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Decision Support System for the Best Share Selection using TOPSIS and VIKOR Methods

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Abstract**—** *Stock selection must to pay careful attention and with full consideration, this is to avoid the risk that can cause large losses. Before selecting stocks for investment purpose, a new investor must have a basic knowledge about the stocks. This knowledge is a basic for mitigating the risk that will happen. As an alternatif way, a new investor can also look some outputs at "a Decision Support System" (DSS) for the best stock selection that will be resulted in this research. The best stock selection is done by TOPSIS and VICKOR methods. Analysis stock was carried out using fundamental analysis approach by looking financial ratio that was taken from a company`s financial statement. The objectives of this research was 45 companies listed in Indonesia Stock Exchange (IDX) in 2017. A Decision Support System that was produced in this research still in prototyping phase. The output prototype of DSS is a list of the best alternative stocks that can be as a reference in selecting stocks.*

Keywords**—** *Stock, Decision Support System, TOPSIS, VIKOR.*

I. INTRODUCTION

Risk management before choosing stocks is the most appropriate way before investing in stocks. In this study, the method used to select the best stock alternative was TOPSIS and VIKOR methods. This method will later be used to process financial report data which will produce the best stock alternatives. The use of these two methods will later be implemented in the Decision Support System prototype.

Shares can be defined as a sign of a person's or business entity's equity participation in a company or limited liability company.

Investment is a commitment to a number of funds or other resources carried out at this time, with the aim of obtaining a number of benefits in the data period. (Faniya, I. 2017).

Fundamental analysis of stocks is a method for measuring the intrinsic value of securities by assessing the economic relationship in a country and the financial factors or financial statements of the company.

This study uses Fundamental Analysis by looking at the microeconomic side by looking at the company's financial statements or corporate financial ratios.

Decision Support Systems can be defined as a system designed to be used to support management in making decisions. (Latif, L.S., Jami, M., and Abbas, S.H., 2018).

Decision Support System is a further development of a computerized Management Information System which is designed in such a way as to be interactive with its use. (Sari, F. 2018).

MCDM is the process of selecting the best alternative from n alternatives based on *m* criteria. (Diana, 2018).

II. METHOD

The stages of the research carried out included data preparation, selection criteria, the method used and the implementation of the Decision Support System prototyping.

A. Data Preparation

The data in this study comes from the company's 2017 LQ45 financial statements summarized by the Indonesia Stock Exchange. Data is public and can be accessed through the Indonesia Stock Exchange website. The financial statements of each company will be selected according to the selection criteria.

B. Selection Criteria

The criteria for selecting stocks are carried out using a fundamental analysis approach, namely by reading the company's financial statements which focus on eight financial ratios, consisting of:

1. Return on Assets (ROA), the higher the better
   High ROA shows the company's performance in generating net income.
2. Return on Equities (ROE), the higher the better
   High ROE shows the company's performance in generating return on investment that has been issued.
3. Net Profit Margin (NPM), the higher the better
   A high NPM shows the percentage or ratio of net income after deducting interest and taxes generated from every dollar of sales or income.
4. Current Ratio (CR), the higher the better
   High CR shows the company's ability to meet short-term financial obligations.
5. Debt Ratio (DR), the smaller the better
   A small DR shows a small amount of company debt.
6. Debt Equity Ratio (DER), the smaller the better
   The small DER shows the amount of debt the company has used to carry out its operations compared to the value of its equity.
7. Total Assets Turnover (TATO), the bigger the better
   A large TATO shows the total return on assets that can be made by the company.
8. Price Per Earning (PER), the smaller the better
   A small PER shows how many times the market price is greater than the share income

Furthermore, each criterion is given a weighted value. The criterion weight is measured based on the assumption that each criterion has an equally important effect in determining the best stock.

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$$\sum Wj = 100\%$$

With:

W is weight = 12.5% = 0.125

j is number of criteria = 8.

TABLE 1. Criteria Weights

No	Criteria	Weight
1	Return on Assets (ROA)	0.125
2	Return on Equities (ROE)	0.125
3	Net Profit Margin (NPM)	0.125
4	Current Ratio (CR)	0.125
5	Debt Rasio (DR)	0.125
6	Debt Equity Rasio (DER)	0.125
7	Total Assets Turnover (TATO)	0.125
8	Price Per Earning	0.125

C. Selection Method

The best stock selection problem can be solved using the MCDM technique with using the TOPSIS and VIKOR methods.

1. TOPSIS Method

The TOPSIS method consists of five steps including:

- Normalization the Decision Matrix

$$R_{ij} = \frac{X_{ij}}{\sqrt{\sum_{i=1}^{m} X_{ij}^2}}$$

- Making a Weighted Normalized Decision Matrix

The matrix that has been normalized at the point will then be multiplied by the weight each of the criteria.

$$y_{ij=w_{ij}r_{ij}}$$

- Ideal Solution Matrix *(A)*

The Ideal solution consist of a positive ideal solution (A^+) and a negative ideal solution (A^-).

- Determining the Ideal Solution Distance (D)

The ideal solution distance consist of positive ideal solution distance (D^+) and the negative ideal solution distance (D^-). By using the following equation.

$$D_i^+ = \sqrt{\sum_{j=1}^{n} \left(y_i^+ - y_{ij}\right)^2}$$

- Preference Value

Calculate the preference value of each alternative using the following equation.

$$V_i = \frac{D_i^-}{D_i^- + D_i^+}$$

- Determination of preference value ranking

The smallest preference value is the best value or stock alternative that has the smallest preference value is the best stock alternative.

2. VIKOR Method

The VIKOR Method consists of five steps including:

- Decision Matrix Normalization

Normalization of the Decision Matrix using the following equation.

$$R_{ij} = \left(\frac{X_j^+ - X_{ij}}{X_j^+ - X_j^-}\right)$$

Before Normalizing the Decision Matrix, first determine the data value best X_j^+ and worst data values X_j^-. By using the following equation.

$$X_j^+ = max\left(X_{1j}, X_{2j}, \ldots, X_{nj}\right)$$

and

$$X_j^- = min\left(X_{1j}, X_{2j}, \ldots, X_{nj}\right)$$

- Weighted Normalized Matrix

Weighted Normalized Matrix multiplied by the weight of each criterion, can be calculated by the equation.

$$N = R_{ij}.Wij$$

- Calculation of the Utility Measure (S) and Regret Measure (R) values.

$$S_i = \sum_{j=1}^{n} W_j \left(\frac{X_j^+ - X_{ij}}{X_j^+ - X_j^-}\right)$$

and

$$R_i = Max\ j\left[W_j \left(\frac{X_j^+ - X_{ij}}{X_j^+ - X_j^-}\right)\right]$$

- VIKOR Index Calculation (Q)

Before calculating the VIKOR index (Q), The (S^+), (S^-) and (R^+) values calculation must first be done.

$$S^+ = \max(S_i)$$

$$S^- = \min(S_i)$$

and

$$R^+ = \max(R_i)$$

$$R^- = \min(R_i)$$

$$Q_i = \left[\frac{S_i - S^+}{S^+ - S^-}\right]V + \left[\frac{R_i - R^+}{R^+ - R^-}\right](1 - V)$$

- Determination of the VIKOR Index ranking

The index ranking is determined by sorting the VIKOR Index. The greater the VIKOR Index value, the better the stock ranking will be.

D. Implementation into Decision Support System Prototyping

DSS prototyping in this study was made based on a website that can be accessed from various devices connected to the Internet. The programming language used is Hypertext Preprocessor (PHP). For data storage using MYSQL. MYSQL database is only a place to store data on data preparation. Furthermore, processing is done in writing the program and the results of the processing will be displayed on the website page, without saving the data into the database.

III. DISCUSSION

Before doing calculations with the above equation, first the criteria and alternatives are compiled into a matrix. Show in Table 2.

TABLE 2. Decision Matrix

	C1	Cn	C8
A1	0.0182	…	9.1591
A2	0.0787	…	11.1947
An	…	…	…
A45	0.0429	…	5.5405

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A. *Topsis Method*

The steps in the TOPSIS method are

- Normalizing the Decision Matrix. Table 3
- Making a Weighted Normalized Matrix. Table 4
- Ideal Solution Matrix. Table 5
- Determining the Ideal Solution Distance. Table 6
- Preference Value. Table 7
- Determination of Preference Value Ranking. Table 8

TABLE 3. Normalizing the Decision Matrix

	C1	Cn	C8
A1	0.0220	…	0.0278
A2	0.0949	…	0.0339
An	…	…	…
A45	0.0517	…	0.0168

The next step is to create a weighted Normalization Matrix.

TABLE 4. Weighted Normalized Matrix

	C1	Cn	C8
A1	0.0027	…	0.0035
A2	0.0119	…	0.0042
An	…	…	…
A45	0.0065	…	0.0021

The next step is determining the positive Ideal Solution and the negative Ideal Solution.

TABLE 5. Ideal Solution Matrix

A^+	0.0558	0.0875	0.0508	…	-0.0699
A^-	-0.0011	-0.0005	-0.0025	…	0.0760

The next step is to determine the Ideal Solution Distance Matrix.

TABLE 6. Ideal Solution Distance Matrix

	D^+	D^-
A1	0.1464	0.0870
A2	0.1327	0.1041
An	…	…
A45	0.1386	0.0915

The next step is to determine the preference value.

TABLE 7. Preference Value

Alternatif	V	Alternatif	V	Alternatif	V
A1	0.3728	A16	0.3036	A31	0.3960
A2	0.4397	A17	0.4533	A32	0.5052
A3	0.4346	A18	0.5299	A33	0.4097
A4	0.2712	A19	0.4301	A34	0.4513
A5	0.4318	A20	0.5692	A35	0.5205
A6	0.3839	A21	0.4215	A36	0.3974
A7	0.3713	A22	0.4492	A37	0.4264
A8	0.3660	A23	0.4231	A38	0.3253
A9	0.3238	A24	0.4307	A39	0.4678
A10	0.3685	A25	0.4960	A40	0.4170
A11	0.4334	A26	0.3728	A41	0.4442
A12	0.4868	A27	0.4672	A42	0.5660
A13	0.4449	A28	0.5796	A43	0.3948
A14	0.4342	A29	0.3949	A44	0.4307
A15	0.4450	A30	0.4541	A45	0.3976

The next step, doing the ranking with the smallest preference value is the value that has the best alternative.

TABLE 8. Preference Value Ranking

Alt	V	R	Alt	V	R	Alt	V	R
ANTM	0.2712	1	PTPP	0.4097	16	ERAA	0.4450	31
EXCL	0.3036	2	TPIA	0.4170	17	INDY	0.4492	32
BBTN	0.3238	3	INDF	0.4215	18	PWON	0.4513	33
TKIM	0.3253	4	INKP	0.4231	19	GGRM	0.4533	34
BBRI	0.3660	5	SRIL	0.4264	20	MNCN	0.4541	35
BMRI	0.3685	6	ICBP	0.4301	21	KLBF	0.4672	36
BBNI	0.3713	7	WSBP	0.4307	22	TLKM	0.4678	37
JSMR	0.3728	8	INTP	0.4307	23	BSDE	0.4868	38
ADHI	0.3728	9	ASII	0.4318	24	ITMG	0.4960	39
BBCA	0.3839	10	BRPT	0.4334	25	PTBA	0.5052	40
WIKA	0.3948	11	ELSA	0.4342	26	SCMA	0.5205	41
MEDC	0.3949	12	AKRA	0.4346	27	HMSP	0.5299	42
PGAS	0.3960	13	ADRO	0.4397	28	UNVR	0.5660	43
SMGR	0.3974	14	UNTR	0.4442	29	INCO	0.5692	44
WSKT	0.3976	15	CPIN	0.4449	30	LPPF	0.5796	45

With :

- Alt is Alternatif or Share Names
- V is Index TOPSIS
- R is Ranking

B. *VIKOR Method*

The steps in the VIKOR method are:

- Normalizing the Decision Matrix. Table 9
- Making a Weighted Normalization Matrix. Table 10
- Utility Measure Value Calculation. Table 11
- VIKOR Index Calculation. Table 12
- Determination of the VIKOR Index Ranking. Table 13

Making normalization of the decision matrix.

TABLE 9. Normalization of the Decision Matrix

	C1	Cn	C8
A1	0.9332	…	0.4973
A2	0.7730	…	0.4921
An	…	…	…
A45	0.8678	…	0.5067

The next step, creating a weighted normalization matrix.

TABLE 10. Weighted Normalization Matrix

	C1	Cn	C8
A1	0.1167	…	0.0622
A2	0.0966	…	0.0615
An	…	…	…
A45	0.1085	…	0.0633

The next step, calculating the value of the Utility Measure and Regred Measure.

TABLE 11. Utility Measure and Regred Measure

	(S)	(R)
A1	0.7234	0.1229
A2	0.7507	0.1190
An	…	…
A45	0.7070	0.1219

The next step, calculating the VIKOR Index.

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TABLE 12. VIKOR Index

	(S)
A1	0.7612
A2	0.6414
An	…
A45	0.7088

The next step is to determine the VIKOR Index Ranking.

TABLE 13. VIKOR Index Ranking

Alt	Q	R	Alt	Q	R	Alt	Q	R
INCO	1.0000	1	SCMA	0.7019	16	BRPT	0.5738	31
INTP	0.8315	2	SMGR	0.6964	17	PTPP	0.5640	32
ANTM	0.8299	3	ELSA	0.6935	18	INDF	0.5481	33
EXCL	0.7943	4	MNCN	0.6788	19	INDY	0.5477	34
BMRI	0.7784	5	ITMG	0.6784	20	TPIA	0.5414	35
BBNI	0.7683	6	MEDC	0.6772	21	AKRA	0.5347	36
KLBF	0.7658	7	ICBP	0.6554	22	ASII	0.5289	37
TKIM	0.7629	8	GGRM	0.6428	23	PWON	0.5202	38
ADHI	0.7612	9	ADRO	0.6414	24	TLKM	0.5121	39
BBRI	0.7501	10	HMSP	0.6362	25	SRIL	0.4826	40
BBTN	0.7404	11	CPIN	0.6285	26	WSBP	0.4652	41
JSMR	0.7265	12	WIKA	0.6068	27	ERAA	0.4425	42
BBCA	0.7248	13	BSDE	0.6020	28	INKP	0.3921	43
PGAS	0.7199	14	UNTR	0.5981	29	UNVR	0.3205	44
WSKT	0.7088	15	PTBA	0.5812	30	LPPF	0.1201	45

Presentation of calculation results using the TOPSIS method and the VIKOR method.

TABLE 14. Presentation Result Calculation TOPSIS and VIKOR

TOPSIS			VIKOR		
Alt	**V**	**R**	**Alt**	**V**	**R**
ANTM	0.2712	1	INCO	1.0000	1
EXCL	0.3036	2	INTP	0.8315	2
BBTN	0.3238	3	ANTM	0.8299	3
TKIM	0.3253	4	EXCL	0.7943	4
BBRI	0.3660	5	BMRI	0.7784	5
BMRI	0.3685	6	BBNI	0.7683	6
BBNI	0.3713	7	KLBF	0.7658	7
JSMR	0.3728	8	TKIM	0.7629	8
ADHI	0.3728	9	ADHI	0.7612	9
BBCA	0.3839	10	BBRI	0.7501	10
WIKA	0.3948	11	BBTN	0.7404	11
MEDC	0.3949	12	JSMR	0.7265	12
PGAS	0.3960	13	BBCA	0.7248	13
SMGR	0.3974	14	PGAS	0.7199	14
WSKT	0.3976	15	WSKT	0.7088	15
PTPP	0.4097	16	SCMA	0.7019	16
TPIA	0.4170	17	SMGR	0.6964	17
INDF	0.4215	18	ELSA	0.6935	18
INKP	0.4231	19	MNCN	0.6788	19
SRIL	0.4264	20	ITMG	0.6784	20
ICBP	0.4301	21	MEDC	0.6772	21
WSBP	0.4307	22	ICBP	0.6554	22
INTP	0.4307	23	GGRM	0.6428	23
ASII	0.4318	24	ADRO	0.6414	24
BRPT	0.4334	25	HMSP	0.6362	25
ELSA	0.4342	26	CPIN	0.6285	26
AKRA	0.4346	27	WIKA	0.6068	27
ADRO	0.4397	28	BSDE	0.6020	28
UNTR	0.4442	29	UNTR	0.5981	29
CPIN	0.4449	30	PTBA	0.5812	30
ERAA	0.4450	31	BRPT	0.5738	31
INDY	0.4492	32	PTPP	0.5640	32
PWON	0.4513	33	INDF	0.5481	33
GGRM	0.4533	34	INDY	0.5477	34
MNCN	0.4541	35	TPIA	0.5414	35
KLBF	0.4672	36	AKRA	0.5347	36
TLKM	0.4678	37	ASII	0.5289	37
BSDE	0.4868	38	PWON	0.5202	38
ITMG	0.4960	39	TLKM	0.5121	39
PTBA	0.5052	40	SRIL	0.4826	40
SCMA	0.5205	41	WSBP	0.4652	41
HMSP	0.5299	42	ERAA	0.4425	42
UNVR	0.5660	43	INKP	0.3921	43
INCO	0.5692	44	UNVR	0.3205	44
LPPF	0.5796	45	LPPF	0.1201	45

The calculation results between the TOPSIS method and the VIKOR method found that 7 of the same stock codes were included in the top ten rankings, namely: ADHI, ANTM, BBRI, BBNI, BMRI, EXCL and TKIM. Each ticker code comes from a different business sector, namely: mining, telecommunications, banking, pulp & paper and property. This difference in business sectors can be used to diversify investment assets to minimize risks.

C. Implementation of Decision Support System Prototyping

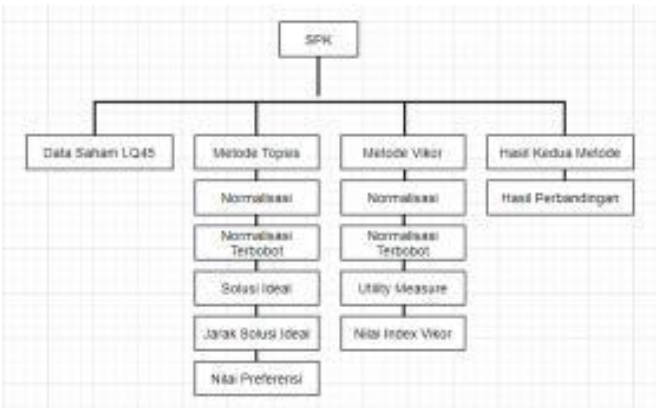

Figure 1. Navigation Structure

Navigation structure describes the menu structure of this DSS prototyping where:

- The LQ45 Stock Data page contains stock data that will be used with the TOPSIS and VIKOR methods.

Figure 2. Presentation Result Calculation TOPSIS and VIKOR

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- TOPSIS Method page, contains the steps taken in selecting stocks using the TOPSIS method.
- The VIKOR Method page, contains the steps involved in selecting the best stock alternative using the VIKOR method.
- Results Page of both methods, contains a comparison of the results of the TOPSIS and VIKOR methods taken from the top 10 rankings.

This prototyping is based on a website created by using PHP as the programming language.

IV. CONCLUSION AND RECOMENDATION

A. Conclution

In the research, the determination of the best stock alternative was carried out by the TOPSIS method and the VIKOR method. The working equation for the two methods is the weighting equation in the criteria used and the decision matrix used. Meanwhile, the difference between the two methods lies in the principles of the two methods. In this case, the TOPSIS method for the chosen alternative not only has the shortest distance from the positive ideal solution but also has the longest distance from the negative ideal solution. Meanwhile, the VIKOR method for the chosen alternatives in the ranking by compromising the alternative results and conflicting criteria.

The results of the ranking of alternative stocks using both methods show that there are seven stocks that are included in the 10 best stocks. The seven shares are ADHI, ANTM, BBRI, BBNI, BMRI, EXCL and TKIM. The best stocks come from various industries, namely Mining, Telecommunications, Banking, Pulp & Paper and Property.

B. Recommendation

The future development suggestions in this prototyping are to add data input form features from financial reports and more dynamic stock analysis results, not only for one year but can be done quarterly analysis.

REFERENCES

[1] Baresa,S., Bogdan,S., dan Ivanovic, Z.(2012). *Strategy of Stock Valuation by Fundamental Analysis.* UTMS Journal of Economics,4(1), 45-51.
[2] Diana. (2018). Metode dan Aplikasi Sistem Penunjang Keputusan .
[3] Faniyah, I.(2017). Investasi Syariah dalam Pembangunan Ekonomi Indonesia.
[4] Herawati, A., dan Putra Setiadi, A.(2018). *The Influence of Fundamental Analysis on Stocck Prices : The Case of Food and Beverage Industries*. European Research Studies Journal, 21(3), 316-326.
[5] IDX. Saham. [Online]. Available at : https://www.idx.co.id/produk/saham [Accessed 07 Desember 2012].
[6] Khotimah, K., dan Murtaqi, I.(2015). *The Fundamental Analysis of Indonesian Stock Return (Case Study : Listed Public Companies in Sub-Sector Food and Beverage for the Period 2003 - 2012).* Journal of Business and Management, 4(1), 95-104.
[7] Latif, L.S., Jamil, M., dan Abbas, S.H., (2018). Buku Ajar : Sistem Penunjang Keputusan Teori dan Implementasi.
[8] Nofriansya, D.(2014). Konsep Data Mining Vs Sistem Penunjang Keputusan.
[9] Nofriansyah, D dan Defit, S. (2017). Multi Criteria Decision Making (MCDM) Pada Sistem Penunjang Keputusan.
[10] Sari, F.(2018). Metode dalam Pengambilan Keputusan.
[11] Seng, D., dan Hancock, R,. (2012). *Fundamental Analysis and the Prediction of Earnings.* International Journal of Business and Management. 7(3).
[12] Wafi, S, A., Hassan, H., dan Mabrouk, A.(2015). *Fundamental Analysis Model in Financial Markets – Review Study.* Procedia Economic and Finance 30(2015), 939-947.