Application of TOPSIS Analysis Method in Financial Performance Evaluation: A Case Study of Construction Sector in Malaysia

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Abstract

This research aims to propose TOPSIS model in evaluating, comparing, and ranking the Malaysian companies under the construction sector according to their financial performance using financial ratio. Previously, TOPSIS model and financial ratio as tools of measurement have been applied to evaluate, compare, and rank the financial performance of the companies. Nevertheless, there are not many researches have been done on TOPSIS model in Malaysia's construction sector. Hence, this paper intends to fill in the loopholes by assessing the performance of the companies from the construction sector in Malaysia stock market by implementing the proposed model. Based from the findings, TOPSIS model was able to assess the companies' financial performance and consequently rank them. The results from the study parallel with the study done by other investment agencies. Therefore, this method can be opted to substitute the fundamental and technical valuation that is commonly utilised by the investment analysts.

Keywords: TOPSIS Analysis, financial performance, multi criteria.

1. Introduction

During 2011-2015, the construction industry in Malaysia was supported by the 10th Malaysia Plan 2011-2015. Under this plan the government distributed a great proportion of investment in residential buildings, infrastructure and industrial park. Since then, the Malaysian construction industry has documented a normal growth rate of 10.7% throughout the review term (2011-2015). Still, Malaysian construction industry is projected to grow bigger over 2016-2020 reinforced by the government's plan to enhance the infrastructure of the country in view to achieve vision of developed country in 2020.

In Bursa Malaysia, there are 70 companies listed under construction sector in main market. Those companies can be evaluated using financial analysis to examine their financial performance. Generally, financial analysis is used

to analyse liquidity, efficiency, solvency, and profitability of a company. For that purpose, the financial report of a company comprises of balance sheet, income statement and cash flow statement will be examined. Financial ratio is the tool used to analyse the statements. Thus, financial ratios such as current ratio, debt to equity ratio, profit margin, return on equity, dividend yield, earnings per share and price earnings ratio will be employed in this study.

These financial ratios will be evaluated by the Technique for Order of Preference by Similarity to Ideal Solution (TOPSIS). TOPSIS model is a multi-criteria decision analysis grounded from the idea that the selected alternative the shortest geometric distance from the positive ideal solution (PIS) and the longest geometric distance from the negative ideal solution (NIS). The model is an approach of compensatory aggregation which collates a set of options by recognising weights for each criterion, normalising scores for each criterion and computing the geometric distance between each option and the ideal option, that is the best score in each criterion. TOPSIS model also enable one to assess and collate the companies' financial performance based on several criteria. However, there is no study has been done on the construction industry in Malaysia, thus, this study aspires to fill in the gap.

The main goal of this research is to recommend TOPSIS model in evaluating, comparing, and ranking the Malaysian companies under construction sector according to their financial performance by using financial ratio. The rest of this paper is separated into four sections. Section 2 presents the literature review; Section 3 explains on the data and methodology; Section 4 documents on the findings and analysis; and Section 5 discusses on the conclusion and future study.

2. Literature Review

2.1 Risks in Investments

The word "invest" is defined by English Oxford Dictionary as "putting money into financial schemes, shares, property or a commercial venture with the expectation of achieving profit". Therefore, any investments done by a person or investor always come with the intention to attain more money or to increase wealth. Investors all over the world make investments in numerous business sectors. The most common risk in any investments is the actual return is less than predicted, in which there is a possibility of losing some or even all the original investments (Mădălina and Mariana, 2017). Thus,evaluation of finance is vital process because the result of evaluation is indicator of future sustainability (Kharusi and BAŞCI 2017).

Investments in stock market or share do not assure good return unless the investors have a knowledge or strategy on how to choose a potential stock or share. (Fahami et al. 2015).Thus, it is very clear that a method or strategy is required to determine the stock or share with good investments potential.

2.2 Investments Sectors in Malaysia

In Malaysia, it was observed that many investors are looking forward to make investments in plantations, services, and consumers sectors (Fahami et al. 2015) Besides that, construction and manufacturing can be considered among the important business sectors in Malaysia since there are 39 companies listed in Bursa Malaysia belong to Construction Sector. The construction industry appears several times in national account such as Gross Domestic Product, Gross National Income and Gross Fix Capital Formation. Its show Construction Sector is powerful mechanism to achieving sustainable development.(Olanrewaju and Abdul-Aziz 2015) Even with the suffer from the great recession, in the last few years constructions works are increasing significantly (Construction World, 2017). The diversity of jobs in the construction industry includes the residential, industrial and commercial sectors. In Malaysia itself, there are many construction companies actively involved in this sector. This is possibly due to the various initiatives and incentives by the government to support the construction industry.

2.3 Financial Ratio as a Tool of Measurement

In the world of investment, an appropriate and accurate data is needed as a platform to evaluate the performance of a company. Financial ratios are created to analyse a company's financial statement. They include essential data for both investors and analysts to recognise the financial performance of a company for specific period of time. Fundamentally, they can be categorised into liquidity ratio, activity ratio, leverage ratio, profitability ratio, and market ratio. The analysis can be done over trend analysis or collation with other companies from the same industry.,Based on past research The analysis of financial performance show the level of sustainability of

companies within industry(Kharusi and BAŞCI 2017),(Fahami et al. 2019)(Fahami et al. 2015) (Fai, Siew, and Hoe 2016)

2.4 TOPSIS Model

Multi-criteria decision-making techniques are handy tools to aid a person in selecting the best alternative. There are many types of multi-criteria techniques. MAXMIN, MAXMAX, SAW, AHP, TOPSIS, SMART, and ELECTRE are among the most commonly utilised methods(Hwang and Yoon 1981) . The selection of which method is determined by the addressed problem: choosing, ranking, or sorting. In this research, TOPSIS (Technique for Order Preference by Similarity to the Ideal Solution) is a tool for evaluating financial performance of construction companies listed in Malaysia's stock exchange market. TOPSIS which stands for "*Technique for Order of Preference by Similarity to Ideal Solution"* (as mentioned in the introduction part), was initially developed by Hwang and Yoon in 1981 (Hwang & Yoon, 1981). The TOPSIS chooses the alternative nearest to the ideal solution and farthest from the non-ideal solution. The classical TOPSIS method is based on information on the attributes from decision makers and numerical data. The solution is aimed at evaluating, prioritising, and selecting. The only subjective inputs are weights.

2.5 TOPSIS Model Application in Evaluating Financial Performance

Technique for Order of Preference by Similarity to Ideal Solution (TOPSIS) is powerful tool that able to solve multi-criteria decision-making problem and rank the best decision options (Hwang and Yoon 1981).There are many studies has been done by using TOPSIS to indicate the financial performance such as Fahami et al (2019) adapting TOPSIS to analysis financial performance of companies listed in Service Sector in Malaysia and recommend TOPSIS as tool to analyse and rank the companies listed accordingly.(Cam, Cam, and Ulutas 2015) has conducted a study on evaluating financial performance of a textile firm which is traded in Borsa Istanbul by using TOPSIS and traditional financial indicator (financial ratio).

Liew Kah Fei et al. (2016) focuses on evaluating, comparing, and ranking the overall financial performance of 23 companies in financial sector which is listed in Malaysia's Stock Exchange by applying the TOPSIS model. According to the author the study is significant to investor due to the capability to evaluate and rank the companies by considering all the financial ratios with TOPSIS model.(Hoe, Siew, and Wai 2017) conducted a study on evaluating, comparing, and ranking the financial performance of bank institution in Malaysia Stock Exchange market by using TOPSIS. The data consisted of 8 banks and the performance of the banks has been determined by 6 types of financial ratios.

Based on a study done by (Gulsun, 2015),the author focuses on analyzing financial performance by using TOPSIS and financial tables of 16 pension and life pension companies. The author used financial ratio table as an indicator of financial strength and calculated separately for each company. Then, the companies are sorted according to the financial score. (Shaverdi et al. 2016) also reported the effectiveness of TOPSIS. The model is construct by using main financial criteria and their sub criteria and the weights were determined by fuzzy analytic hierarchy process.

Based on the previous studies, TOPSIS model and financial ratio as tool of measurement has been applied in different fields and countries to evaluate, compare and rank the financial performance of the companies based on several criteria. Nonetheless, studies on TOPSIS model in Malaysia's construction sector has not been done extensively. Thus, the research intends to fill the void by assessing the companies' performance in the construction sector in Malaysia stock market by using the model.

3. Data and Methodology

The data which consists of 42 listed construction companies in Malaysia for 2016 was retrieved from *DataStream* and tabulated in Table 1.

Table 1: Margin specifications Construction companies in Malaysia stock market

Company	Code
Malaysian Resources	C1
UEM Edgenta Bhd	C2
Benalec Holdings Bhd	C3
Eversendai Corp	C4
Gamuda Berhad	C5
Hock Seng Lee Berhad	C6
IJM Corporation Bhd	C7
Mudajaya Group Bhd	C8
Muhibbah Engineering	C9
WCT Holdings Bhd	C10

The 10 companies in 2016 were analysed by TOPSIS method depends on seven financial ratios. The financial ratios involved in this paper are current ratio, return on equity (ROE), profit margin, debt to equity ratio, earnings per share (EPS), dividend yield, and price earnings (PE) ratio to evaluate their financial performance.

The most ideal alternatives seek the criteria that are required to be maximised are current ratio, ROE, profit margin, EPS and dividend yield. Meanwhile, the criteria such as debt to equity ratio and PE ratio are the ones required to be minimised.

TOPSIS method intends to resolve challenges relating to multi-criteria decision making [6]. The geometric distance from both positive and negative ideal solutions are taken into consideration in the TOPSIS method. The method comprises of seven steps as listed below.

Step 1: Formation of decision matrix ($(x_{ij})_{m\times n}$).

Create a decision matrix which comprises of *m* alternatives (companies) and *n* criteria (financial ratio). The score of each alternative relating to each criterion is specified as x_{ij}, and then a matrix $(x_{ij})_{m\times n}$ is formed as below.

$$(x_{ij})_{m\times n} = \begin{bmatrix} x_{11} & x_{12} & \dots & x_{1n} \\ x_{21} & x_{22} & \dots & x_{2n} \\ . & & & . \\ . & & & . \\ . & & & . \\ x_{m1} & x_{m2} & \dots & x_{mn} \end{bmatrix} \quad (1)$$

Step 2: Normalisation of the decision matrix.

Create normalised decision matrix $R = (r_{ij})_{m\times n}$ by converting different attribute dimensions into non-dimensional attributes as presented below.

$$r_{ij} = \frac{x_{ij}}{\sqrt{\sum_{i=1}^{m} x_{ij}^2}}, i = 1,2,\dots,m, j = 1,2,\dots,n \quad (2)$$

$$\mathbf{R} = (r_{ij})_{m\times n} = \begin{bmatrix} r_{11} & r_{12} & \dots & r_{1n} \\ r_{21} & r_{22} & \dots & r_{2n} \\ . & & & . \\ . & & & . \\ . & & & . \\ r_{m1} & r_{m2} & \dots & r_{mn} \end{bmatrix} \quad (3)$$

*Step 3: Formation of weighted normalised decision matrix (***T***).*

Calculate the weighted normalised decision matrix as follow.

$$\mathbf{T} = (t_{ij})_{m\times n} = (w_j r_{ij})_{m\times n}, i = 1,2,..., m \quad (4)$$

where $w_j = \dfrac{W_j}{\sum_{j=1}^{n} W_j}, j = 1,2,...,n$

$\sum_{j=1}^{n} w_j = 1$ and W_j is the original weight given to the indicator w_j, j=1, 2, …,n.

$$\mathbf{T} = \begin{bmatrix} w_1 r_{11} & w_2 r_{12} & \dots & w_n r_{1n} \\ w_1 r_{21} & w_2 r_{22} & \dots & w_n r_{2n} \\ . & & & . \\ . & & & . \\ . & & & . \\ w_1 r_{m1} & w_2 r_{m2} & \dots & w_n r_{mn} \end{bmatrix} \quad (5)$$

Step 4: Determination of the positive/best ideal (A_b) solution and the negative/worst ideal (A_w) solution.

$$A_b = \{\langle \min(t_{ij} \mid i = 1,2,...,m) \mid j \in J_- \rangle, \\ \langle \max(t_{ij} \mid i = 1,2,...,m) \mid j \in J_+ \rangle\} \equiv \{t_{bj} \mid j = 1,2,...,n\}, \quad (6)$$

$$A_w = \{\langle \max(t_{ij} \mid i = 1,2,...,m) \mid j \in J_- \rangle, \\ \langle \min(t_{ij} \mid i = 1,2,...,m) \mid j \in J_+ \rangle\} \equiv \{t_{wj} \mid j = 1,2,...,n\}, \quad (7)$$

where,

$J_+ = \{j = 1,2,..., n \mid j$ relates with the criteria that have a positive impact, and

$J_- = \{j = 1,2,..., n \mid j$ relates with the criteria that have a negative impact.

Step 5: Calculation of the separation measures for each alternative from the best ideal solution and negative ideal solution.

The equation of the separation measures for each alternative is shown below:

$$d_{ib} = \sqrt{\sum_{j=1}^{n}(t_{ij} - t_{bj})^2}, i = 1,2,...,m \quad (8)$$

The calculation of the distance from the negative ideal solution is presented below:

$$d_{iw} = \sqrt{\sum_{j=1}^{n}(t_{ij} - t_{wj})^2}, i = 1,2,...,m \quad (9)$$

Step 6: Calculation of the relative closeness to the ideal solution for each alternative:

The calculation of relative closeness to the ideal solution s_{iw} for each alternative is presented below.

$$s_{iw} = \frac{d_{iw}}{d_{ib} + d_{iw}}, 0 \le s_{iw} \le 1, i = 1,2,...,m \quad (10)$$

$s_{iw} = 0$ if and only if the alternative solution has the worst condition while $s_{iw} = 1$ if and only if the alternative solution has the best condition.

Step 7: Rank the alternatives.

Rank the alternatives can be analysed by looking at the relative closeness coefficient in s_{iw} descending order. The alternative with the highest s_{iw} is considered as the best alternative.

4. Results

The decision making matrix, normalised decision matrix, and weighted normalised decision matrix are exemplified in the following tables. Table 2 which refers to the decision making matrix shows decisions based on certain decision criteria. Table 3 and Table 4 compares a set of alternatives by identifying weights for each criterion, normalising the scores for each criterion while Table 5 displays the positive ideal solution and negative ideal solution for each decision criterion. And, Table 6 shows the distance of the alternative from the positive and negative ideal solution. All these tables signify the process to reach the final result as tabulated in Table 7.

Table 2: Multi Criteria Decision Making Matrix

Company	Current ratio	ROE (%)	Profit margin (%)	Debt to equity ratio	EPS	Dividend yield (%)	PE ratio
C1	1.33	1.97	0.138	9.79	10.31	39.68	10.84
C2	1.89	2.3	0.097	2.65	5.91	28.46	26.24
C3	1.99	2.97	12.5	15.89	0.021	1.44	29.69
C4	1.26	-28	-9.79	39.88	-0.36	0.53	-3.7
C5	2.37	9.48	18.28	34.05	0.26	2.23	20.62
C6	3.55	8.3	14.36	0.78	0.103	1.45	17.41
C7	2.98	9.09	15.47	29.84	0.222	2.14	19.16
C8	1.44	-41.87	-0.13	39.86	-0.711	0	-2.02
C9	1.09	11.62	4.86	32.72	0.222	2	12.26
C10	1.43	2.54	6.24	40.74	0.055	1.42	28.95

Table 3: Normalised Decision Matrix

Company	Current ratio	ROE (%)	Profit margin (%)	Debt to equity ratio	EPS	Dividend yield (%)	PE ratio
C1	0.202	0.036	0.004	0.107	0.865	0.809	0.176
C2	0.287	0.042	0.002	0.029	0.495	0.580	0.426
C3	0.302	0.054	0.377	0.174	0.001	0.029	0.482
C4	0.191	-0.516	-0.295	0.437	-0.030	0.010	-0.060
C5	0.360	0.174	0.552	0.373	0.021	0.045	0.334
C6	0.539	0.153	0.434	0.008	0.008	0.029	0.282
C7	0.452	0.167	0.467	0.327	0.018	0.043	0.311
C8	0.218	-0.772	-0.003	0.437	-0.059	0	-0.032
C9	0.165	0.214	0.146	0.358	0.018	0.040	0.199
C10	0.217	0.046	0.188	0.446	0.004	0.028	0.470

Table 4: Weighted Normalised Decision Matrix

Company	Current ratio	ROE (%)	Profit margin (%)	Debt to equity ratio	EPS	Dividend yield (%)	PE ratio
C1	0.028	0.005	0.000	0.015	0.123	0.116	0.025
C2	0.040	0.006	0.000	0.004	0.070	0.083	0.060
C3	0.043	0.007	0.053	0.024	0.000	0.004	0.068
C4	0.027	-0.073	-0.042	0.062	-0.004	0.001	-0.008
C5	0.051	0.024	0.078	0.053	0.003	0.006	0.0478
C6	0.076	0.021	0.061	0.001	0.001	0.004	0.0403
C7	0.064	0.023	0.066	0.046	0.002	0.006	0.044
C8	0.031	-0.110	-0.000	0.062	-0.008	0	-0.004
C9	0.023	0.030	0.020	0.051	0.002	0.005	0.028
C10	0.030	0.006	0.026	0.063	0.000	0.004	0.067

Table 5: Positive Ideal (A_b) and Negative Ideal (A_w) Solutions

Ideal Solution	Current ratio	ROE (%)	Profit margin (%)	Debt to equity ratio	EPS	Dividend yield (%)	PE ratio
Positive ideal solution (A_b)	0.076	0.030	0.078	0.001	0.123	0.116	-0.008
Negative ideal solution (A_w)	0.023	-0.110	-0.042	0.063	-0.008	0	0.068

The distance of all alternatives from the positive ideal solution (d_{ib}) and negative ideal solution (d_{iw}) by using the equation (8) and (9) are displayed separately in Table 6.

Table 6: Distance of the alternatives from the positive ideal solution (d_{ib}) and negative ideal solution (d_{iw})

Company	d_{ib}	d_{iw}
C1	0.101831964	0.224731793
C2	0.129209322	0.180513496
C3	0.19147272	0.15856423
C4	0.247516832	0.085825388
C5	0.182213806	0.185411239
C6	0.174186376	0.189587089
C7	0.178925112	0.180431768
C8	0.251057339	0.084795836
C9	0.192123419	0.160602578
C10	0.206773749	0.136412882

The relative closeness to the ideal solution, s_{iw} for each alternative is determined based on equation (10). Table 7 presents the relative closeness distance of each decision alternative to the ideal solution, s_{iw}. The overall financial performance of the companies is measured by looking at their relative closeness distance to the ideal solution, s_{iw} in downward direction. The company with the highest S_{iw} is ranked as the best alternative which gives the utmost financial performance.

Table 7: Relative closeness distance of the decision alternative to ideal solution (s_{iw})

Code	Companies	Relative Closeness to the Ideal Solution, s_{iw}	Rank
C1	Malaysian Resources	0.688171	1
C2	UEM Edgenta Bhd	0.582823	2
C6	Hock Seng Lee Berhad	0.521168	3
C5	Gamuda Berhad	0.504349	4
C7	IJM Corporation Bhd	0.502096	5
C9	Muhibbah Engineering	0.455318	6
C3	Benalec Holdings Bhd	0.452993	7
C10	WCT Holdings Bhd	0.397489	8
C4	Eversendai Corp	0.257469	9
C8	Mudajaya Group Bhd	0.252479	10

Table 7 indicates the ranks of the companies based on their financial performance using TOPSIS method. From the table, it can be seen that the top three companies are Malaysian Resources, UEM Edgenta and Hock Seng Lee Berhad. The result has been compared with the analyses from the *Datastream* and it can be determined that the methodology used is reliable. As an illustration, the analysts recommended that the investors should 'buy' (invest) or 'hold' the Malaysian Resources share which also has been ranked number one based on TOPSIS model. Similarly, the analaysts has recommend 'buy' and 'hold' signal for the UEM Adgenta which has been ranked as number two among the selected construction companies. On the other hand, the ranking of the last two companies which are eversendai Corp and Mudajaya Group Sdn Bhd have also been certified by the *Datastream.* Majority of the analysts has suggest the 'sell' signal for Eversendai while there is no recommendation for Mudajaya by the analysts. This finding confirms that TOPSIS method is not only significant in assessing the companies' financial performance but most importantly can give ranking among the companies under study.

5. Conclusion

In short, the research objectives have been fulfilled. The finding reveals that the TOPSIS analysis method is reliable to be used in evaluating the financial performance and subsequently ranking the companies. The results are also consistent with the analysis by other investment agencies obtained from the *Datastream.* Therefore, it is evident that this method can be opted as another choice to the fundamental and technical valuation which is extensively utilised by the investment analysts. Nevertheless, the findings is limited to construction sector in Malaysia only. Thus, future research should be focusing on other sectors as well in testing the viability of the method and consequently enhance the approach used.

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