting appropriate competitors for benchmarking involves crucial criteria. Since PT Gunung Raja Paksi Tbk is a private company, it's essential to choose competitors from the private sector to ensure fair comparisons, avoiding state-owned enterprises (SOEs) due to their government support during economic difficulties, which can lead to misleading conclusions. Competitors must also be publicly listed on the IDX (Indonesia Stock Exchange) to ensure data reliability and validation. Publicly listed companies undergo rigorous regulatory standards, regular financial disclosures, and external audits, providing credible and transparent financial data for accurate benchmarking and objective assessment of PT Gunung Raja Paksi Tbk's performance.

3.3 Data Analysis

The methodology used to conduct this study is quantitative methods. The examinations and investigations of a company's situation in order to identify potential financial risk factors and causes so that the company's authorized people can plan risk prevention measures in advance to avoid the occurrence of financial crisis is referred to as the method of financial risk early warning (Zhu, 2021). Experts in this discipline perform extensive investigation and identification of the enterprise's difficulties, creating a full report file for the enterprise's relevant staff (Wang and Yu, 2022).

To examine the company's risk, a qualitative technique is employed. Initially, the author conducts a thorough risk identification process to pinpoint potential risks from both external and internal sources. For the external analysis, the author uses a PESTEL analysis, focusing on the latest domestic political factors and economic conditions in Indonesia that might affect the company. This approach is justified because 95% of PT Gunung Raja Paksi Tbk's transactions come from domestic sales. Consequently, developments and construction plans within Indonesia have a significant impact on the company's sustainability.

For the internal analysis, the author will identify the causes of the risks, assess the current controls in place (if any), and evaluate the risk ratings. This evaluation uses standard risk parameters specific to the company. Risks are assessed qualitatively based on two main criteria: likelihood and severity. Each of these criteria is rated on a scale of 1 to 5, with 1 representing the lowest level of risk and 5 representing the highest. By applying these measurement methodologies to both likelihood and severity, risk ratings for each identified risk are calculated using a specified formula:

$$\text{Risk Rating} = \text{Risk Likelihood} \times \text{Risk Severity}$$

Then, each of the risks is plotted in the risk matrix according to its risk rating. The risk classification gives a clear indication of which risk is more significant and which risk should be transferred or mitigated.

The quantitative approach of financial risk early warning analysis involves calculating Z-scores as well as financial ratio by selecting appropriate financial data of the company, processing the financial data, and then developing a relevant system that is utilised to anticipate the enterprise's financial risk. Indicators of the company's solvency, profitability, and liquidity situation are included in a set of variable early warning indicators.



Edward Altman, a professor at New York University, has developed a model using financial statement ratios and multiple discriminant analysis to predict bankruptcy for publicly traded manufacturing firms. The Z multivariate model, which is based on financial ratios, may forecast corporate finance and bankruptcy risks (Bekasiewicz and Koziel, 2016). The technique developed a multiple linear regression. Linear discriminant Z score model made up of the five highest predictive financial variables. The expression is as follows:

$$Z = 1.2X_1 + 1.4X_2 + 3.3X_3 + 0.6X_4 + 1.0X_5$$

Where:

X₁ is the net working capital/total assets

X₂ is accumulated retained earnings / total assets

X₃ is profit before interest and taxes / total assets

X₄ is the market value of equity / book value of debt, and

X₅ is sales / total assets (Georgakopoulos and Jayaraman, 2016)

The meaning of the model is consistent with the interpretation of each variable in the Z-Score Model. Table 2 shows the Z-value judgment standard.

Table 2. Z-value judgment standard

Z range	Outcome
$Z > 2.99$	There is no risk of bankruptcy because the financial condition is steady.
$1.8 \leq Z \leq 2.99$	There is a modest financial crisis, but effective risk-prevention can be put in place
$Z < 1.8$	There is a serious financial crisis, and the likelihood of bankruptcy is very high.

The organization’s challenges will be highlighted by the results of a financial risk early warning study using the Z-score methodology. To further examine, financial indicator analysis with selected variables will be performed as seen in Table 3. It is crucial to concentrate on looking at financial metrics, choosing components at different levels, and then performing dynamical evaluations in order to more accurately evaluate an enterprise’s financial situation. Because each variable reflects financial information from a different point of view during the development of a business, the complexities of the financial position grows and can even generate data overlap across variables when numerous variables take place (Lee et al., 2016).

Table 3. Selected variables of financial indicator analysis

Financial Ratio	Formula	Explanation
Liquidity	Current Ratio = Current Assets / Current Liabilities	These ratios assess a company’s ability to meet short-term obligations. A low current ratio (less than 1) may indicate potential liquidity issues
Profitability Ratios	Gross Profit Margin = (Revenue – Cost of Goods Sold) / Revenue	These ratios measure a company’s ability to generate profits. Declining profit margins or a consistent drop in net income can be warning signs of potential issues



Debt-to-Equity Ratio	Debt-to-Equity Ratio = Total Debt / Total Equity	This ratio measures the proportion of a borrower’s debt to their equity. A high ratio may indicate that a company is financing its operations primarily through debt, leaving it vulnerable to economic downturns or increasing interest rates
Operating Cash Flow Ratio	Operating Cash Flow Ratio = Operating Cash Flow / Total Debt	This ratio indicates a company’s ability to generate cash from operations. A deteriorating trend in this ratio can signal potential credit risks and indicate that the company is struggling to meet its debt obligations
Inventory turnover ratio	Inventory turnover = COGS/Inventory	This ratio measures how many days it takes a company to collect money from customers. A higher DSO may indicate cash flow issues or that the company is taking longer to collect payments from its customers
Quick Ratio	Quick Ratio = (Current Assets – Inventory) / Current Liabilities	This ratio measures a company’s ability to cover immediate liabilities. A ratio below industry averages may suggest potential liquidity challenges

4. RESULT AND DISCUSSION

4.1 External analysis – PESTEL Analysis

The author uses PESTEL analysis to identify the macro-environment forces affecting PT GRP business now and are likely to continue to do so in the future by examining political factors, economic conditions, sociocultural forces, technological factors, environmental forces, and legal or regulatory factors.

4.1.1 Political Factor

The political landscape and national security policy are crucial to the steel sector’s development, particularly for supplying raw materials needed in light, heavy, and military equipment industries. Political uncertainty, especially during election years like 2024, can hinder industry operations, including the steel sector. With elections approaching, the intensifying political climate and global economic challenges such as inflation and recession lead to a wait-and-see attitude among investors, emphasizing the need for internal stability to maintain investor confidence (Lahadalia, 2022).

This analysis of the export and import dynamics of steel products for the first quarter of 2024 shows a 38.3% increase in steel exports and a 10.2% decrease in imports, reflecting a broader positive trend over the past five years. Effective import control measures and anti-dumping policies have bolstered domestic steel production and stabilized local supply chains, reducing financial distress and enhancing profitability for the steel manufacturing sector. However, companies must remain cautious of potential raw material shortages and fluctuating market conditions, highlighting the importance of staying informed about industry developments and regulatory changes.

4.1.2 Economic Conditions

The IMF’s World Economic Outlook (WEO) April 2024 forecast highlights that major economies, which together account for about 83 percent of global output, are showing varying growth projections. The United States is projected to grow by 2.1 percent in 2024, up from 1.8 percent previously, reflecting strong consumer spending and job growth. The Euro Area is expected to see a 1.5 percent growth, slightly higher than the 1.4 percent forecast earlier. China’s growth is forecasted at 4.6 percent, revised up from 4.4 percent, driven by domestic consumption and investment. India’s growth is anticipated to be 6.2 percent, an increase from 6.1 percent. In contrast, Japan’s growth is now projected at 0.7 percent, down from 0.9 percent, while the UK’s growth forecast has been reduced to 0.8 percent from 0.9 percent. Brazil’s growth for the fiscal year is forecasted at 1.9 percent, a slight upward revision from 1.8 percent.



The WEO forecasts are presented on a fiscal year basis, providing a snapshot of economic performance aligned with governmental planning cycles. The fiscal year projections show Brazil's growth at 1.9 percent, slightly improved from the previous 1.8 percent forecast. These revisions illustrate the shifting dynamics of global economies, with major economies like the US, China, and India showing stronger than previously expected growth, while Japan and the UK face downward adjustments. This analysis underscores the importance of continuous economic monitoring and adaptation to navigate the complexities and uncertainties of the global economic landscape.

4.2 Corporate Risk Assessment

The top ten corporate risks that a steel manufacturing company must contend withRisk assessment consists of three activities: risk identification, risk analysis, and risk evaluation, as outlined in ISO 31000:2018. The author initially conducted risk assessment by utilizing the reports of the steel manufacturing industry for external risk and internal performance company reports for internal risk. Then, management engaged in a discussion regarding the list of risks, which resulted in the identification of the top 10 corporate risks that the company faced:

1. Volatility of raw material price
2. Cybersecurity threats
3. Supply chain disruption
4. Difficulties in getting financing
5. Manpower incompetency
6. Major accident
7. Environmental regulation
8. Competition
9. Inventory Impairment
10. Geopolitical risk

Each risk was examined in detail with the relevant department heads to identify potential causes, assess the consequences if the risk materializes, review any existing controls the company has to mitigate these risks, and determine the risk level by evaluating both likelihood and severity. The outcome of this risk assessment is a risk matrix that plots all identified corporate risks according to their respective risk levels, as illustrated in Figure 3.



	Insignificant (1)	Minor (2)	Moderate (3)	Major (4)	Catastrophic (5)
Almost certain (A)			Competition		
Likely (B)				<ul style="list-style-type: none"> Volatility of raw material Manpower incompetency 	Supply chain disruption
Possible (C)			Inventory impairment	Difficulties in finding financing	Major accident
Unlikely (D)				<ul style="list-style-type: none"> Environmental regulation Geopolitical risk 	
Rare (E)				Cybersecurity threat	

Figure 2: Top risk matrix of The Company

Based on the risk matrix of PT GRP, the top five risks that have extreme levels are:

- Supply chain disruption
- Competition
- Volatility of raw material
- Manpower incompetencies
- Major accident

This five top risks are analysed and evaluated by qualitative judgement of management.

4.3 Financial Risk Analysis

The financial risk analysis is divided into two parts: modified Z-score analysis and main financial ratios analysis. The Z-score model assessment uses financial data from the company’s annual reports for the years 2020 to 2023, with the goal of evaluating the risk of bankruptcy. This analysis will highlight the areas of the firm that pose the highest risk, facilitating a deeper examination of crucial financial ratios.

To begin, calculate the variables for the modified Z-scores formula for the years 2020 and 2021, as detailed in Table IV.3. Multiply each variable by its corresponding coefficient and sum the results for each year to obtain the Z-score, as demonstrated in Table IV.4. The interpretation of these scores follows the Z-value judgment standards outlined in Chapter III. The findings indicate that the firm is experiencing a minor financial crisis from 2020 to 2023, suggesting that effective risk-prevention measures could be beneficial. The results are illustrated in Figure IV.2.

Table 4: Calculation of variables in the Z-score of company



	GGRP 2020	GGRP 2021	GGRP 2022	GGRP 2023
Net working capital	82,516,547.00	160,090,693.00	187,575,847.00	201,132,421.00
Total assets	1,032,641,969.00	1,068,331,723.00	1,186,322,555.00	1,228,574,394.00
x1	0.08	0.15	0.16	0.16
Retained earnings	28,459,476.00	90,356,336.00	142,566,675.00	179,836,871.00
Total assets	1,032,641,969.00	1,068,331,723.00	1,186,322,555.00	1,228,574,394.00
x2	0.03	0.08	0.12	0.15
Profit before interest and tax	65,174,637.00	133,409,999.00	118,539,151.00	111,679,353.00
Total assets	1,032,641,969.00	1,068,331,723.00	1,186,322,555.00	1,228,574,394.00
x3	0.06	0.12	0.10	0.09
Market value of Equity	165,774,461.15	295,214,793.83	193,025,057.50	235,162,553.72
Book value of debt	243,396,313.00	211,697,563.00	171,542,150.00	134,288,233.00
x4	0.68	1.39	1.13	1.75
Sales	613,006,216.00	721,806,619.00	945,497,149.00	709,839,048.00
Total assets	1,032,641,969.00	1,068,331,723.00	1,186,322,555.00	1,228,574,394.00
x5	0.59	0.68	0.80	0.58

Table 5: Calculation of Z-score of the company

Variable	Formula	Coefficient	GGRP 2020	GGRP 2021	GGRP 2022	GGRP 2023
x1	X_1 is the net working capital $((Cash+inv+AR)-(AP+ST\ debt+Accrued))/total\ assets$	1.2	0.10	0.18	0.19	0.20
x2	X_2 is accumulated retained earnings / total assets	1.4	0.04	0.12	0.17	0.20
x3	X_3 is profit before interest and taxes / total assets	3.3	0.21	0.41	0.33	0.30
x4	X_4 is the market value of equity/book value of debt	0.6	0.41	0.84	0.68	1.05
x5	X_5 is sales / total assets	0.99	0.59	0.67	0.79	0.57
			1.34	2.22	2.15	2.32

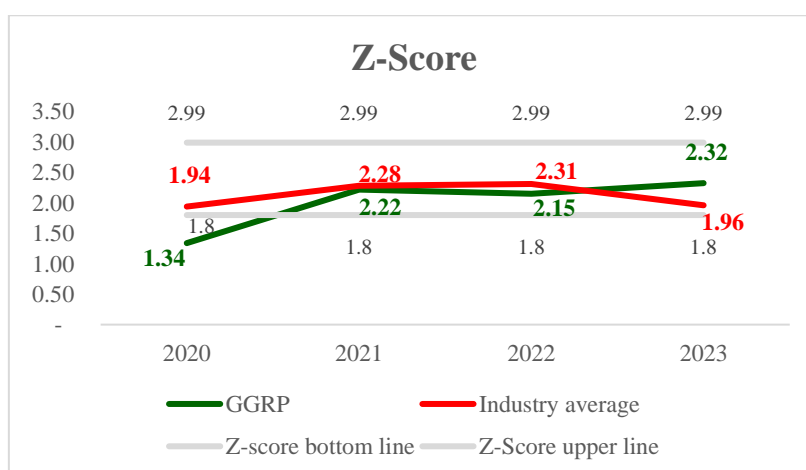


Figure 3: Graph calculation result of Altman Z-score of company

The Z-score model analysis reveals varying degrees of risk across different dimensions of the company, including liquidity, profitability, and solvency. The first variable, net working capital to total assets (X1), measures liquidity. Over the years, the company has improved its liquidity, indicating a positive trend in its short-term financial health. This suggests effective management of current assets and liabilities, enhancing its ability to meet short-term obligations.



The second variable, retained earnings to total assets (X2), reflects profitability and reinvestment. Although there was a temporary decline in 2022 due to the company's digital transformation, the overall trend remains positive, signaling robust profitability and reinvestment strategies. The third variable, EBIT to total assets (X3), indicates operating profitability. Fluctuations from 2020 to 2023 highlight a dynamic performance, with concerns raised by a decline in 2022 and 2023 potentially related to ongoing digital transformation. The fourth variable, total equity to total debt (X4), shows a generally positive trend, suggesting improved financial strength and effective capital management, though a slight decline in 2022 merits further analysis. Finally, the total sales to total assets ratio (X5) demonstrates fluctuating asset turnover efficiency, with recent declines indicating potential issues in asset utilization, which could adversely affect financial performance and the Z-score.

Further financial ratio analysis is performed to gain a comprehensive understanding of the company's financial risks, with a focus on profitability. This analysis evaluates five key profitability ratios: current ratio (liquidity), profitability ratio, debt to equity ratio (DER), operating cash flow ratio, inventory turnover, and quick ratio. The analysis is limited to the years 2020 to 2023, as the company went public in 2020. Additionally, the company's ratios are compared to the average performance of the steel manufacturing industry for each year to provide context.

Financial ratio	2020		2021		2022		2023	
	GGRP 2020	Industry average	GGRP 2021	Industry average	GGRP 2022	Industry average	GGRP 2023	Industry average
Current ratio (Liquidity)								
Current asset =	221,585,752.00	1.18	275,848,320.00	1.45	386,729,154.00	1.46	355,916,500.00	1.64
Current liabilities	187,709,345.00	1.17	190,390,645.00	1.63	265,334,188.00	1.77	217,322,064.00	1.94
Profitability ratio								
Gross profit =	34,480,102	0.06	104,816,226	0.17	88,390,343	0.09	78,779,594	0.11
Revenue	613,006,216	0.10	616,990,393	0.14	945,497,149	0.10	709,839,048	0.12
DER (Debt to equity) ratio								
Total debt =	243,396,313.00	0.35	211,697,563.00	0.28	171,542,150.00	0.21	134,288,233.00	0.15
Total equity	690,178,750.00	0.33	753,064,749.00	0.18	806,218,730.00	0.41	924,450,461.00	0.30
Operating cash flow ratio								
Operating cash flow =	78,565,657	0.32	107,119,962	0.51	78,565,657	0.46	107,119,962	0.80
Total debt	243,396,313	0.59	211,697,563	0.78	171,542,150	0.09	134,288,233	0.44
Inventory turnover								
COGS =	578,526,114	3.37	616,990,393	2.88	857,106,806	3.32	631,059,454	3.00
Inventory	171,415,958.00	5.51	213,958,721.00	5.15	258,231,840.00	5.09	210,257,987.00	4.91
Quick ratio								
(Current asset - Inventory) =	50,169,794.00	0.27	61,889,599.00	0.33	128,497,314.00	0.48	145,658,513.00	0.67
Current liabilities	187,709,345.00	1.18	190,390,645.00	1.07	265,334,188.00	1.02	217,322,064.00	1.15

Table 6: Calculation of financial ratio on PT Gunung Raja Paksi Tbk and compared to steel manufacturing industry average on year 2020 – 2023

The analysis of GRP's financial ratios reveals several key insights. The current ratio, which measures liquidity, has been improving steadily, indicating effective management of current assets and liabilities. However, compared to industry peers, GRP still needs to enhance its short-term liability management. The profitability ratio showed an increase in 2021 due to the IKN government project but declined afterward. This suggests that while GRP's profitability aligned with industry averages during the project, it fell short compared to peers afterward, indicating a need for better raw material management and production efficiency.

The Debt-to-Equity Ratio (DER) is decreasing, reflecting a positive trend in financial stability, suggesting that GRP is either reducing its debt or increasing its equity. This trend is beneficial for creditworthiness and financial flexibility. The operating cash flow ratio has remained strong, despite a slight decrease in 2022, demonstrating the company's ability to generate cash from operations effectively. The inventory turnover ratio indicates better cash collection through efficient inventory management compared to the industry average. Lastly, while GRP's quick ratio is rising, it remains below that of competitors, suggesting room for improvement in short-term liquidity management.

4.4 Construction of Early Warning System



On the first sub subchapter, corporate risk assessment is conducted resulting in the top 5 corporate risks and on the second sub subchapter, the financial risk analysis is conducted resulting in the company facing a great risk of profitability. Combining these two results of analysis will have the answer to decide which risk will be constructed in the early warning system. The analysis is shown in table 7:

Table 7: Risk prioritization based on qualitative and quantitative analysis

No	Risk	Risk Score	Risk Level	Financial dimension	Priority
1	Supply chain disruption	20	Extreme	Profitability	1
2	Volatility of Raw Material	16	Extreme	Profitability	2
3	Manpower incompetency	16	Extreme	Profitability	4
4	Major accident	15	Extreme	Profitability	5
5	Competition	15	Extreme	Profitability	3

Priority risks are identified by evaluating the highest risk scores and their impact on profitability, with supply chain disruptions emerging as the most significant risk. To address this, the company will prioritize developing an early warning system. This system will be constructed through focus group discussions with management to determine key indicators related to operational and financial aspects, specifically targeting supply chain disruptions and raw material volatility due to their high impact. Additionally, the company's strong financial results indicate a capable management team, with further analysis to be conducted by each department and the HR team.

For major accidents, the company has invested substantially in technology to enhance efficiency and ensure safe production processes. However, there is room for improvement in competitiveness. Financial results highlight a need to boost profitability and liquidity, which can be achieved by reducing raw material costs. Lower raw material costs are expected to contribute to higher profitability, thus improving the company's competitive position. Constructing the early warning system involves focus group discussions with management to agree on relevant indicators, encompassing both operational and financial aspects. The primary focus is on supply chain disruption and raw material volatility, as these are interconnected and have the highest impact. Each indicator has its own measurement unit and is categorized into three criteria values: Green, Yellow, and Red.

Table 8: The early warning signals for the risk of supply chain disruption.

Category	Indicator	Measurement	Green	Yellow	Red
Financial	RM Cost	% actual to target	≤ 97%	97%-100%	>100%
	Profitability	% actual to target	≥ 100%	95%-100%	<95%



Operational	Inventory level (excess/shortage)	% variance actual to target	0%	0%-10%	>10%
	Scrap receiving	% actual to target	0%	0%-10%	>10%
	Order fulfillment rate	% achievement	≥100%	95%-100%	<95%

4.5 Business Solutions

The proposed solutions are segmented into three distinct timeframes to ensure a structured and comprehensive approach to addressing the company’s challenges: short-term (1-6 months), mid-term (6-12 months), and long-term (1-3 years).

- Short Term (1-6 months):
 - a. Cost Reduction Initiatives: Conduct a thorough audit to identify and eliminate wasteful spending across all departments, ensuring immediate cost savings and improved financial performance.
 - b. Supplier Negotiations: Engage in negotiations with suppliers to secure better pricing and more favorable contract terms, reducing raw material costs and improving profit margins.
 - c. Enhanced Supplier Relationships: Strengthen relationships with suppliers through increased communication and rigorous performance monitoring, enabling early identification and mitigation of potential risks.
 - d. Inventory Optimization: Implement strategies to optimize inventory levels, reducing excess stock while ensuring the availability of critical materials to support uninterrupted production.
- Mid Term (6-12 months):
 - a. Product Differentiation Strategy: Develop and launch higher-value product lines to differentiate the company’s offerings in the market, thereby enhancing competitiveness and profitability.
 - b. Value Chain Optimization: Streamline production processes to achieve cost savings and operational efficiencies, enhancing overall productivity and reducing waste.
 - c. Supplier Diversification: Expand the supplier base to reduce dependence on single sources, thereby mitigating the risk of supply disruptions and enhancing supply chain resilience.
- Long Term (1-3 years):
 - a. Hedging Strategies: Implement hedging strategies to protect against raw material price fluctuations, ensuring greater financial stability and predictability.
 - b. Technological Advancements: Invest in advanced technologies to improve production efficiency and explore the use of alternative materials, reducing costs and enhancing product innovation.
 - c. Operational Efficiency Improvements:



Focus on reducing energy consumption and increasing yield rates through continuous improvement initiatives, leading to long-term cost savings and sustainability.

d. Research and Development (R&D):

Invest in R&D to explore and develop alternative materials and innovative processes, positioning the company at the forefront of industry advancements and enhancing its competitive edge.

5. CONCLUSIONS

PT Gunung Raja Paksi faces significant challenges in maintaining profitability, which impacts its overall financial health. Key risk factors include the volatility of raw material prices, intense competition within the steel industry, and economic downturns. Fluctuations in raw material prices affect production costs and profit margins. Rising raw material costs can squeeze margins unless passed on to customers, which is challenging in a competitive market. The competitive landscape requires the company to balance competitive pricing with quality, leading to potential price wars and further margin erosion. Additionally, economic downturns reduce demand for steel products, impacting sales volumes and revenues.

A detailed Z-score and financial ratio analysis shows that PT Gunung Raja Paksi's profitability metrics lag behind industry averages, indicating potential financial distress. This analysis, supported by the company's corporate risk assessment, identifies profitability as the highest priority risk due to its substantial impact on financial stability. To tackle these issues, the company plans to focus on mitigating supply chain disruptions, which can enhance profitability through cost reductions, improved production timelines, and better inventory management. By stabilizing and optimizing the supply chain, PT Gunung Raja Paksi aims to manage production costs more effectively and adapt to market demands more efficiently.

REFERENCES

1. CS, N., R, N. N., S, N., & Thangjam, N. R. (2018). THE RELEVANCE OF ALTMAN Z-SCORE ANALYSIS. *IJRAR - International Journal of Research and Analytical Reviews (IJRAR)*, 5(4), 233–240. <https://www.ijrar.org/download1.php?file=IJRAR190I024.pdf>
2. Naujok, N. and H. Stamm (2019). "Agility in Metals: Digital Transformation in the Steel and Aluminium Industry". Strategy&. PricewaterhouseCoopers.
3. Maulana, Mohamad T., and Yos Sunitiyoso. "Scenario Planning Development for PT Krakatau Steel." *Indonesian Journal of Business Administration*, vol. 1, no. 3, 2012.
4. Dickinson, Gerry. (2001). *Enterprise Risk Management: Its Origins and Conceptual Foundation*. The Geneva Papers on Risk and Insurance - Issues and Practice. 26. 360-366. 10.1111/1468-0440.00121.
5. Lam, J. (2003), *Enterprise Risk Management – From Incentives to Controls*. Wiley, Hoboken, NJ.
6. Miccolis, J. and Shah, S. (2000). *Enterprise Risk Management: An Analytic Approach*. Tillinghast-Towers Perrin, Parsippany, NJ
7. Loghry, J.D. and Veach, C.B. (2009). Enterprise risk assessments: holistic approach provides companywide perspective. *Professional Safety*, 31-35
8. Dionne, G. (2013). Risk management: History, definition, and critique. *Risk Management and Insurance Review*, 16(2), 147-166.
9. Abrams, C., J von, K., Müller, S., Pfitzmann, B., & Ruschka-Taylor, S. (2007). Optimized enterprise risk management. *IBM Systems Journal*, 46(2), 219-234.
10. Ivan K.W. Lai, & Henry C.W. Lau. (2012). A hybrid risk management model: A case study of the textile industry: IMS. *Journal of Manufacturing Technology Management*, 23(5), 665-680.
11. Altman, E. I., Iwanicz-Drozowska, M., Laitinen, E. K., et al. (2017). Financial Distress Prediction in an International Context: A Review and Empirical Analysis of Altman's Z-Score Model. *Journal of International Financial Management & Accounting*, 28(2), 131–171.
12. Padhan, Rakesh & kp, Prabheesh. (2019). EFFECTIVENESS OF EARLY WARNING MODELS: A CRITICAL REVIEW AND NEW AGENDA FOR FUTURE DIRECTION. *Buletin Ekonomi Moneter dan Perbankan*. 22. 457-484. 10.21098/bemp.v22i4.1188.



13. Lin, Jianxiong. (2021). Design of enterprise financial early warning model based on complex e 1.
14. Klopota I, Zoroja J, Meško M. Early warning system in business, finance, and economics: Bibliometric and topic analysis. *International Journal of Engineering Business Management*. 2018;10. doi:10.1177/1847979018797013mbedded system, Microprocessors and Microsystems, Volume 80.
15. Miles, M.B, Huberman, A.M, & Saldana, J. (2014). *Qualitative Data Analysis, A. Methods Sourcebook, Edition 3.* USA: Sage Publications
16. Swaen, B., and George, T. (2022). What is a Conceptual Framework? Tips and Examples. Retrieved on 6 June 2023 from <https://www.scribbr.com/methodology/conceptual-framework/>, Technological University Dublin Library Service (2023). Theories, Theoretical Perspective and Theoretical Framework. Retrieved on 17 June 2023 from https://tudublin.libguides.com/research_methods/Theoretical_Framework
17. Yameen, Mohd & Pervez, Asif. (2016). Impact of Liquidity , Solvency and Efficiency on Profitability of Steel Authority of India Limited. *International Journal of Accounting Research*. 2. 32-41. 10.12816/0033281.
18. Xie, Minhe. (2024). Financial Risk Analysis of Steel Enterprises Based on Z-score Model-Taking Gansu Jiugang Hongxing as an Example. *Highlights in Business, Economics and Management*. 33. 643-653. 10.54097/h34c7x84.
19. Lei Zhu, Menghao Li, N Metawa. (2021). Financial Risk Evaluation Z-Score Model for Intelligent IoT-based enterprises. *Information Processing and Management*, 58.
20. Li-Li, Y., Yi-Wen, Q., Hou, Y., & Zhao-Jun, R. (2022). A convolutional neural network based model for supply chain financial risk early warning. *Computational Intelligence and Neuroscience*:
21. CIN. Wang, A., & Yu, H. (2022). The construction and empirical analysis of the Company's financial early warning model based on data mining algorithms. *Journal of Mathematics*.
22. Bekasiewicz, A., & Koziel, S. (2016). Compact UWB monopole antenna for internet of things applications. *Electronics Letters*, 52(7), 492–494
23. Lee, S., Seo, K. K., & Hybrid, A. (2016). Multi-Criteria Decision-Making Model for a Cloud Service Selection Problem Using BSC, Fuzzy Delphi Method and Fuzzy AHP. *Wireless Personal Communications*, 86(1), 57–75.
24. Tong, Lili & Tong, Guoliang. (2022). A Novel Financial Risk Early Warning Strategy Based on Decision Tree Algorithm. *Scientific Programming*. 2022. 1-10. 10.1155/2022/4648427.

Cite this Article: Nazla Sagita Maharani, Raden Aswin Rahadi (2024). Leveraging Z-Score and Financial Ratio as Early Warning System to Mitigate Supply Chain Disruption at PT Gunung Raja Paksi TBK. International Journal of Current Science Research and Review, 7(9), 6889-6905, DOI: <https://doi.org/10.47191/ijcsrr/V7-i9-07>