DEVELOPMENT OF START-UP COMPANY FINANCIAL HEALTH PREDICTION APPLICATION USING Z-SCORE MODIFICATION METHOD WITH SDLC APPROACH

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Abstract: CV Bee Digital Prestasi Nusantara is a start-up company in Indonesia. To maintain its existence, CV Bee must be more careful with the condition of its financial health. This is due to the high percentage of start-up company failures caused by capital problems and the inability of resources to manage them. This study aims to overcome these problems, by designing an application prototype to predict the financial health of start-up companies to provide early warning, support company acceleration, and anticipate bankruptcy. This application prototype is designed using the SDLC Waterfall method approach because it uses a systematic and sequential flow with the PHP Native programming language, while the calculation of financial health uses the Modified Z-Score method. From the 9 quarters studied, it was found that in the 5th quarter the company obtained the highest Z-Score, which was 5.025. This value indicates that in this quarter the company is in a healthy financial condition. The results of this study are prototype of a financial health prediction application, and based on white box testing, no failures were found in the application's functional testing process. With this application, it is hoped that start-up companies will find it easier to know the condition of their financial health, be able to provide policy recommendations and actions that must be taken. So that start-up companies, especially CV Bee Digital Prestasi Nusantara, can have better financial conditions to maintain their company's existence.

Keywords: financial health, altman z-score modification, sdlc

INTRODUCTION

The development of the current digital era 4.0, increasing business activities both locally and internationally. This is marked by the emergence of several companies that are just developing and offer products or services that have never been offered to the market, which are known as start-ups. The number of start-ups in Indonesia has grown significantly. However, the development of local startups in Indonesia in the early stages of development is still not consistent so that most local start-ups fail.

A start-up is a company or human institution designed to develop products or services in a sustainable manner in environmental conditions that have external uncertainties (Adhrevi & Wessiani, 2018). Based on a survey conducted by Small Business Trends, global start-ups have low business resilience. This is indicated by approximately 50% of start-ups globally experiencing failure in the first four years of development (Adhrevi & Wessiani, 2018). In addition, according to Startup Genome data by Kotashev in failory.com (2022), it is reported

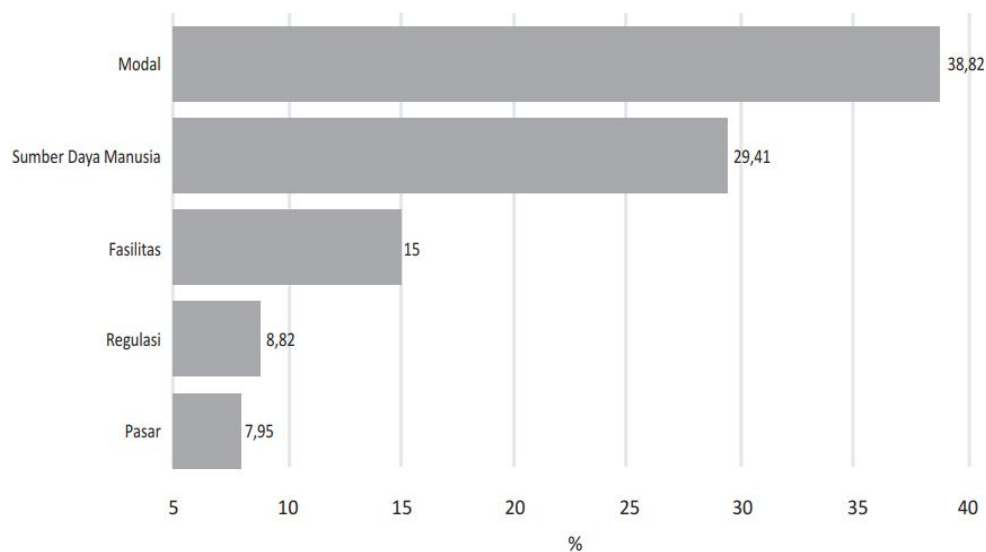*Corresponding Author.
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Figure 1 Graph of Startup Business Problems in Indonesia
Source: Based on Bekraf and MIKTI Survey (2018)

that 9 out of 10 startup companies fail to run operations and make a profit.

According to the Bekraf and MIKTI Survey (2018) which is shown in Figure 1, working capital or capital and the inability of human resources to manage it are the two main causes of failure of start-up businesses in Indonesia. And based on Kotashev (2022) shown in Figure 2, it is explained that finance occupies the 4th position with a percentage of 16%. It was even reported in Dailysocial.id that at least 4 start-up companies had to go out of business because they were unable to manage their finances prop-

erly, namely Paraplou, Wework, MoviePass, and ODG. Therefore, it is very important for other start-ups to pay attention to the level of their financial health condition to maintain the existence of their company.

Financial soundness level is an assessment of the company's financial health condition within a certain period in accordance with applicable regulations and indicators. This level of soundness analysis needs to be done to assess the company's financial health so that it can anticipate the possibility of bankruptcy and failure of a company.

Table 1 Condition of SGR vs Growth in Sales

No.	Period	Sales Growth	SGR	Cash Surp/Def
1	KW 1	22,83%	9,88%	-12,94%
2	KW 2	-4,20%	4,00%	8,21%
3	KW 3	-0,77%	2,92%	3,69%
4	KW 4	5,34%	11,09%	5,75%
5	KW 5	15,91%	40,87%	24,96%
6	KW 6	-9,52%	15,52%	25,04%
7	KW 7	-19,12%	-14,82%	4,30%
8	KW 8	-3,30%	-18,83%	-15,53%
9	KW 9	4,05%	-13,90%	-17,95%

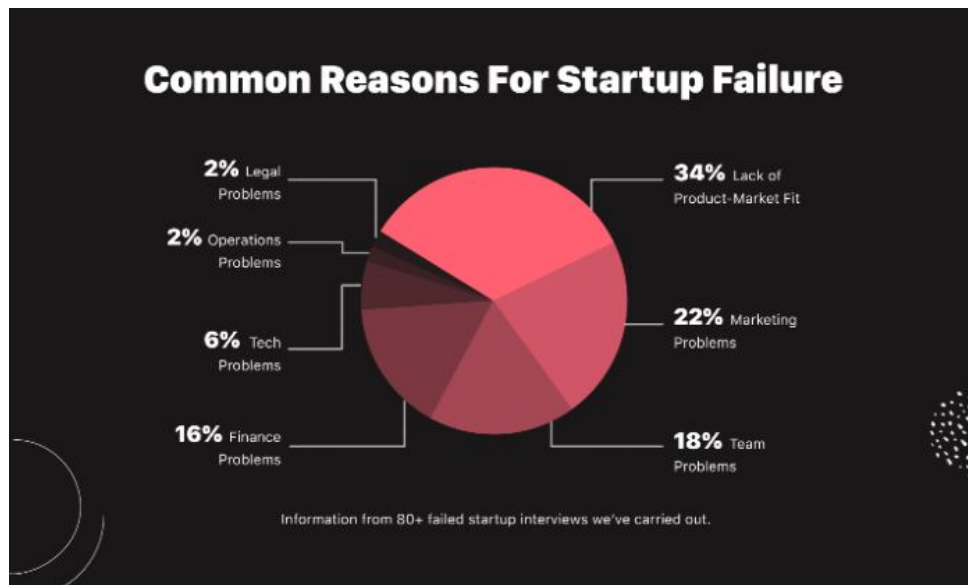Source: Based on author's data processing

Figure 2 Reasons for Startup Failure
Source: Kotashev (2022)

Bankruptcy of a company begins with financial failure or financial distress. Start-up companies are companies that must be aware of the condition of their financial health. This is because the environmental conditions of start-up companies are very extreme and also the high probability of company bankruptcy due to failing to manage finances properly. Celli (2015) defines that financial distress is the stage of decreasing financial condition before bankruptcy or liquidation occurs. This condition is generally characterized by uncertainty in future profitability and the company's inability to pay maturing obligations (Kurniawansyah & Agustia, 2021).

There are several analytical methods that can be used as a measuring tool and predict the level of health and the possibility of company bankruptcy. The methods are Altman Z-Score method, modified Altman Z-Score method, Grover method, Springate method, Ohlson method, Wang and Chambel method, and Zmijewski method. From some of these methods, the researcher chose to use the modified Altman Z-score method because this method was deliberately developed from the previous

Table 1 Condition of SGR vs Growth in Sales

No.	Period	NOPAT	IC	WACC	EVA
1	KW 1	Rp 8.943.038	Rp 189.430.638	-0,469%	Rp 9.832.364
2	KW 2	Rp 4.186.445	Rp 198.717.083	-0,294%	Rp 4.770.866
3	KW 3	Rp 3.187.161	Rp 202.404.244	0,000%	Rp 3.187.161
4	KW 4	Rp 12.516.867	Rp 215.421.111	0,000%	Rp 12.516.867
5	KW 5	Rp 51.463.545	Rp 267.384.656	0,000%	Rp 51.463.545
6	KW 6	Rp 20.636.867	Rp 243.631.523	-0,277%	Rp 21.312.159
7	KW 7	-Rp 21.633.440	Rp 214.305.323	0,000%	-Rp 21.633.440
8	KW 8	-Rp 24.971.036	Rp 197.628.047	0,000%	-Rp 24.971.036
9	KW 9	-Rp 15.060.866	Rp 183.317.180	0,000%	-Rp 15.060.866

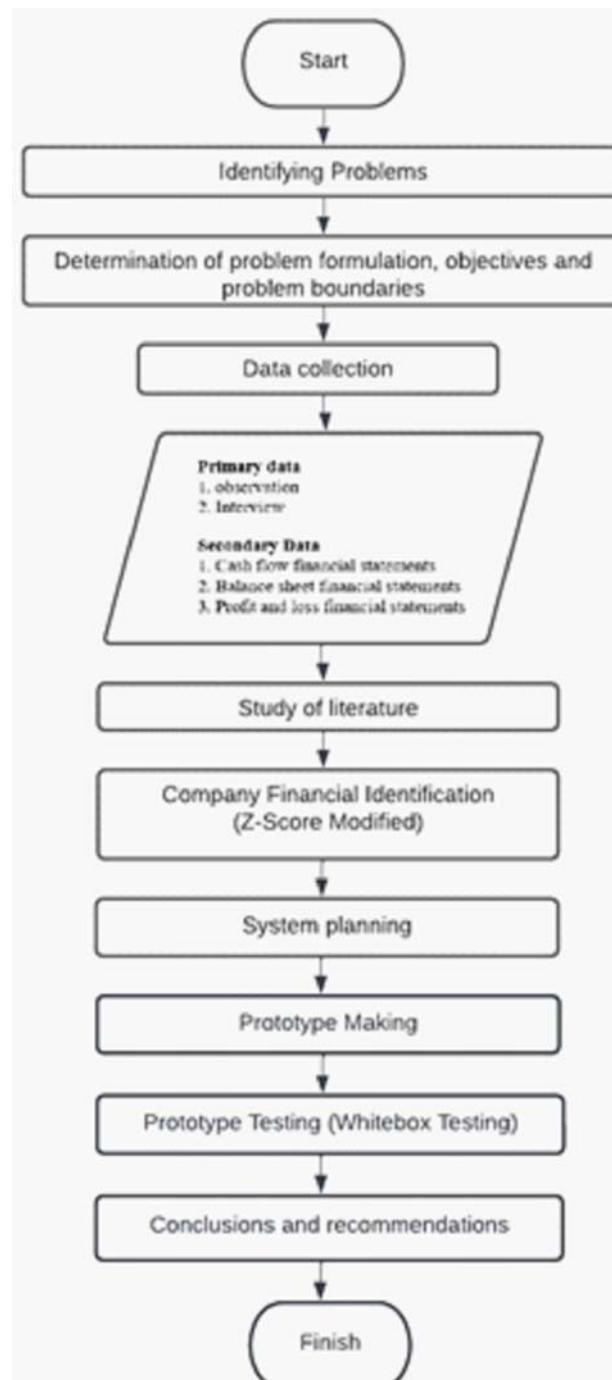Source: Based on author's data processing

Figure 3 Research Flowchart
Source: Based on author's data processing

method so that it can be used by all types of companies, be it companies go public or non-go public and manufacturing or non-manufacturing companies. This method is also appropriate to be chosen because according to (Kusumastuti et al., 2021) the cash flow ratio calculation method is not sufficient to predict the existence of a company bankruptcy, because the cash flow ratio has no effect on financial distress. Meanwhile, according to (Kurniawansyah &

Agustia, 2021) Modified Altman Z-Score method has a 97% accuracy rate for predicting financial distress.

With the advancement of information technology that currently exists, it is possible to modify the Z-Score method to be made in the form of website-based software (application). The application that will be designed and built will be tested using the white-box testing method, where the application will be tested based on the scenario structure design. This application is expected to be able to support the company's acceleration, anticipate bankruptcy in the future, and make it easier for management who have a structural composition that is less focused on the financial sector to make a quick and precise assessment of the company's financial condition, namely whether the company is in good health or in good health, problematic conditions. So that the

Table 3 Components of Modified Z-Score Calculation

Component	Period				
	KW 1	KW 2	KW 3	KW 4	KW 5
Current assets	149,385,698	154.138.142	153.291.304	161,774,171	209,203,716
Current Debt	122,955,060	115,455,060	107,955,060	100,455,060	92,955,060
Working Capital	26,430,638	38,683,082	45,336,244	61.319.111	116,248,656
Total Assets	312,385,698	314.172.142	310,359,304	315,876,171	360,339,716
Retained earning	24,430,638	33,717,083	37,404,244	50,421.111	102,384,656
EBIT	8,987,978	4,207,482	3,203.177	12,579,766	51,722,156
BVE	99,430,638	108.717.083	112.404.244	125.421.111	177,384,656
BVD	212,955,060	205.455.060	197,955,060	190,455,060	182,955,060
Component	Period				
	KW 6	KW 7	KW 8	KW 9	
Current assets	230,916,584	204,965,143	175,734,106	156.889.240	
Current Debt	135,455,060	135,863,820	120,344,060	112.844.060	
Working Capital	95,461,524	69,101,323	55,390,046	44,045,180	
Total Assets	379,086,584	350,169,143	317,972,106	296,161,240	
Retained earning	78,631,523	49,105,323	32,628,047	18,317,180	
EBIT	20,740,570	- 21,742,151	- 25,096,519	- 15,136,549	
BVE	153,631,523	124.305.323	107,628,047	93.317.180	
BVD	225,455,060	225,863,820	210,344,060	202.844.060	

Source: Based on author's data processing

Information:
KW 1: 1st quarter of January–April 2019
KW 2: 2nd quarter of May–August 2019
KW 3: 3rd quarter of September–December 2019
KW 4: 4th quarter of January–April 2020
KW 5: 5th quarter of May–August 2020
KW 6: Quarter 6 September–December 2020
KW 7: 7th quarter of January–April 2021
KW 8: 8th quarter of May–August 2021
KW 9: 9th quarter of September–December 2021

Table 4 Modified Z-Score Formula

Description	Formula
X1	Working Capital / Total Assets
X2	Retained Earnings / Total Assets
X3	EBIT / Total Assets
X4	BVE / BVD

Source: Based on author's data processing

company's financial condition can be known earlier, and able to provide an early warning. The early warning function itself is so that the company can prepare policies that are in accordance with its conditions, and can find out the predictions of income that must be obtained in order to obtain a better financial health condition.

CV Bee Digital Prestasi Nusantara is a startup company engaged in educational technology or edutech. This start-up company is appropriate to be used as a research case study because this company does not yet have a prediction system or has never predicted the financial health of its company. To prevent CV Bee Digital Prestasi Nusantara from having the same fate as other start-ups, this company needs a prediction that can measure its financial health condition.

Based on the phenomenon of problems in the start-up business above, the author will conduct research in the form of developing a prototype application for predicting the financial health of start-up companies.

METHOD

This type of research is descriptive quantitative research that collects, processes, and interprets data so as to obtain accurate and complete results. Figure 3 is a Flow Chart that shows the stages of research from the beginning to the end systematically.

The writing of this paper begins by identifying the problem, namely that start-up companies have a high percentage of failure or bankruptcy due to a lack of attention to the company's financial management. The next stage is the formulation of goals and problem boundaries. Then the data collection, the data used in this study include primary data obtained from inter-

Table 5 Calculation of Modified Z-Score

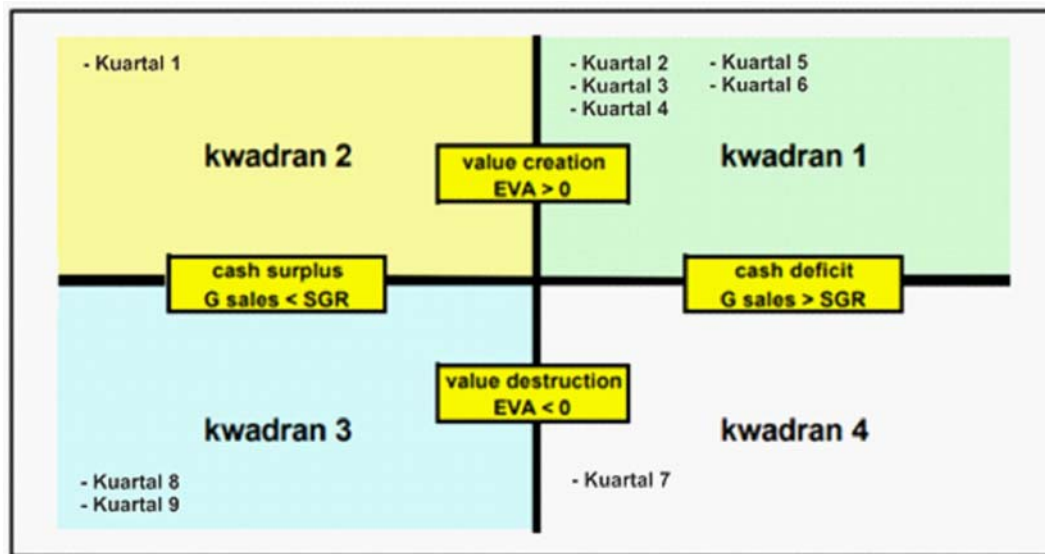| Description	Period				
	KW 1	KW 2	KW 3	KW 4	KW 5
X1	0.085	0.123	0.146	0.194	0.323
X2	0.078	0.107	0.121	0.160	0.284
X3	0.029	0.013	0.010	0.040	0.144
X4	0.467	0.529	0.568	0.659	0.970
Component	Period				
	KW 6	KW 7	KW 8	KW 9	
X1	0.252	0.197	0.174	0.149	
X2	0.207	0.140	0.103	0.062	
X3	0.055	-0.062	-0.079	-0.051	
X4	0.681	0.550	0.512	0.460	

Source: Based on author's data processing

Figure 4 Company Financial Matrix
Source: Based on author's data processing

views and direct observation of the company as well as secondary data obtained from literature, articles and various other sources. Includes Cash flow financial statements, Balance sheet financial statements, Profit and loss financial statements.

After collecting data, the researcher will conduct a literature study, then identify the predictions of the company's financial health using the Modified Z-Score method. In addition, to strengthen the results, the authors also pay attention to the company's financial condi-

tion based on the financial matrix as shown in Figure 4. The following is the condition of the company's CV. Bee

After calculating EVA and cash surplus or deficit, here are the results of grouping the company's financial condition in 9 quarters in four quadrants according to the matrix financial strategy.

In Figure 4 of the 9 quarters of company data, there are 6 quarters that have more than one EVA value, namely quarter 1, 2, 3, 4, 5, and 6, 1 quarter is in quadrant 2 and 5 quarters is in

Table 6 Modified Z-Score Calculation Results

Period (1)	Modification Z-Score Calculation Results (2)	Financial Condition (3)
KW 1	1,494	Potential for bankruptcy
KW 2	1,803	Potential for bankruptcy
KW 3	2.017	Potential for bankruptcy
KW 4	2,753	Healthy financial
KW 5	5.025	Healthy financial
KW 6	3,411	Healthy financial
KW 7	1,912	Potential for bankruptcy
KW 8	1.484	Potential for bankruptcy
KW 9	1.317	Potential for bankruptcy

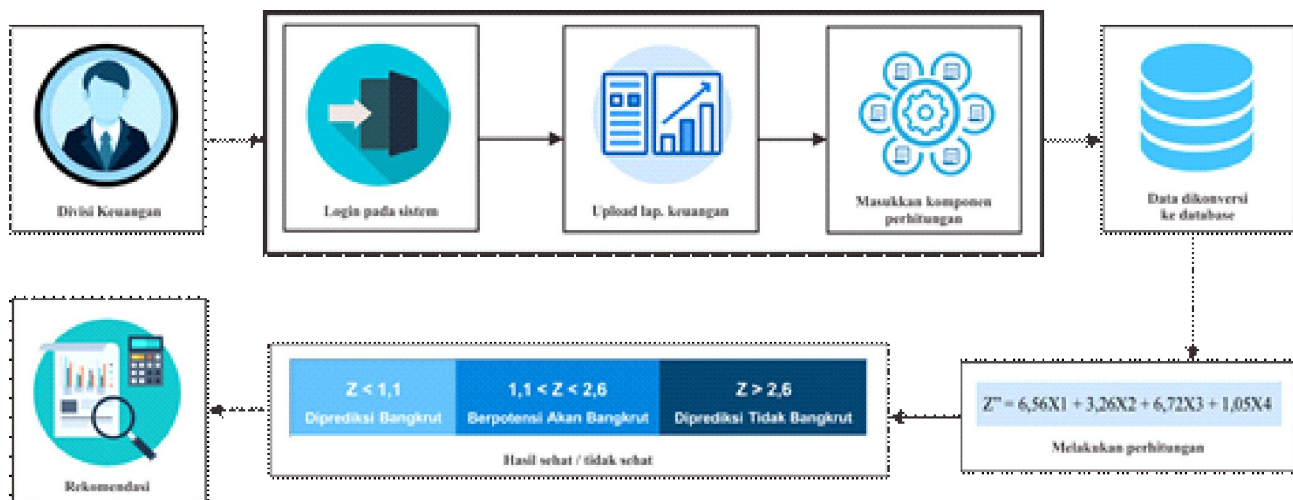Source: Based on author's data processing

Figure 5 System Requirements Design
Source: Based on author's data processing

quadrant 1. In addition, there are also 3 quarters that have an EVA of less than 1, 2 quarters in quadrant 3 i.e. quarter 8 and quarter 9, and 1 quarter in quadrant 4 which is quarter 7.

After identifying financial health predictions, the author will design a system according to the needs of the company. Then after completing the system design and database design stage, at this stage, the author makes a prototype using the SDLC development flow, then the information system development model used is waterfall, while the programming language used is PHP Native. After the program is completed, system testing will be carried out using the whitebox-testing method, where every function contained in the company's financial health prediction system is tested based on the scenario structure. And the last stage is to provide conclusions and suggestions.

RESULTS

Financial Condition of Start-Up Using Modified Z-Score Method

Here are some steps to determine the financial health condition of a Start-Up company using the Modified Z-Score method.

Identification of Modified Z-Score Calculation Components

The first thing to do to start the modified Z-Score calculation is to identify the components contained in the calculation formula defined in this equation
$$Z'' = 6{,}56X1 + 3{,}26X2 + 6{,}72X3 + 1{,}05X4$$
Which includes 8 components, namely:
1. Current assets
2. Current Debt
3. Working Capital
4. Total Assets
5. Retained earning

Table 7 Modified Z-Score Matrix

Z < 1,100 Predicted Bankrupt	1,100 < Z < 2,600 Potential to Bankrupt	Z > 2,600 Predicted Not Bankrupt

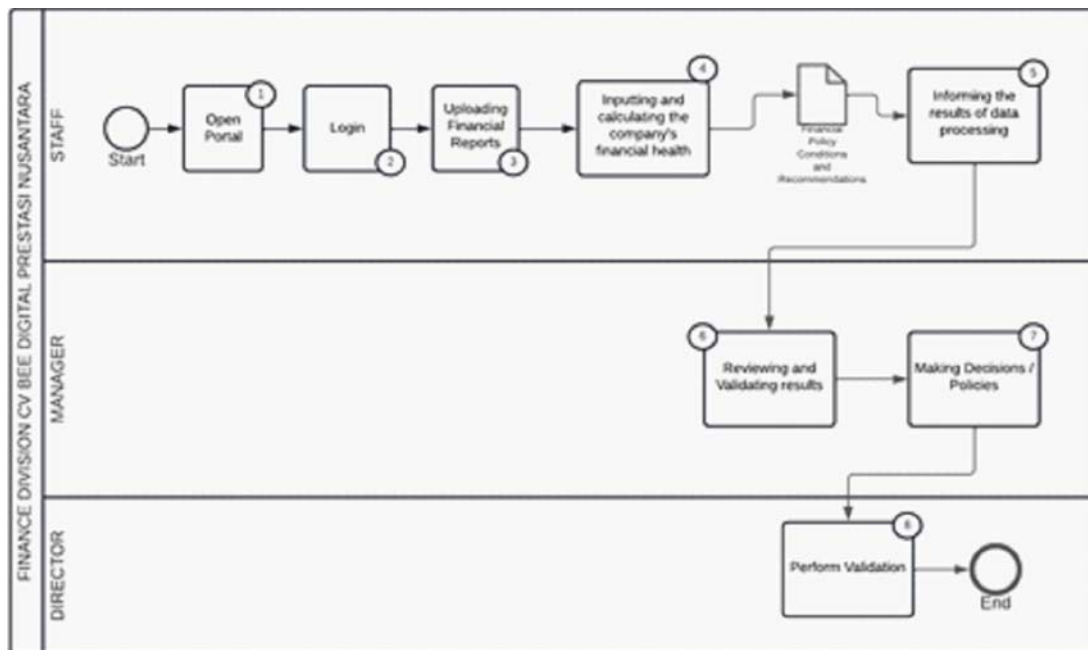Source: Based on author's data processing

Figure 6 BPMN Design
Source: Based on author's data processing

6. EBIT (Earning Before Interest and Tax)
7. EBV (Book Value of Equity)
8. EBD (Book Value of Debt)

The results of the identification of the Modified Z-Score calculation components in the financial statements of Start Up CV Bee Digital Prestasi Nusantara for 9 quarters are presented in Table 3.

Modified Z-Score Calculation

After obtaining the components of the Modified Z-Score calculation from several financial periods of the company, the next step is to calculate the Modified Z-Score according to the formula above. Which consists of the calculation of X1 to X4, which is shown by Table 4.

The results of X1 to X4 can be known by entering the identification results of each calculation component contained in table 3 into each of the calculation formulas X1 to X4 according to equation. The following are the results of the calculation of X1, X2, X3, and X4 for 9 quarters which are shown in Table 5.

And then, after knowing the value from X1 to X4, then the next step is to perform calculations for the modified Z-Score results. The results of the modified Z-Score can be known by multiplying the value of X1 to X4 with the coefficient value according to the formula. The following is the result of calculating the Z-Score value of the Start-Up company CV Bee Digital Prestasi Nusantara for 9 quarters, which is shown in Table 6.

Start-Up Financial Health Indicator Using Modified Z-Score Method

The results of the financial condition for each period of the Start-Up companies listed in table 6 column (3) are the results of the interpretation of the financial health indicators from the Modified Z-Score formula. Indicators for financial health are listed in Table 7. From Table 7 it can be seen that:

Table 8 System Process Requirements

No.	System Process Requirements
1	Users can login and logout
2	The finance division can upload financial reports
3	The finance division can input the modified Z-Score calculation component data to assess the company's financial health
4	The system can display a modified Z-Score calculation component graph
5	The system can convert the input data into a database
6	System can perform Modified Z-Score calculation
7	The system can provide an overview of the real condition of the company's financial health based on the calculation results of the Modified Z-Score
8	The system can provide an overview of the ideal condition of the company's financial health based on the results of the modified Z-Score calculation
9	The system can provide recommendations based on the calculation results of the Modified Z-Score

Source: Based on author's data processing

1. If the index value Z "< 1.100 then the company is predicted to go bankrupt
2. If the index value is 1,100 < Z" < 2,600 then it is a gray area (the company is predicted to face financial problems and has the potential to go bankrupt).
3. If the Z index value is > 2,600 then it is a company that is not bankrupt.

The results of the Z-Score calculation for the Start-Up company CV Bee Digital Prestasi Nusantara. Table 6 shows that in the first quarter to the third quarter CV Bee Digital Prestasi Nusantara was declared in the grey area company category or has the potential to go bankrupt. This is because the results of the Z-Score index calculation for the quarter were between 1,100 and 2,600, namely 1,494 in the 1st quarter, then 1,803 in the 2nd quarter and 2,017 in the 3rd quarter. due to an increase in the value of Z-Score.

In quarter 4 to quarter 6, the company is declared to be in the category of companies with healthy financial conditions (not bankrupt). This is because in that quarter the company had a *Z-Score value* greater than 2,600, namely 2,753 in the 4th quarter, then 5,025 in

the 5th quarter and 3,411 in the 6th quarter good.

However, in the 7th to 9th quarters, the company's financial condition was again declared to be in a potentially bankrupt condition. This is because the results of the Z-Score calculation in the last 3 quarters show a lot of decline and the index value is between 1,100 and 2,600. In a row the results of the company's Z-Score for the last 3 quarters are 1,912; 1.484; and 1.317.

Average Comparison Test

The average comparison test is tests carried out for measure level accuracy prediction given by Altman Z- Score Modification perhitungan with researching there is at least 2 types error. 2 types error this could detected with compare results Z-Score prediction with company real condition 1 period after prediction given. Whereas company real condition could is known with to do analysis ratio finance in accordance the formulas contained in Table 14 in chapter before. For continue on stage calculation, writer required To do identification the components that become base calculation

analysis ratio finance based on the formula in Table 14 below is results identification components calculation ratio analysis financial report company Start Up CV Bee Digital Prestasi Nusantara for 10 quarters, presented in Table 15.

After getting components calculation analysis ratio finance from a number of period, author could enter component the to in formula in accordance with Table 14 for get real condition of the company. Calculation analysis ratio finance done in 1 quarter after prediction conducted that is quarter 2. It is because in To do testing, predictive data Modified Z-Score calculation period t will compared with results analysis ratio finance period t+1. Table 16 is results calculation ratio analysis finance for 9 quarters.

After knowing results calculation this. The values in Table 16 will be interpreted based on indicator condition finance. Interpretation re-

sults analysis ratio finance company Start-Up CV Bee Digital Prestasi Nusantara is shown in Table 17.

From Table 17 results calculation a number of ratio finance show that in quarters 2, 3 and 6, CV Bee Digital Prestasi Nusantara 's performance was sufficient good. Condition this could seen through calculation existing ratio, that is ratio smooth and ratio fast show results more big of 1, while start from calculation rotation accounts receivable until with results on total equity (HAE) shows positive results. Although score sales growth and negative net income, hal this no influence condition finance by whole. Negative value on sales growth and net income caused by the presence a little decrease in income company in the period concerned. So that results analysis, show that condition CV Bee Digital Prestasi Nusantara in quarters 2, 3, and 6 are healthy.
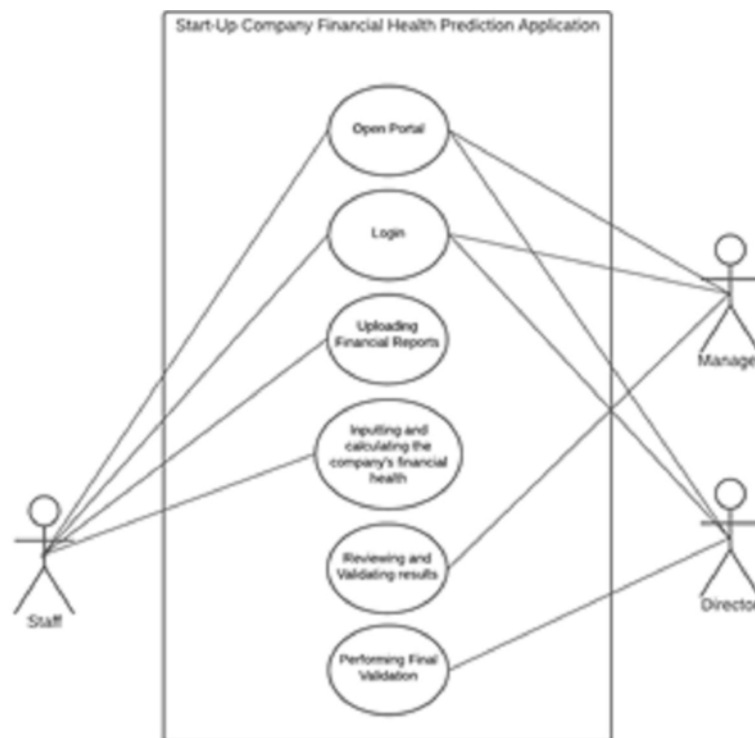

Figure 7 Use Case Diagrams
Source: Based on author's data processing

Table 9 System Input Requirements

No.	System Input Requirements	Information
1	Username and password	Username and password given by admin
2	Financial statements	The company's financial statements, which consist of: - Balance Sheet - Income statement - Cash flow statement
3	Modified Z-Score calculation component data to assess the company's financial health	There are 8 components of the Z-Score calculation that must be included, including: 1. Current assets 2. Current Debt 3. Working Capital 4. Total Assets 5. Retained earning 6. EBIT (Earning before Interest and Tax) 7. EBV (Book Value of Equity) 8. EBD (Book Value of Debt)

Source: Based on author's data processing

4th and 5th quarters show results performance the best company. This thing showed with results analysis ratio liquidity i.e. positive working capital, current ratio and excellent cash ratio liquid that is ratio > 1. While that for ratio activity, the company has also enough effective in management period billing/receivables and management the active. Whereas from ratio debt, company capital structure show that capital is sufficient many financed with debt, however from calculation ratio the could seen that company capable pay every his obligations. Even show enough high value. From ratio profitability, performance company enough give enough profit on 2 in a row this, that is quarters 4 and 5. So that from results CV Bee Digital Prestasi Nusantara analysis, shows healthy results.

Meanwhile, in quarter 7-9, CV Bee Digital Prestasi Nusantara showed that : performance lack of finance good. Though if seen from ratio liquidity that shows that the working capital owned company is positive and second ratio other liquidity, namely ratio fluent as well as cash ratio shows ratio > 1. This indicates from ability company in Fulfil obligation smooth is good. However if seen from ratio profitability, CV Bee Digital Prestasi Nusantara condition shows that company this enough experience difficulty in produce profit, because margin profit operation, margin profit net, HAA, HAE, Sales growth, and net income growth show results negative. And plus in the 7th quarter the ratio ability pay flowers are worth negative, which means company no capable pay flower loan. However Thing this not yet make company said bankrupt. Because even though there is a number of negative value ratio, however by whole still many value ratio _ positive. So that from results analysis could said that in the 7,8 and 9 quarters the company experience less good condition but not yet can said bankrupt, so right conditions is healthy.

Whereas in quarter 10 shows sufficient performance good. This thing seen from ratio liquidity indicating company enough liquid, that is positive working capital, ratio current and cash ratio >1. Then for analysis activity com-
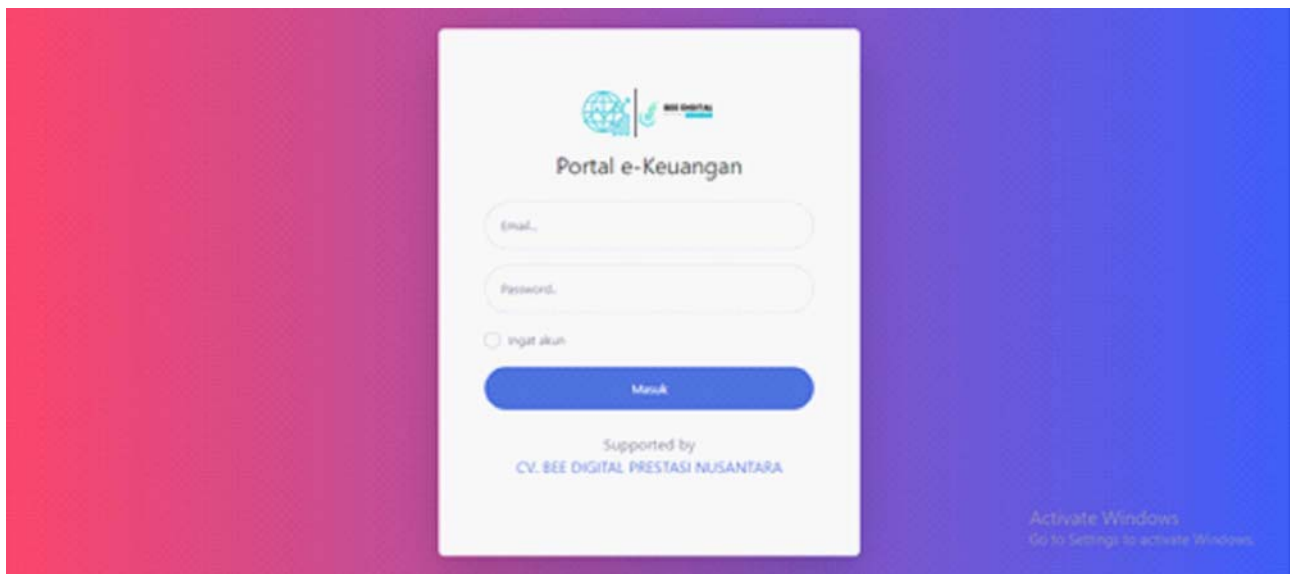
Figure 8 Login Page
Source: Based on author's data processing

pany show that at 10, the company could manage assets more efficient compared period before. Whereas for ratio debt and also profitability also show positive results, where thing this indicates that company capable produce profit and pay his obligations with good. For ratio growth enough good, but at the ratio net income growth experience a little drop so that negative value. This thing no influence condition finance by whole. So that from analysis could concluded that in the 10th quarter the condition CV Bee Digital Achievement Nusantara finance in condition healthy or no bankrupt.

Type Analysis Error

This analysis will researching more carry on is there is type error in prediction bankruptcy use Modified Z-Score method, As the author convey in discussion previously in sub chapter 2.11, that for see type error occurred, author will compare results prediction bankruptcy in period t (eg quarter 1) compared with condition company in period t+1 (eg quarter 2) or condition companies that occur 1 period then. For determine type error good error type 1 or error type 2, writer required To do appropriate classification. As for the classification

Table 10 List of Nouns

No.	Noun
1	Login/Logout
2	Upload Financial Report
3	Modified Z-Score calculation component data
4	Modified Z-Score calculation component graph
5	Company Financial Condition
6	Details of the modified Z-Score calculation results (Real Condition)
7	Details of the calculation results of the Modified Z-Score (Ideal Conditions)
8	Policy recommendations

Source: Based on author's data processing

Table 11 Definition of Actor

No.	Actor	Description
1	Director	The director is a user who can use the *prototype* to monitor and validate the results of system calculations and the results of decisions/policies from financial managers.
2	Manager	Manager is a user who acts as a validator for the results of system calculations, besides that he is also responsible for making decisions or policies.
3	Staff	Staff is a user whose job is to perform all forms of data processing, both data input, calculations and uploading some required financial reports.

Source: Based on author's data processing

carried out for determine prediction received or no with use evaluation analysis ratio finance companies that can seen in Figure 13.

Figure 13 is results survey classification condition finance company made by the author to department finance researched company namely CV Bee Digital Prestasi Nusantara. Of the 10 respondents, 9 of them state accepted. With details results surveys that can seen in Table 18.

On Table 18 there are 3 underlying questions classification condition results prediction with condition company estate, that is is condition finance healthy results prediction received as condition healthy finance by real, then the second is condition finance potential will bankrupt received as condition healthy finance by real. And lastly, is condition no healthy results prediction received as condition no healthy finance company by real. In questions 1 and 3, 10 respondents state accepted. Whereas in question second there is 1 in 10 respondents state no agree. So that by whole results survey classification condition finance company is could accepted. Comparison results analysis type mistakes made by the author shown in Table 19.

From Table 19 that is comparison Among prediction bankruptcy in period t with condition company 1 period then (t+1) shows that no found error type 1 or error type 2. So that calculate bro accuracy for Modified Z-Score predictions that have been conducted is 100%, with details calculation as following:
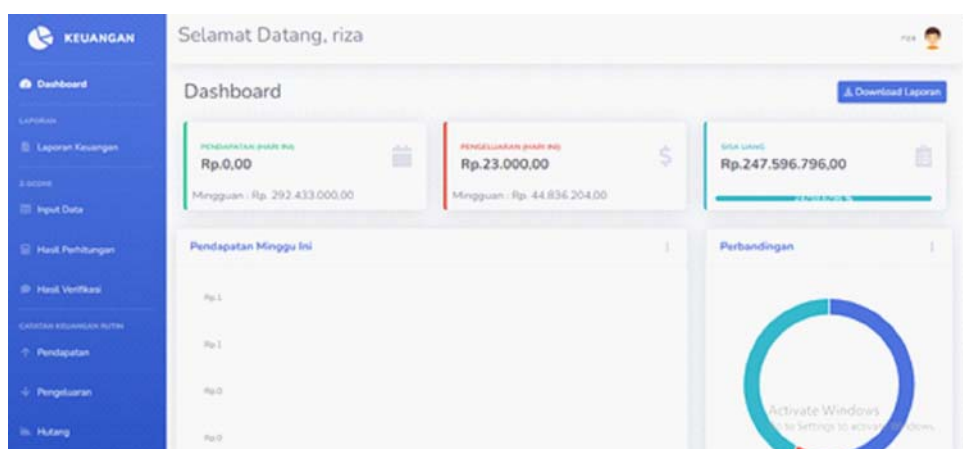

Figure 9 Dashboard Page
Source: Based on author's data processing

Accuracy Level $= \dfrac{\text{Total prediction true}}{\text{Total observed}}$ x 100%

$\qquad\qquad$ = (9/9) x 100%

$\qquad\qquad$ = 100%

View calculation level accuracy prediction using 9 quarters of data on the company, can received with level type error of 0 data. With so calculation prediction health finance use Altman Z-Score Modification Method could accepted.

Prototype of Financial Health Prediction Application with SDLC Approach

For the stages of making a *prototype* of a financial health application using the SLDC method, follow the flow method in accordance with Figure 3 which will be explained as follows:

Software Requirements Analysis

In this first stage we will perform the analysis that will be required for the system. This needs analysis aims to find and confirm errors, deficiencies that exist in order to perfect all existing requirements (Hidayati, 2019).

At this stage the required needs are illustrated in Figure 5.

From Figure 5 above, it can be concluded that the system requirements for prototyping financial health applications include system process requirements and system input requirements, which are further explained in Tables 8 and 9.

From the list of process functional requirements and system input requirements above, the next step is to select the nouns contained in the functional requirements stage.

The results of the identification of object-oriented nouns have been identified a number of 8, which aims to describe the system requirements needed to carry out a process / to identify what menus will be contained in the system.

Design

In this stage, a design according to system requirements will be made regarding the database design, software architecture and User Interface that will be created. The use of the Unified Modelling Language (UML) is intended to explain in more detail in the program design and database design.

Figure 10 Financial Report Page
Source: Based on author's data processing

Table 12 Definition of Use Case

No.	Use Case	Description
1	Open Portal	This use case is used for actors to open system portals on the web
2	Login	This use case is used for actors to login to access the system by entering a username and password
3	Uploading Financial Reports	This use case serves for actors, especially staff, to upload some of the necessary financial reports
4	Inputting and calculating the company's financial health	This use case is used for actors, especially staff, to input several components of the modified Z-Score calculation and perform the process of calculating the company's financial health predictions.
5	Reviewing and validating calculation results	This use case is used for actors, namely managers, to review the results of calculations and validate the results of these calculations
6	Performing Final Validation	This use case serves for the actor, namely the director, to review the results of the decisions and policies of the financial manager and carry out the final validation process for the results of calculations on the system.

Source: Based on author's data processing

BPMN

The first stage will explain the application workflow which is described through BPMN in Figure 6.

Figure 6 shows the application work process flow to determine the financial health of the company proposed by the author, and shows that with this system, start-up companies can find out their financial condition easily, precisely and accurately. And can find out how the policy recommendations that must be taken by the company's stakeholders. The following is a further explanation of the application workflow:

1. Finance Division staff opens application portal.
2. The financial division staff logs in on the available web page by entering the username and password given by the previous admin.
3. On the home page, Finance Division staff can upload financial reports which include 3
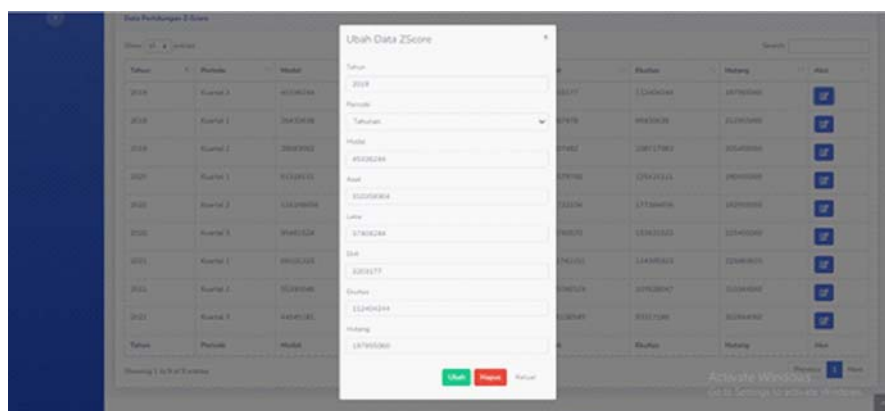

Figure 11 Modified Z-Score Calculation Page
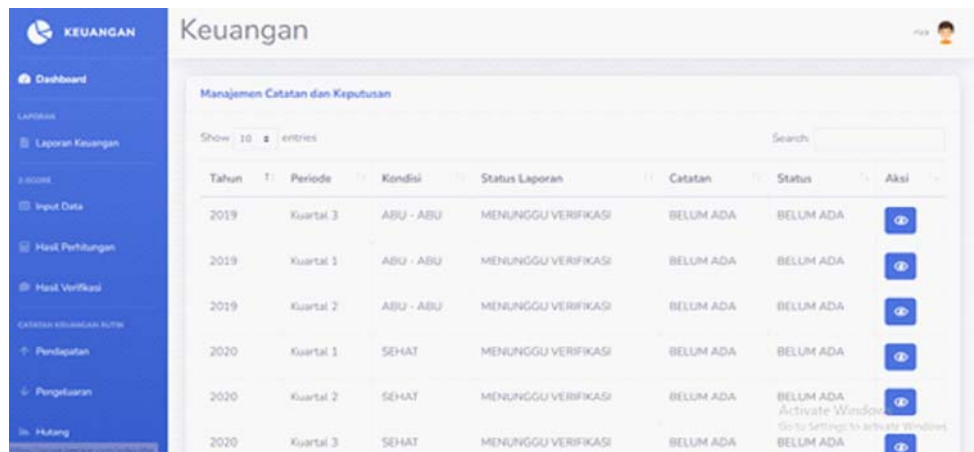Source: Based on author's data processing

Figure 12 Decision Making and Validation Page
Source: Based on author's data processing

types of reports, namely balance reports, profit and loss statements and also cash flow statements from the company.

4. After that, the Finance Division staff will input the modified Z-Score calculation component data and perform calculations on the company's financial health. From the data processing, the staff will produce data on financial conditions and recommendations/ financial policies.

5. The resulting data will then be informed (outside the system) by the finance division staff to the financial manager.

6. The financial manager will review and validate the results of data processing.

7. Financial managers make decisions or policies based on the results of data processing.

8. The results of decisions or policies will be informed (outside the system) by the financial manager to the finance director for validation.

Use Case Diagrams

The use case diagram stage is carried out to display the design of who uses the system and what interactions can be carried out on the system by the actor. The design of the use case diagram that will be developed on the prototype of the Start-Up company's financial health application system is depicted in Figure 7.

Definition of Actor and Use Case

In Figure 7 there is a use case diagram of a prototype application for predicting the finan-

Table 13 Activity Diagrams

No.	Activity
1	Open Portal
2	Login
3	Uploading Financial Reports
4	Inputting and calculating the company's financial health
5	Reviewing and validating calculation results
6	Performing Final Validation

Source: Based on author's data processing

Table 14 Financial Ratio Formula

Ratio Type	Formula
Liquidity Ratio:	
Working Capital Clean	$\text{Current Assets} - \text{Current Liabilities}$
Fluent Ratio	$\dfrac{\text{Current asset}}{\text{Current Liabilities}}$
Cash Ratio	$\dfrac{\text{Cash} + \text{Cash Equivalent}}{\text{Current Liabilities}}$
Activity Ratio	
Rotation Receivables	$\dfrac{\text{Income}}{\text{Receivables}}$
Rotation Assets Permanent	$\dfrac{\text{Income}}{\text{Net Fixed Assets}}$
Total Asset Turnover	$\dfrac{\text{Income}}{\text{Total assets}}$
Debt Ratio	
Ratio Debt to Equity	$\dfrac{\text{Long} - \text{term debt}}{\text{Total Equity}}$
Ratio Able to Pay Interest	$\dfrac{\text{Profit Before Interest and Tax}}{\text{Interest}}$
Debt to Asset Ratio	$\dfrac{\text{Total Debt}}{\text{Total Assets}}$
Total debt ratio to Equity	$\dfrac{\text{Total Debt}}{\text{Total Equity}}$
Profitability Ratio	
Gross Profit Margin	$\dfrac{\text{Gross profit}}{\text{Income}}$
Operation Profit Margin	$\dfrac{\text{Profit Before Interest and Tax}}{\text{Sale}}$
Clean Profit Margin	$\dfrac{\text{Net Profit After Tax}}{\text{Sale}}$
Yield on Total Assets (HAA)	$\dfrac{\text{Net Profit After Tax}}{\text{Total Assets}}$
Return on Total Equity (HAE)	$\dfrac{\text{Net Profit After Tax}}{\text{Total Equity}}$
Growth Ratio	
Sales Growth	$\dfrac{\text{Income in year t} - \text{Revenue in year t} - 1}{\text{Revenue year t} - 1}$
Net Income Growth	$\dfrac{\text{profit year t} - \text{profit year t} - 1}{\text{profit year t} - 1}$

Source: Based on author's data processing

Pie Bar Survei Penggolongan Prediksi

Figure 13 Pie Bar Classification Prediction
Source: Based on author's data processing

cial health of a start-up company that has several activities or access to the system. In the use case diagram it is described that there are 3 actors involved in this application, namely staff, managers, and directors of the finance division. The explanation regarding the actors involved in the system is explained in Table 11.

Meanwhile, the description of the function of each use case in the prototype application for predicting the financial health of start-up companies is described in Table 12.

Activity Diagram

The next step after creating a scenario use case diagram is to draw up an activity diagram. This diagram is compiled based on the system design in accordance with the use cases that have been made, as well as the functions that can be run by users in the system. A list of activity diagrams for a prototype financial health prediction system is described in Table 13.

Programming

The next stage is the construction stage or program creation, at this stage the author together with the application developer will combine the modules from the designs that have

been made and made into a user interface for the financial health prediction system of Start-Up companies using the Modified Z-Score method and with a modified approach. SDLC SK. CV Bee Digital Prestasi Nusantara web-based. The user interface that has been created consists of several parts, namely login displays, dashboards, financial reports, data input, calculation results, verification results, and routine financial records, which consist of records of income, expenses, debts, and reports. which is depicted through Figure 8 until Figure 11.

DISCUSSION

From the calculation of the results of the modified Z-Score, it was found that in 9 quarters the start-up company CV Bee Digital Prestasi Nusantara experienced ups and downs in financial conditions. This is evidenced by the unstable Z-Score results. The company experienced poor financial conditions in quarters 1–3, then increased in quarters 4–6, and fell again in quarters 7–9. The highest value calculated by the Z-Score occurred in the 5th quarter, which was 5,025, with a healthy financial condition. From the results of these calculations, the researcher will provide several recommendations

Table 15 Financial Ratio Calculation Components

Component	KW 1	KW 2	Period KW 3 In Rupiah (Rp)	KW 4	KW 5
Cash + Cash Equivalent	147,385,698	148,592,180	166,375,168	177.937.070	222,339,271
Receivables	27,044,940	30,567,000	11932.152	8,900,000	12,123,056
Fluent Assets	149,385,698	154.138.142	153.291.304	161,774,171	209,203,716
Permanent Assets	163,000,000	160,034,000	157,068,000	154,102,000	151.136.000
Total Assets	312,385,698	314.172.142	310,359,304	315,876,171	360,339,716
Passive Fluent	122,955,060	115,455,060	107,955,060	100,455,060	92,955,060
Long Term Debt	90,000,000	90,000,000	90,000,000	90,000,000	90,000,000
Total Debt	212,955,060	205.455.060	197,955,060	190,455,060	182,955,060
Total Equity	99,430,638	108.717.083	112.404.244	125.421.111	177,384,656
Income	245.650.000	235,330,000	233.510.000	245,970,000	285.100.000
Gross Profit	56,806.778	52451.230	48,350,985	60.527.118	99,725,744
EBIT	8,987,978	4,207,482	3,203.177	12,579,766	51,722,156
Flower	599,999	600,000	400,000	-	-
EAT	8,943,038	4,186.445	3,187,161	12,516,867	51,463,545

Component	KW 6	KW 7	Period KW 8 In Rupiah (Rp)	KW 9	KW 10
Cash + Cash Equivalent	240,621,523	211,988,083	180,017,047	157,956,180	160.808.970
Receivables	15,398,763	17,868,349	20,591,577	23,857,377	26,948,572
Fluent Assets	230,916,584	204,965,143	175,734,106	156.889.240	162,708,030
Permanent Assets	148,170,000	145,204,000	142.238.000	139,272,000	136,306,000
Total Assets	379,086,584	350,169,143	317,972,106	296,161,240	299,014,030
Passive Fluent	135,455,060	135,863,820	120,344,060	112.844.060	105,344,060
Long Term Debt	90,000,000	90,000,000	90,000,000	90,000,000	90,000,000
Total Debt	225,455,060	225,863,820	210,344,060	202,844,060	195,344,060
Total Equity	153,631,523	124.305.323	107,628,047	93.317.180	103,669,970
Income	257,950,000	208,630,000	201.750.000	209.930.000	245.760.000
Gross Profit	80,827,518	31,258,025	23,242.573	33,864,135	57,302,985
EBIT	20,740,570	- 21,742,151	-25,096,519	- 15,136,549	9,902,301
Flower	-	400,000	-	-	-
EAT	20,636,867	- 21,633,440	- 24,971,036	- 15,060,866	9,852,789

Source: Based on author's data processing

for action for the three financial conditions in the calculation of the Modified Z-Score method based on healthy, potentially bankrupt, and un-healthy conditions. And here is the full explanation:

1. Healthy Financial Condition
   a. Maintaining the existing financial condition while still paying attention to all aspects that can affect the company's condition
   b. Improve company performance by:

1) Minimize the existence of idle assets to maximize profitability
2) Finding innovative products, paying attention to consumer trends, improving business strategies, product quality, and building integration and synergies for the expansion of social networks outside the company.

2. Potentially Bankrupt Financial Condition
   a. Focusing on increasing EBIT by improving company performance, increasing sales

Table 16 Financial Analysis Calculation

Type S Ratio	KW 2	KW 3	KW 4	KW 5	KW 6
Working Capital Net (in rupiah)	38,683,082	45,336,244	61.319.111	116,248,656	95,461,524
Fluent Ratio	1.335	1,420	1,610	2,251	1,705
Cash Ratio	1,287	1.541	1,771	2,392	1,776
Rotation Receivables	7,699	19.570	27,637	23,517	16,751
Rotation Assets Permanent	1,471	1,487	1,596	1,886	1,741
Total Asset Turnover	0.749	0.752	0.779	0.791	0.680
Ratio Debt to Equity	0.828	0.801	0.718	0.507	0.586
Ratio Able to Pay Interest	7,012	8.008	-	-	-
Debt to Asset Ratio	0.654	0.638	0.603	0.508	0.595
Total debt ratio to Equity	1,890	1,761	1,519	1.031	1,468
Gross Profit Margin	0.223	0.207	0.246	0.350	0.313
Operation Profit Margin	0.018	0.014	0.051	0.181	0.080
Clean Profit Margin	0.018	0.014	0.051	0.181	0.080
Yield on Total Assets (HAA)	0.013	0.010	0.040	0.143	0.054
Return on Total Equity (HAE)	0.039	0.028	0.100	0.290	0.134
Sales Growth	-0.042	-0.008	0.053	0.159	-0.095
Net Income Growth	-0.532	-0.239	2,927	3,112	-0.599
Ratio Type	**KW 7**	**KW 8**	**KW 9**	**KW 10**	
Working Capital Net (in rupiah)	69,101,323	55,390,046	44,045,180	57,363.970	
Fluent Ratio	1,509	1,460	1,390	1.545	
Cash Ratio	1,560	1,496	1,400	1,527	
Rotation Receivables	11,676	9,798	8,799	9,120	
Rotation Assets Permanent	1,437	1.418	1,507	1,803	
Total Asset Turnover	0.596	0.634	0.709	0.822	
Ratio Debt to Equity	0.724	0.836	0.964	0.868	
Ratio Able to Pay Interest	-54,355	-	-	-	
Debt to Asset Ratio	0.645	0.662	0.685	0.653	
Total debt ratio to Equity	1,817	1,954	2,174	1,884	
Gross Profit Margin	0.150	0.115	0.161	0.233	
Operation Profit Margin	-0.104	-0.124	-0.072	0.040	
Clean Profit Margin	-0.104	-0.124	-0.072	0.040	
Yield on Total Assets (HAA)	-0.062	-0.079	-0.051	0.033	
Return on Total Equity (HAE)	-0.174	-0.232	-0.161	0.095	
Sales Growth	-0.191	-0.033	0.041	0.171	
Net Income Growth	-2,048	0.154	-0.397	-1.654	

Source: Based on author's data processing

volume by taking into account business strategies and massive product promotions, as well as streamlining existing operational expenses.

b. Improving the working capital structure by reducing the use of current debt as a source of operational costs.

c. Utilizing the profits earned to become retained earnings to finance extraordi-

nary expenses and can finance market share expansion or business development.

3. Unhealthy Financial Condition
   a. Paying attention to 2 main factors in the company:
      1) Internal conditions, namely policies, strategies, controls and supervision carried out by the company.

Table 17 Interpretation of the Calculation Results of Ratio Analysis

Ratio Type	KW 2	KW 3	KW 4	KW 5	KW 6
Working Capital Net (in rupiah)	Positive	Positive	Positive	Positive	Positive
Fluent Ratio	> 1	> 1	> 1	> 1	> 1
Cash Ratio	> 1	> 1	> 1	> 1	> 1
Rotation Receivables	Positive	Positive	Positive	Positive	Positive
Rotation Assets Permanent	Positive	Positive	Positive	Positive	Positive
Total Asset Turnover	Positive	Positive	Positive	Positive	Positive
Ratio Debt to Equity	Positive	Positive	Positive	Positive	Positive
Ratio Able to Pay Interest	Positive	Positive	Positive	Positive	Positive
Debt to Asset Ratio	Positive	Positive	Positive	Positive	Positive
Total debt ratio to Equity	Positive	Positive	Positive	Positive	Positive
Gross Profit Margin	Positive	Positive	Positive	Positive	Positive
Operation Profit Margin	Positive	Positive	Positive	Positive	Positive
Clean Profit Margin	Positive	Positive	Positive	Positive	Positive
Yield on Total Assets (HAA)	Positive	Positive	Positive	Positive	Positive
Return on Total Equity (HAE)	Positive	Positive	Positive	Positive	Positive
Sales Growth	Negative	Negative	Positive	Positive	Negative
Net Income Growth	Negative	Negative	Positive	Positive	Negative
Condition	Health	Health	Health	Health	Health
Ratio Type	**KW 7**	**KW 8**	**KW 9**	**KW 10**	
Working Capital Net (in rupiah)	Positive	Positive	Positive	Positive	
Fluent Ratio	> 1	> 1	> 1	> 1	
Cash Ratio	> 1	> 1	> 1	> 1	
Rotation Receivables	Positive	Positive	Positive	Positive	
Rotation Assets Permanent	Positive	Positive	Positive	Positive	
Total Asset Turnover	Positive	Positive	Positive	Positive	
Ratio Debt to Equity	Positive	Positive	Positive	Positive	
Ratio Able to Pay Interest	Negative	Positive	Positive	Positive	
Debt to Asset Ratio	Positive	Positive	Positive	Positive	
Total debt ratio to Equity	Positive	Positive	Positive	Positive	
Gross Profit Margin	Positive	Positive	Positive	Positive	
Operation Profit Margin	Negative	Negative	Negative	Positive	
Clean Profit Margin	Negative	Negative	Negative	Positive	
Yield on Total Assets (HAA)	Negative	Negative	Negative	Positive	
Return on Total Equity (HAE)	Negative	Negative	Negative	Positive	
Sales Growth	Negative	Negative	Negative	Positive	
Net Income Growth	Negative	Negative	Negative	Negative	
Condition	Health	Health	Health	Health	

Source: Based on author's data processing

Table 18 Prediction Classification

Results Prediction	Condition Finance	Survey Results		Conclusion
		Agree	Not Agree	
Healthy	Healthy	10	0	Received
Potential Bankrupt / Grey	Healthy	9	1	Received
Not Healthy	Not Healthy	10	0	Received

Source: Based on author's data processing

Table 19 Type Analysis Error

Error Type Analysis				
Period	Prediction	Period	Condition Finance	Type Error
Quarter 1	Potential Bankrupt (Grey)	Quarter 2	Healthy	-
Quarter 2	Potential Bankrupt (Grey)	Quarter 3	Healthy	-
Quarter 3	Potential Bankrupt (Grey)	Quarter 4	Healthy	-
Quarter 4	Healthy	Quarter 5	Healthy	-
Quarter 5	Healthy	Quarter 6	Healthy	-
Quarter 6	Healthy	Quarter 7	Healthy	-
Quarter 7	Potential Bankrupt (Grey)	Quarter 8	Healthy	-
Quarter 8	Potential Bankrupt (Grey)	Quarter 9	Healthy	-
Quarter 9	Potential Bankrupt (Grey)	Quarter 10	Healthy	-

Source: Based on author's data processing

2) External conditions, namely the level of industrial competition, economic and political stability, government policies, recession and global crisis.

3) Manage assets effectively and efficiently to maximize profitability, adjust the amount of debt used in financing, restructure the company including the management structure, and consider mergers and acquisitions to save the company.

The results of the prediction of the company's financial health from the calculation show that the 1–3 quarters of CV Bee Digital Prestasi Nusantara are declared in the grey area company category or have the potential to go bankrupt. In quarter 4 to quarter 6, the company is declared to be in the category of companies with healthy financial conditions (not bankrupt). And, in the 7th to the 9th quarter, the company's financial condition was again declared in a potentially bankrupt condition.

The results of the analysis of the system model/design (system architecture and Information System Framework) that have been made show that the use of a prototype system for predicting financial health. Web-based start-ups will be able to meet the basic needs of providing early warnings to support company acceleration, and anticipate bankruptcy.

This research is expected to be continued by further researchers, by expanding the aspects studied. Where research does not only stop at providing recommendations for financial decisions, but continues through the decision-making process. The decision-making process itself can be determined by several existing methods, such as AHP, Fuzzy and others.

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