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# Optimization on the Efficiency of the Construction Sector Companies in Malaysia With Data Envelopment Analysis Model

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## Abstract

Construction industry contributes to the growth of economy in Malaysia. Therefore, efficiency is important to measure how well the construction company is performing in utilizing the resources to generate outcomes. The aim of this research is to evaluate the efficiency of the listed construction sectors companies in Malaysia with Data Envelopment Analysis model. In this study, BREM, DKLS, ECONBHD, HSL, KERJAYA, MELATI, MLGLOBAL, PTARAS, PUNCAK, SUNCON and ZECON are ranked as efficient companies which achieve 100% efficiency score. This study is significant because it helps to identify the efficient companies that serve as benchmark to other inefficient companies for further improvement.

**Keywords:** Construction sector; Data envelopment analysis; Efficiency; Total inputs; Total outputs.

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## 1. Introduction

The construction industry contributes to the growth of economy in Malaysia in term of economic development (Olanrewaju, 2015). There is RM280.25 billion allocated under construction sector towards on expanding an exclusive economy while looking forward to the Transformasi Nasional 2050 (TN50) goals and making Malaysia as a top 20 country in the world (CIDB, 2018). The construction activities involve building construction, civil and infrastructure, property development, mechanical, electric as well as plumbing (MEP). Data Envelopment Analysis (DEA) is a linear programming model (Charnes, 1978) that widely applied in different organizations such as hospitals, banks, insurances, universities, school and service operations.

Ling (2010) applied DEA model in year 2003 to measure the efficiency of 20 listed companies in Malaysia. In their study, the inputs were current ratio (CR), debt ratio (DR), debt-to-equity ratio (DER) whereas the outputs were returns on investment (ROI), return on equity (ROE) and earnings per share (EPS). Genting Berhad, Maxis and YLI were identified as efficient companies because these companies obtained 100% efficiency score. Arsad *et al.* (2014) applied DEA model on 50 selected listed companies in Malaysia to evaluate the efficiency scores for year 2011 and 2012. In their study, price to earnings ratio (PER), Altman's z- score and rating are the 3 inputs while EPS, divided per share (DPS) and return of earnings (ROE) are the 3 outputs that been used to compute the efficiency score as the financial ratios.

Sufian (2013) examined the efficiency score for bank sectors from year 1997 to 2006. The results of their study showed that most efficient banks were highly ranked in terms of returns with comparatively low standard deviation and beta. In addition, DEA model has also been applied in different stock market for bank sectors, real estate investment trust and aquaculture sector (Abdul-Wahab, 2015; Chuweni, 2016; Harun *et al.*, 2012; Iliyasu, 2016; Kamarudin and Ismail, 2014; Ng *et al.*, 2014; Tahir and Bakar, 2009; Tahir *et al.*, 2010; Yang, 2014; Yue, 1992).

Since there is no comprehensive study done on the efficiency of construction sector companies in Malaysia, this research aims to fill the research gap by using DEA model with financial ratios.

This study aims to evaluate the efficiency of listed construction sector companies in Malaysia with DEA model. Besides that, this study also aims to identify the efficient companies which can serve as benchmark to other inefficient companies for potential improvement. The methodology of DEA model is presented in Section 2. The next section presents the empirical results of this study. The last section concludes the paper and implication for future study.

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## 2. Data and Methodology

DEA model is utilized to assess the efficiency of the organizational units as a ratio of total outputs to total inputs (Charnes, 1978; Ramanathan, 2003). DEA model has been applied by Tsolas (2012) to evaluate the profitability and stock market performance of 19 listed construction firms in Athens Exchange.

Data is obtained from the financial reports of 46 companies in year 2016 to perform the financial ratios analysis. Financial ratio analysis is a powerful tool which helps the organization to monitor their company's performance (Lam W. H. *et al.*, 2017; Lam W. S. *et al.*, 2018b; Lam W. H. *et al.*, 2018a; Lam W. S. *et al.*, 2018c). Based on the analysis, the strength and weakness of the company can be identified for further improvement. In this study, the inputs include debt to equity ratio (Fraser and Ormiston, 2004; Östring, 2003), debt to assets ratio (Östring, 2003) and current ratio (Ablanedo-Rosas *et al.*, 2010; Price *et al.*, 1993). On the other hand, the outputs consist of return on equity (Ablanedo-Rosas *et al.*, 2010; Akguc, 2010), return on assets (Ercan and Ban, 2005) and earning per share (Östring, 2003).

In this study, the BBC DEA model is applied and formulated as follows (Banker *et al.*, 2012; Martić *et al.*, 2009):

$$h_k = \frac{\sum_{r=1}^{s} u_r y_{rk} + \alpha}{\sum_{i=1}^{m} v_i x_{ik}}$$

Maximize (1)

Subject to

$$\frac{\sum_{r=1}^{s} u_r y_{rj} + \alpha}{\sum_{i=1}^{m} v_i x_{ij}} \leq 1; j = 1,2,3,\ldots,n \quad (2)$$

$$u_r, v_i \geq \varepsilon;\ r = 1,\cdots,s; i = 1,\cdots,m. \quad (3)$$

where

$h_k$ is relative efficiency of $DMU_k$

$s$ is the number of outputs

$u_r$ is the weights to be determined for output $r$

$m$ is the number of inputs

$v_i$ is the weights to be determined for input $i$

$n$ is the number of entities

$\varepsilon$ is the positive value

$\alpha$ is the free variable

Equation (1) is an objective function which maximizes the efficiency of $DMU_k$. Constraint (2) ensures that $0 \leq h_k \leq 1$ for each DMU. As the previous model is a nonlinear integrate with a linear and fractional objective function together with the constraint, hence transformation into general output maximization BCC DEA model in linear programming form can be simplified as follows (Ling, 2010; Martić *et al.*, 2009):

$$h_k = \sum_{r=1}^{s} u_r y_{rk} + \alpha$$

Maximize (4)

Subject to

$$\sum_{i=1}^{m} v_i x_{ij} - \sum_{r=1}^{s} u_r y_{rj} - \alpha \geq 0; j = 1,2,3,\ldots,n \quad (5)$$

$$\sum_{i=1}^{m} v_i x_{ik} = 1 \quad (6)$$

$$u_r, v_i \geq \varepsilon;\ r = 1,\cdots,s; i = 1,\cdots,m. \quad (7)$$

## 3. Empirical Results

Table 1 presents the efficiency and ranking of construction sector companies based on the optimal solution of DEA model.

**Table-1.** Efficiency and Ranking of Construction sector Companies

| Companies | Efficiency | Rank |
|---|---|---|
| ARK | 86.07 | 15 |
| AZRB | 54.82 | 45 |
| BENALEC | 71.92 | 34 |
| BPURI | 66.30 | 40 |
| BREM | 100.00 | 1 |
| CRESBLD | 68.03 | 39 |
| DKLS | 100.00 | 1 |
| ECONBHD | 100.00 | 1 |
| EKOVEST | 66.26 | 41 |
| FAJAR | 74.05 | 29 |
| GADANG | 64.88 | 42 |
| GAMUDA | 70.65 | 38 |
| GBGAQRS | 72.58 | 33 |
| HOHUP | 86.33 | 14 |
| HSL | 100.00 | 1 |
| IJM | 62.99 | 43 |
| IKHMAS | 77.93 | 25 |
| IREKA | 79.93 | 21 |
| JAKS | 82.06 | 18 |
| JETSON | 78.67 | 23 |
| KERJAYA | 100.00 | 1 |
| KIMLUN | 82.30 | 17 |
| LEBTECH | 82.88 | 16 |
| MELATI | 100.00 | 1 |
| MERGE | 87.45 | 13 |
| MITRA | 91.19 | 12 |
| MLGLOBAL | 100.00 | 1 |
| MTDACPI | 73.16 | 30 |
| MUDAJYA | 71.79 | 35 |
| MUHIBAH | 79.90 | 20 |
| PESONA | 78.44 | 24 |
| PRTASCO | 73.04 | 31 |
| PSIPTEK | 76.16 | 27 |
| PTARAS | 100.00 | 1 |
| PUNCAK | 100.00 | 1 |
| SENDAI | 71.18 | 37 |
| SUNCON | 100.00 | 1 |
| SYCAL | 71.74 | 36 |
| TRC | 81.05 | 19 |
| TRIPLC | 62.53 | 44 |
| TSRCAP | 79.52 | 22 |
| VIZIONE | 77.52 | 26 |
| WCEHB | 47.10 | 46 |
| WCT | 75.01 | 28 |
| ZECON | 100.00 | 1 |
| ZELAN | 72.95 | 32 |
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| WCT | 75.01 | 28 |
| ZECON | 100.00 | 1 |
| ZELAN | 72.95 | 32 |

A shown in Table 1, BREM, DKLS, ECONBHD, HSL, KERJAYA, MELATI, MLGLOBAL, PTARAS, PUNCAK, SUNCON and ZECON obtain efficiency score of 100% and therefore ranked as efficient companies. The rest of 35 companies are ranked as inefficient companies since their efficiency scores are less than 100%. MITRA, MERGE, HOHUP, ARK, LEBTECH, KIMLUN, JAKS and TRC obtain maximum efficiency scores at 91.19%, 87.45%, 86.33%, 86.07%, 82.88%, 82.30%, 82.96% and 81.05% respectively which close to 100%.
Table-2. presents the reference set for the inefficient companies based on the optimal solution of DEA model.

**Table-2.** Reference set for the inefficient companies

| **Inefficient** | **Efficiency** | **Efficient companies (optimal coefficients)** | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| companies | | BREM | DKLS | ECONBHD | KERJAYA | MELATI | MLGLOBAL | SUNCON | ZECON |
| ARK | 0.8607 | 0.6458 | | | 0.3542 | | | | |
| AZRB | 0.5482 | | 0.0207 | | 0.1103 | | 0.6864 | 0.1826 | |
| BENALEC | 0.7192 | | | | 0.4261 | | 0.5739 | | |
| BPURI | 0.6630 | | 0.0390 | | | | 0.6126 | 0.3484 | |
| CRESBLD | 0.6803 | | 0.1369 | | 0.0198 | | 0.7809 | 0.0624 | |
| EKOVEST | 0.6626 | | 0.1865 | | 0.3041 | | 0.2902 | 0.2192 | |
| FAJAR | 0.7405 | | | | 0.6309 | | 0.2071 | 0.1620 | |
| GADANG | 0.6488 | | 0.3056 | | 0.5705 | 0.0184 | | | 0.1056 |
| GAMUDA | 0.7065 | | 0.3330 | | 0.4889 | | 0.1780 | | |
| GBGAQRS | 0.7258 | | 0.0119 | | 0.2420 | | 0.5585 | 0.1876 | |
| HOHUP | 0.8633 | | 0.3952 | 0.3611 | | | | 0.2438 | |
| IJM | 0.6299 | | 0.2208 | | 0.7586 | | 0.0207 | | |
| IKHMAS | 0.7793 | | | | 0.2447 | | 0.6746 | 0.0807 | |
| IREKA | 0.7993 | | | | | | 0.5601 | 0.4399 | |
| JAKS | 0.8206 | | | | | | 0.8381 | 0.1619 | |
| JETSON | 0.7867 | | | | 0.1192 | | 0.8808 | | |
| KIMLUN | 0.8230 | | 0.4470 | 0.0931 | 0.3697 | | | 0.0902 | |
| LEBTECH | 0.8288 | 0.5878 | | | 0.4122 | | | | |
| MERGE | 0.8745 | | | | 0.2479 | | 0.7521 | | |
| MITRA | 0.9119 | | 0.4876 | 0.3373 | | | | 0.1751 | |
| MTDACPI | 0.7316 | | | | | | 0.5608 | 0.4392 | |

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| MUDAJYA | 0.7179 | | | | 0.0139 | | 0.9861 | | |
| MUHIBAH | 0.7990 | | 0.5177 | | | | | 0.4719 | 0.0104 |
| PESONA | 0.7844 | | | | 0.4301 | | 0.2383 | 0.3315 | |
| PRTASCO | 0.7304 | | 0.1047 | | 0.1534 | | 0.3609 | 0.3809 | |
| PSIPTEK | 0.7616 | | | | 0.4611 | | 0.5389 | | |
| SENDAI | 0.7118 | | | | | | 0.8675 | 0.1325 | |
| SYCAL | 0.7174 | | | | 0.4329 | | 0.5671 | | |
| TRC | 0.8105 | | | | 0.3277 | | 0.5570 | 0.1154 | |
| TRIPLC | 0.6253 | | 0.5836 | | 0.1319 | | 0.0829 | 0.2016 | |
| TSRCAP | 0.7952 | | 0.0370 | | 0.0942 | | 0.7275 | 0.1413 | |
| VIZIONE | 0.7752 | 0.1317 | | | | | 0.8683 | | |
| WCHEHB | 0.4710 | | | | 0.7185 | | 0.2815 | | |
| WCT | 0.7501 | | 0.0731 | | 0.0420 | | 0.8533 | 0.0315 | |
| ZELAN | 0.7295 | | | | | | 0.3166 | 0.6834 | |

As shown in Table 2, the efficient companies such as BREM, DKLS, ECONBHD, HSL, KERJAYA, MELATI, MLGLOBAL, PTARAS, PUNCAK, SUNCON and ZECON serve as benchmark to the inefficient companies for further improvement. ARK obtains efficiency score of 0.8607 which is categorized as inefficient company if compared with BREM and KERJAYA based on the optimal coefficients. In order to achieve the efficiency score of 100%, ARK needs to benchmark the efficient BREM and KERJAYA, as reference sets with the coefficients such as 0.6458 and 0.3542 based on the optimal solution of DEA model. As shown in Table 2, all the inefficient companies can benchmark the efficient companies based on the optimal coefficient respectively in order to achieve 100% efficiency score.

## 4. Conclusions

In summary, BREM, DKLS, ECONBHD, HSL, KERJAYA, MELATI, MLGLOBAL, PTARAS, PUNCAK, SUNCON and ZECON are ranked as efficient companies based on the optimal solution of DEA model in this study. Therefore, these efficient companies can serve as benchmark to other inefficient companies for further improvement.

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