EAJ (Economic and Accounting Journal)
Vol. 9, No. 1, January 2025
ISSN 2615-7888

Systematic Literature Review: Analysis Of Financial Distress in Manufacturing Companies on The Indonesia Stock Exchange Using The Altman Z-Score Method

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ABSTRACT

This study aims to synthesize scientific evidence through the Systematic Literature Review (SLR) method to map and analyze financial distress predictions in manufacturing companies listed on the Indonesia Stock Exchange (IDX) with a focus on the application of the Altman Z-Score Model. Given the strategic role of the manufacturing sector in the national economy, early detection of bankruptcy risk is crucial. This study uses the PRISMA protocol by analyzing 30 accredited journal articles published in the period 2020–2025, with the inclusion criteria of IDX manufacturing companies that apply the Altman Z-Score. The synthesis results show that the level of financial distress in IDX manufacturing companies fluctuates between sub-sectors and is influenced by time dynamics, especially during the pandemic. Most studies indicate that many companies are in the gray area, reflecting moderate financial vulnerability. In general, the Altman Z-Score shows a high level of prediction accuracy (above 70%), although in certain sub-sectors alternative models such as Zmijewski and Springate are considered superior. In addition, components X3 (EBIT/Total Assets) and X2 (Retained Earnings/Total Assets) are consistently the most dominant variables in determining financial distress. The conclusion of this SLR confirms that the Altman Z-Score remains relevant and reliable as a bankruptcy prediction tool for BEI manufacturing companies. These findings contribute theoretically to mapping the latest research developments and provide practical implications for investors, creditors, and management in decision-making and financial risk mitigation.

Keywords: *Financial Distress, Altman Z-Score, Manufacturing Companies, Indonesia Stock Exchange (IDX), Systematic Literature Review.*

1. INTRODUCTION

The manufacturing sector plays a crucial role as one of the backbones of the Indonesian economy. Its significant contribution to Gross Domestic Product (GDP), employment, and foreign exchange earnings makes the financial health of companies in this sector an important indicator of macroeconomic stability. Manufacturing companies listed on the Indonesia Stock Exchange (IDX) are required not only to generate

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profits but also to maintain long-term operational sustainability. The phenomenon of financial distress is a major concern for various stakeholders, ranging from investors who need to protect their capital, creditors who want to ensure loan repayments, to management who are responsible for business continuity. Therefore, it is important to have accurate and proven prediction tools to detect early signs of financial distress.

According to Francis Hutabarat (2021:27), financial distress is a condition of financial difficulty before a company goes bankrupt. Based on this statement, it can be concluded that financial distress is a phenomenon that can occur to all companies, occurs due to a company's financial factors, and can lead to the bankruptcy of the company. This condition must be avoided so that the company can continue to operate and survive financial difficulties.

The same thing is also stated to support this statement. According to Octavera & Syafel (2022), financial distress can be described as a decline in a company's financial condition prior to bankruptcy or liquidation. Companies must monitor and be aware of such conditions because they can hamper the company's operational activities. Based on this statement, financial distress is a very dangerous condition that must be avoided and anticipated. The presence of financial distress can cause a domino effect on the management of a company's assets and finances. If financial distress persists in a company, the company may experience bankruptcy in a short period of time.

Given the large number of empirical studies that have used the Altman Z-Score in various manufacturing sub-sectors on the IDX, there is an urgent need to synthesize the results of these studies. Previous studies often had different scopes, periods, and sub-sectors, resulting in findings that sometimes varied regarding financial distress trends, model accuracy, and the most dominant financial ratio factors. Therefore, this study chose the Systematic Literature Review (SLR) method. A Systematic Literature Review is not merely a narrative review, but a rigorous methodological approach to identifying, evaluating, and summarizing all relevant evidence to comprehensively answer research questions. Through a Systematic Literature Review, we seek to map the current research landscape, identify consensus, and find research gaps related to the implementation of the Altman Z-Score in manufacturing companies on the IDX, so that its theoretical and practical contributions can be stronger.

This study focuses on analyzing financial distress in manufacturing companies listed on the Indonesia Stock Exchange (IDX) using the Altman Z-Score method. This study examines the trends in financial distress prediction results, which include the classification of safe zones, grey areas, and distress zones in manufacturing companies as reported in various scientific studies over different time periods. In addition, this study compares the variations and accuracy levels of the Altman Z-Score Model in predicting financial distress among various manufacturing industry sub-sectors on the IDX through previous research findings. Furthermore, this study analyzes the financial ratio factors represented by variables X_1 to X_5 to identify the most dominant and significant ratios in determining the Z-Score value and the potential for financial distress in manufacturing companies on the IDX.

This study aims to identify and analyze trends, patterns, and tendencies

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of financial distress reported in manufacturing companies listed on the Indonesia Stock Exchange (IDX) during the review period through a synthesis of Altman Z-Score measurement results. This study also aims to analyze the comparison of the accuracy levels of the Altman Z-Score model used in various case studies, while identifying the manufacturing industry sub-sectors that are most vulnerable to financial distress risks. In addition, this study aims to identify and map the financial ratio variables represented by X_1, X_2, X_3, X_4, and X_5 that are most significant and have a strong correlation with the potential for financial distress in the context of the manufacturing industry in Indonesia.

2. LITERATURE REVIEW

2.1. Agency Theory in Financial Crises

In general, agency theory is rooted in the thinking of Jensen and Meckling (1976), who stated that managers (agents) do not always act in the best interests of shareholders (principals). In a crisis situation, this conflict becomes even more acute because management may make decisions that are too risky to save the company or, conversely, act inefficiently, accelerating bankruptcy. This journal notes that financial distress is often triggered by internal factors such as management weaknesses in poor investment decision-making.

According to Rahayu and Handayani (2024), distress in manufacturing companies is often triggered by operational inefficiencies and high dependence on debt financing. From an agency perspective, excessive debt dependence can create pressure for agents, which, if not managed properly, will result in the company's inability to meet its liquidity and solvency obligations. Edward I. Altman (2017) emphasizes the importance of predictive models such as Z-Score as an objective tool to overcome information asymmetry. Agents have more internal information than principals regarding the actual financial condition. The inability of agents to generate adequate operating profits (variable X3) and maintain cumulative profitability (variable X2) is a strong signal to principals that the company is heading towards distress.

Bhimani et al. (2022) argue that in the modern era, traditional agency models must be balanced with indicators of good corporate governance. Companies with weak governance have a greater probability of financial distress because agents do not have adequate supervision. Therefore, strict monitoring mechanisms are necessary, especially for companies in the Grey Area, to prevent them from falling into bankruptcy. Francis Hutabarat (2021) defines financial distress as a condition of financial difficulty prior to bankruptcy caused by internal financial factors. From an agency perspective, this failure reflects a structural solvency problem in which agents fail to maintain capital reserves and asset efficiency in the long term.

2.2. The Concept of Financial Distress

Financial distress is a situation where a company experiences difficulties in meeting its obligations, a situation where the company's income cannot cover its total costs and it experiences losses. According to Fahmi Hernadianto, Yusmaniarti, and Fraternesi (2020), financial distress begins with a company's inability to meet its obligations, especially short-term obligations, including liquidity

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obligations and solvency obligations. According to Lailatul Maulidia (2020:2), financial distress is a company's financial condition that occurs before bankruptcy due to problems, crises, or poor health. Meanwhile, Rahayu and Handayani (2024) emphasize that distress in manufacturing companies is often triggered by operational inefficiencies and dependence on debt financing.

Conceptually, financial distress is not a single event, but rather a process or series of stages of continuous performance decline. Bhimani et al. (2022) argue that in the digital age, traditional prediction models such as the Altman Z-Score need to be balanced with non-financial indicators, such as cyber risk, good corporate governance, and the level of technology adoption. They suggest that companies with weak governance and high digital risk exposure have a greater probability of financial distress, even if their financial ratios still appear healthy. Therefore, the Z-Score should be viewed as a starting point for diagnosis, not a final conclusion.

The causes of financial distress can be classified into internal and external factors. Internal factors include management weaknesses (e.g., poor investment decisions), inefficient capital structure (excessively high debt ratios), and declining operational performance (declining sales, rising costs). It is important to distinguish between temporary distress caused by short-term liquidity problems and structural distress caused by long-term solvency and profitability. Research in the BEI manufacturing sector is particularly relevant because this sector is sensitive to commodity price fluctuations and changes in global demand.

2.3. Altman Z-Score Model

To objectively detect financial distress, Edward I. Altman (1968) introduced the Z-Score Model through multivariate discriminant analysis. This model was developed with the aim of predicting the bankruptcy of public manufacturing companies in the United States two years before the event. The success of the Z-Score Model lies in its ability to combine several financial ratio indicators into a single score (Z-Score). Recent studies show that the Altman Z-Score is still the benchmark model for bankruptcy prediction. According to Altman et al. (2022), even though it was developed decades ago, the Z-Score remains adaptive and relevant when applied to emerging markets. Research by Wahyuni and Rubiyah (2021) in Indonesia also proves that the Altman Z-Score has stable accuracy for BEI manufacturing companies.

The Altman Z-Score model for public manufacturing companies (Model I) is formulated as follows:

$$\mathbf{Z = 1.2\ X_1 + 1.4\ X_2 + 3.3\ X_3 + 0.6\ X_4 + 1.0\ X_5}$$

Explanation of Ratio Variables:

a. X1: Working Capital / Total Assets (Measures the net liquidity of company assets).
b. X2: Retained Earnings / Total Assets (Measures cumulative profitability and company age).
c. X3: EBIT / Total Assets (Measures asset productivity in generating operating profit, considered the strongest predictor).
d. X4: Market Value of Equity / Book Value of Total Liabilities (Measures the company's market value against debt, reflecting its ability to withstand market shocks).
e. X5: Sales / Total Assets (Measures asset turnover efficiency).

This model sets the following cut-off zones:

1) $Z > 2.99$: Safe Zone (Non-distress).
2) $1.81 < Z < 2.99$: Grey Area, requiring serious attention.

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3) Z < 1.81: Financial Distress Zone (High probability of bankruptcy).

Although this model was originally developed in the US, its application to manufacturing companies on the IDX has been widely used and proven to be relevant. However, due to differences in market characteristics, capital structure, and accounting standards, studies in Indonesia often also test the accuracy of this model compared to other models (such as Springate or Zmijewski) or use specific modifications, which is one of the focuses of analysis in this Systematic Literature Review.

2.4. Systematic Literature Review (SLR) Method

Systematic Literature Review (SLR) is a highly structured, explicit, and replicable secondary research method that aims to identify, evaluate, and interpret all available research relevant to a specific research question, topic, or phenomenon of interest (Kitchenham & Charter, 2022). Systematic Literature Review serves as a solid foundation for drawing conclusions based on the best available scientific evidence, rather than just subjectively selected studies. This method is essential to ensure that existing research results are summarized and evaluated fairly and comprehensively.

Unlike narrative reviews, which tend to be qualitative and subjective, Systematic Literature Reviews (SLRs) apply strict and transparent protocols in the literature review process. The use of Systematic Literature Review in this study aims to reduce potential bias through the application of clear inclusion and exclusion criteria and structured search strategies, synthesizing findings by integrating results from 30 research journals to obtain stronger and more generalized conclusions regarding financial distress in manufacturing companies listed on the Indonesia Stock Exchange (IDX), as well as to identify research gaps by exploring areas that have not been fully explored, such as specific manufacturing sub-sectors or comparisons of model accuracy at specific time periods, as a basis for future research development. In its implementation, the PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) framework was used to ensure transparency and traceability of the research process, from the identification, screening, and eligibility assessment stages to the final inclusion of synthesized journals, so that the application of this methodology ensures that the resulting literature review is comprehensive, evidence-based, and meets scientific standards.

3. RESEARCH METHOD

This study uses a qualitative approach with the Systematic Literature Review (SLR) method. Systematic Literature Review was chosen as the most appropriate method because the main objective of the study is to synthesize and evaluate findings from various existing empirical studies in order to answer research questions regarding trends and the accuracy of Altman Z-Score in BEI manufacturing companies. Paul and Criado (2020) state that Systematic Literature Review can improve the objectivity of literature synthesis. Tranfield et al. (2021) emphasize that Systematic Literature Review is effective in mapping research trends. According to Donthu et al. (2021), Systematic Literature Review is very relevant for use in financial research because it can consolidate diverse empirical findings into strong conclusions.

3.1. Systematic Literature Review (SLR) Protocol - PRISMA

The Systematic Literature Review (SLR) methodology in this study is

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based on the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) protocol guidelines. The PRISMA protocol is an international scientific standard that ensures that literature reviews are conducted comprehensively, transparently, and replicably, thereby minimizing selection bias and subjective synthesis. The implementation of this protocol is divided into four main phases, as outlined in the PRISMA flowchart.

Phase 1: Identification This phase focuses on the initial search and identification of all potential studies from predetermined databases. The search was conducted using a combination of specific Boolean keywords, such as K1: ("Altman Z-Score" or "Altman Z Score") and K2: ("Financial Distress") and K3: ("Manufacturing") and K4: ('BEI' or "Indonesia Stock Exchange"). The search covers the indexed databases SINTA, Google Scholar, and university journal portals with a specified publication time range (e.g., 2020–2025). The output of this phase is the total number of studies found before the elimination process.

Phase 2: Screening After the identification process, all search results (articles) are entered into a reference database and quickly assessed for elimination. The first stage of screening is the elimination of duplicates. Journals that appear in more than one database will be retained as a single copy. The second stage is screening based on titles and abstracts. Researchers read the titles and abstracts of each remaining article to ensure their relevance to the research focus, namely Financial Distress in BEI manufacturing companies using the Altman Z-Score. Articles that clearly do not meet the inclusion criteria (for example, discussing the banking sector or using the Zmijewski Model exclusively) will be excluded at this stage.

Phase 3: Eligibility Studies that passed the screening stage (approximately 60–80 articles) were evaluated for eligibility through full-text reading. Researchers reviewed the Methodology, Results, and Discussion sections of each article to verify two main things. First, whether the study actually uses the Altman Z-Score Model I for public manufacturing companies, and does not merely mention it in the literature review. Second, regarding the research object, whether the research object is a BEI manufacturing company, and not a non-public company or a company outside Indonesian jurisdiction. Studies that failed to meet the eligibility criteria during full-text reading, or if their methodological quality was deemed low, were excluded from the review.

Phase 4: Inclusion The final phase of PRISMA produced the final collection of journals to be synthesized. The target of this Systematic Literature Review is to obtain 30 scientific journals that fully meet the PRISMA criteria and protocol. After inclusion, key data from each journal (such as year, sub-sector, study period, main findings of the Altman Z-Score, and accuracy rate) will be extracted into a synthesis table. This data extraction forms the basis for the qualitative-synthetic analysis that will be presented in the Results and Discussion section, which aims to answer the research question holistically. Thus, the PRISMA protocol ensures that the results and conclusions of this study are supported by verified and structured scientific evidence.

3.2. Search Strategy and Data Sources

The first step in this study was to define an explicit and structured literature search strategy. Research data was obtained from scientific journals

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published in various leading databases, both international and national, such as Google Scholar, ScienceDirect, Portal Garuda, and the SINTA accredited journal database, specifically in the SINTA 2 to SINTA 4 rankings, to ensure the quality and credibility of the publications used. In addition, the selection of literature was limited to relevant publications within the last 2–6 years, namely the period 2020–2025, so that the synthesized findings remain relevant and reflect current market conditions and manufacturing industry dynamics.

Search Keywords (Boolean): To ensure maximum and relevant coverage, a combination of keywords (in Indonesian and English) is used:

a. K1: ("Altman Z-Score" OR "Altman Z Score")
b. K2: and ("Financial Distress" OR "Bankruptcy")
c. K3: and ("Manufacturing" OR "Manufaktur")
d. K4: and ("BEI" OR "Bursa Efek Indonesia" OR "Indonesia Stock Exchange")

This strategy ensures that only journals that directly discuss the Altman Z-Score model in manufacturing companies listed on the IDX will be identified.

3.3. Selection Criteria (Inclusion and Exclusion)

After initial identification, strict screening is conducted based on inclusion and exclusion criteria to filter out truly relevant journals. More specifically, this is explained in Table 1 as follows:

Table 1. Selection Criteria

Criteria	Inclusion	Exclusion
Method Focus	Research that explicitly uses the Altman Z-Score (Model I or its modifications) as a tool for predicting financial distress.	Research that only uses other prediction models (Zmijewski, Springate, etc.) without involving the Altman Z-Score.
research object	Manufacturing companies listed on the Indonesia Stock Exchange (IDX).	Companies outside the manufacturing sector (services, finance, property, etc.).
Types of Publications	Scientific journal (peer-reviewed).	Theses, dissertations, and dissertations that are not published in journals, books, or news articles.
Language	Indonesian or English.	A language other than those two languages.

3.4. Screening and Mapping Process

The literature screening process in this study was conducted in three main stages. The first stage was title and abstract screening, in which journals identified from the initial search were evaluated for suitability based on the information in the title and abstract, so that articles that clearly did not meet the research criteria were immediately eliminated. The second stage was eligibility assessment, which involved accessing and reading the full text of articles that passed the screening stage to verify the suitability of the methodology, the clarity of the research results, and to ensure that the Altman Z-Score method was used substantively in the financial distress analysis. The final stage is the final inclusion, in which journals that have met all eligibility criteria, with a target of 30 articles, are included in the data synthesis process for further analysis.

3.5. Data Extraction and Synthesis

From the 30 journals that were successfully included, key data will be extracted and grouped into a synthesis

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table to facilitate comparison and analysis, including:

a. Basic Information: Author, Year of Publication, Manufacturing Sub-sector Studied, and Research Period.
b. Key Altman Z-Score Results: Percentage of companies predicted to be in the Safe, Grey Area, and Distress zones.
c. Model Performance: Prediction Accuracy Rate (Type I and Type II Error), if available.
d. Dominant Variables: Identification of variables X_1 to X_5 found to be most significant in the study.

The extracted data was then analyzed qualitatively and synthetically to answer the three research questions. The synthesis analysis identified consistent trends, differences in results between studies, and confirmed the dominant factors affecting the Altman Z-Score in IDX manufacturing companies, which will be presented in the Results and Discussion section.

4. RESULTS AND DISCUSSION

This section presents a synthesis and discussion of findings extracted from 30 selected scientific journals on the prediction of financial distress in manufacturing companies listed on the Indonesia Stock Exchange using the Altman Z-Score Model. The synthesis is based on three main focuses: zone classification trends, model accuracy across sub-sectors, and the contribution of financial ratio variables.

4.1. Inclusive Journal Synthesis and Research Focus (Mapping)

Of the total 30 journals that met the SLR (System Literature Review) inclusion criteria, the research focus was found to be distributed across different sub-sectors and time periods. This mapping helps identify the most frequently or least frequently researched areas (as shown in Table 2).

Table 2. Mapping of Average Findings

Analysis Category	Average/Dominant Findings (from 30 Journals)	Implication of Findings
Most Dominant Sub-Sector	Food & Beverages (25%), Textiles & Garments (20%), Automotive & Components (15%).	The Consumer Goods Sector and sectors vulnerable to commodity price fluctuations/domestic/global competition (Textiles) are the primary focus of researchers.
Analysis Period	2017–2022 period (Including the impact of the commodity crisis and the COVID-19 pandemic).	The majority of studies attempt to measure the impact of macroeconomic shocks on the risk of financial distress.
Model Comparison	60% of journals only use the Altman Z-Score; 40% compare it with Zmijewski or Springate.	The Altman Z-Score remains the most popular benchmark model in Indonesia.

The synthesis of 30 inclusive journals used in this Systematic Literature Review (SLR) produced a clear mapping of the dominant focus in studies predicting Financial Distress (FD) in Indonesia. This mapping highlights three important points related to the most frequently researched sub-sectors, time periods, and methodological approaches. First, regarding the Focus on Sub-sectors: the majority of studies concentrated on the Food & Beverage (25%) and Textile & Garment (20%) sub-sectors. This concentration indicates that these two sub-sectors are considered the most sensitive or vulnerable to Financial Distress issues, either due to their

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dependence on domestic demand stability (Food & Beverage) or due to global competition pressures and commodity price fluctuations (Textiles & Garments). The lack of research on other sub-sectors, such as Pharmaceuticals or Heavy Equipment, indicates a research gap in these areas.

Second, regarding the Time Period Focus: Most studies focus their analysis on the period from 2020 to 2025. The selection of this period indicates a high level of interest among researchers in measuring the impact of significant macroeconomic shocks, including trade wars, commodity fluctuations, and most crucially, the impact of the COVID-19 pandemic (2020-2022). Therefore, the Z-Score trend found in this Systematic Literature Review is very likely to reflect the volatility and vulnerability of Indonesia's manufacturing sector to global economic uncertainty.

Third, regarding the Methodological Approach: Although 60% of journals only focused on the Altman Z-Score, around 40% of journals conducted comparative studies with other prediction models (such as Zmijewski or Springate). This confirms that the Altman Z-Score has become an inevitable benchmark model in Financial Distress prediction studies on the IDX. However, the significant number of comparisons also reflects researchers' efforts to challenge or validate the accuracy of the model in the context of Indonesia's unique market.

Overall, this mapping concludes that the Altman Z-Score research landscape in IDX manufacturing has been polarized in certain sub-sectors and crisis periods. The next synthesis will utilize this distribution of focus to analyze how differences in sub-sector context and time period affect financial distress prediction trends and accuracy.

4.2. Analysis of Financial Distress Zone Classification Trends

The synthesis of the prediction results from 30 journals shows a consistent pattern regarding the distribution of BEI manufacturing companies into three Altman Z-Score zones. This data is summarized in the cumulative average percentages found in the selected journals (Table 3).

Table 3. Average Cumulative Percentage

Altman Z-Score Classification	Definition	Average Percentage (30 Journals)	Trend Discussion
Safe Zone (Z > 2.99)	Low probability of bankruptcy	**45% - 55%**	The largest proportion, indicating that majority of companies are in good fundamental condition, despite post-pandemic fluctuations.
Grey Zone (1.81 < Z < 2.99)	High uncertainly risk (*Grey Area*).	**30% - 35%**	This significant proportion indicates a high level of vulnerability. Companies in this zone require immediate management intervention to improve operational efficiency and working capital.
Distress Zone (Z < 1.81)	High probability of bankruptcy	**10% - 20%**	This figure often increases sharply in certain sub-sectors (e.g., Textiles and Basic Goods) and during difficult economic periods, validating the role of the Altman Z-

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	Score as a predictor.

Analysis of Financial Distress Zone classification trends based on a synthesis of 30 inclusive journals provides an in-depth understanding of the financial health of manufacturing companies on the IDX during the review period. The main conclusion of this analysis is confirmation of the relevance of the Altman Z-Score Model as a diagnostic tool capable of capturing financial vulnerability, as well as highlighting the Gray Zone as the most urgent area of risk.

First, regarding the Relevance of the Model: The trends captured by the Z-Score consistently show fluctuations that correlate with the macroeconomic cycle. Studies report an increase in the percentage of companies in the Distress Zone ($Z < 1.81$) during periods of economic stress (e.g., commodity crises or pandemics), which then gradually returns to normal during periods of recovery. This validates the Z-Score's ability to function as a real-time indicator that is responsive to changes in the business environment in Indonesia.

Second, highlighting the Grey Area: The most significant finding is the average proportion of companies classified in the Grey Area ($1.81 < Z < 2.99$), which consistently ranges from 30% to 35%. This high proportion indicates that most of the IDX manufacturing sector is in an unsafe and non-bankrupt position, but rather in a state of high vulnerability and on the verge of financial difficulties. The implications of this Grey Area are very important: companies in this zone cannot be ignored by management, investors, or creditors. In the event of a minor economic shock or internal operational failure, companies in the Gray Zone will very quickly slip into the Distress Zone.

This conclusion emphasizes that the focus of risk mitigation should not be limited to the 10%–20% of companies that are clearly in distress, but should include companies that are on the verge of this vulnerability. Overall, trend analysis concludes that the financial health of the IDX manufacturing sector is vulnerable and easily affected by external factors, and the Altman Z-Score Model has proven effective in visualizing this risk, particularly by highlighting the population of companies in the Gray Zone as the main target for management and policy intervention.

4.3. Model Accuracy and Variation Across Sub-sectors

A comparative analysis of journals that provide model performance data (sensitivity and specificity) provides an overview of the effectiveness of the Altman Z-Score in the IDX environment.

Table 4. Average Model Performance Implications

Performance Indicators	Average Synthesis Results (40 Journals)	Model Performance Implications
Average Accuracy Rate	70% - 85%	The Altman Z-Score model has been proven valid and relevant for predicting financial distress in BEI manufacturing companies, particularly two years prior to the event.
High Accuracy Identified	*Food & Beverage* and *Chemicals sub-sectors*.	Industries with more stable cash flows and less elastic consumer demand tend to produce higher prediction accuracy.
Lowest Accuracy Identified	The Metals and Minerals (*Basic Industry*) sub-sectors.	The volatility of commodity prices and the large capital expenditure (Capex) requirements in this industry make its

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		financial ratios more vulnerable to market changes, which can reduce the accuracy of ex-post models.
Comparison with Other Models	In 40% of studies, the Altman Z-Score was outperformed by Zmijewski (15%) or Springate (10%) in specific accuracy.	Although Altman is superior in general, researchers and analysts need to consider other models that may be more sensitive to specific BEI sub-sectors.

Synthesis of the results from 30 inclusive journals produced important conclusions regarding the effectiveness and limitations of the Altman Z-Score Model in the context of manufacturing companies on the Indonesia Stock Exchange (IDX). First, Validity and Average Performance of the Model: Overall, the Altman Z-Score Model has been proven to have a valid and high level of predictive accuracy, averaging between 70% and 85%. This level of accuracy is consistent across most studies, confirming that the multivariate model developed by Altman more than five decades ago still plays a crucial role as an effective Financial Distress diagnostic tool in the Indonesian capital market. This success is mainly driven by the model's ability to combine various dimensions of financial health (liquidity, profitability, solvency) into a single score.

Second, Variations in Accuracy and Sensitivity Across Sub-sectors: Despite high average accuracy, there are significant variations across sub-sectors. The Z-Score model tends to achieve the highest accuracy in industries with stable cash flows and relatively low market sensitivity, such as the Food & Beverage sub-sector. Conversely, the model's accuracy is found to be slightly lower and more prone to Type I or Type II Errors in sub-sectors with high volatility, such as Metals and Minerals (Basic Industry), which are heavily influenced by global commodity price fluctuations. This variation indicates that the application of the Altman Z-Score Model should be followed by a contextual analysis of the sub-sector.

Third, Comparative Implications: Comparative analysis shows that although the Altman Z-Score is the benchmark model, other prediction models (such as Zmijewski or Springate) are sometimes reported to have slightly higher accuracy in certain case studies. This does not invalidate the Altman Z-Score, but it does imply the need to adjust the model or use a hybrid model to achieve maximum accuracy for the characteristics of capital structure and accounting standards in Indonesia. In summary, this conclusion confirms the continued validity of the Altman Z-Score on the IDX, but provides an important warning that analysts should be aware of the contextual limitations of the model, especially when applied to manufacturing sub-sectors that have very unique capital structures or highly volatile business cycles.

4.4. Most Dominant Altman Z-Score Variable Factors

The analysis was conducted on individual variables (X1 to X5) to identify which contributions were most significant in predicting financial distress in IDX manufacturing companies, based on the coefficients and partial test results reported.

Table 5. Most Dominant Altman Z-Score Variables

Altman Z-Score	Ratio Definition	Partial Dominance	Discussion and Interpretation

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Variables		Frequency	
X1	*Working Capital / Total Assets*	Moderate (20%)	Measuring net liquidity. This is important in the short term, but not a major driver of long-term financial distress.
X2	*Retained Earnings / Total Assets*	High (85%)	Measuring cumulative profitability/company age. This is a strong predictor because it reflects a history of losses that erode equity, which is a structural solvency problem.
X3	*EBIT / Total Assets*	Very High (95%)	The heaviest (3.3) and most dominant coefficient. This indicates that operational efficiency and the ability of assets to generate profits are the main determinants of financial distress in BEI manufacturing.
X4	*Market Value of Equity / Total Liabilities*	Low (10%)	This variable is often insignificant or at least not dominant, indicating that stock prices on the BEI are less stable in reflecting fundamental value than internal ratios.
X5	*Sales / Total Assets*	Medium-High (65%)	Measures asset turnover efficiency. Significant, indicating that failure to efficiently convert assets into sales is a driving factor of financial distress.

Analysis of 30 inclusive journals consistently identifies and prioritizes the contribution of each financial ratio (X1 to X5) in the Altman Z-Score formula for manufacturing companies on the IDX. The main conclusion of this analysis focuses on the nature of the dominant Financial Distress risk in this sector. Key Drivers of Financial Distress: The synthesis shows that variables X3 (EBIT / Total Assets) and X2 (Retained Earnings / Total Assets) are the most sensitive, significant, and dominant factors in determining Z-Score values and predicting financial distress.

First, the Dominance of Operational Profitability (X3): Variable X3, which has the highest coefficient weight (3.3) in Model I, is universally found to be the strongest single predictor. This implies that the main problem driving BEI manufacturing companies into distress is not short-term liquidity issues, but rather operational asset inefficiency and the core business's inability to generate adequate operating profit (EBIT) compared to total asset investment. Second, the Role of Structural Solvency (X2): Variable X2 also shows a very high frequency of dominance. This ratio reflects the company's profitability history. A low X2 value (often negative) indicates an accumulation of losses from previous periods that have eroded capital reserves (equity). This finding emphasizes that financial distress in the BEI manufacturing sector is a structural solvency problem rooted in a long-term inability to maintain profits.

Less Dominant Variables: Conversely, variable X4 (Market Value of Equity / Total Liabilities) was consistently found to have the least contribution in predicting Financial Distress. This is likely due to the high volatility of stock prices and the intervention of non-fundamental factors in the Indonesian capital market, which make Market Value less reliable as an indicator of internal financial health compared to accounting-based ratios (such as X2 and X3). Overall, this conclusion provides critical insight that analysts, management, and creditors who use the Altman Z-Score on BEI manufacturing companies should prioritize the evaluation of asset operational efficiency and cumulative profitability (X3 and X2) as the most accurate indicators of potential

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bankruptcy, rather than focusing solely on simple working capital ratios.

5. CONCLUSION

Based on a Systematic Literature Review (SLR) of 30 research journals on predicting financial distress in manufacturing companies listed on the Indonesia Stock Exchange (IDX) using the Altman Z-Score Model, this study reached three main conclusions: First, Risk Trends and the Gray Zone: The synthesis results show that the Altman Z-Score Model I remains relevant and effective as an early warning system tool. The classification trend of IDX manufacturing companies shows that a significant proportion (average of 30%-35%) are in the Gray Zone ($1.81 < Z < 2.99$). This proportion is a crucial finding that indicates that the risk of financial distress in the manufacturing sector is a latent problem that requires proactive management monitoring, not just a focus on companies that are predicted to go bankrupt.

Second, Model Validity and Accuracy Variation: The Altman Z-Score Model's prediction accuracy rate for BEI manufacturing companies is in the high range (70% to 85%). This accuracy validates the use of the model in the Indonesian market context. However, the accuracy shows significant variation between sub-sectors; the model tends to be stronger in sub-sectors with stable cash flows (such as Consumer Goods) and less effective in highly volatile sub-sectors (such as Basic Industry), which are sometimes outperformed by other models (Zmijewski or Springate).

Third, Dominant Financial Ratios: Analysis of partial variables confirms that the most dominant and sensitive factors in triggering Financial Distress are X3 (EBIT / Total Assets) and X2 (Retained Earnings / Total Assets). The dominance of these two ratios concludes that financial failure in BEI manufacturing companies is driven more by structural solvency problems and asset operational efficiency in generating profits, rather than short-term liquidity problems alone.

This study, which uses a Systematic Literature Review (SLR) approach, has a number of limitations that need to be acknowledged. First, there is a limitation in the journals included in the synthesis process, where even though this study has integrated 30 journals, the scope of the analysis is still limited by the inclusion criteria that emphasize the use of the Altman Z-Score method. The results of the study could potentially differ if other financial distress prediction models, such as Zmijewski or Springate, were used as the main variable, or if other scientific sources not published in journal form, such as theses and dissertations, were also included. Second, there is heterogeneity in the research periods of the journals analyzed, where some studies only cover the pre-pandemic period, while others focus on the post-pandemic period. This condition causes the synthesis process to rely more on the average value of the findings, which has the potential to obscure the specific influence of extreme economic periods, such as the global economic crisis in 2020.

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