Construction Company Performance Trends During the Covid-19 Pandemic

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Abstract

In the occurrence of a pandemic, limitations on human movement have a negative influence on construction productivity, and if the epidemic persists, construction firm performance will inevitably fall. This paper discusses the performance measurement of construction company using Data Envelopment Analysis (DEA) and the influence of the Covid-19 outbreak on the performance of public listed construction company in Indonesia. The objective is to assess construction company efficiency and compare their performance to other comparable companies before and throughout the pandemic. Non-parametric data envelopment analysis (DEA) was utilized to focus on sales and market value as output measures in a two-step DEA approach with different input and output configurations. This paper examines eighteen significant construction companies listed on the Indonesia Stock Exchange, with two types of ownership, private companies, and state-owned companies. According to the findings of the study, the pandemic condition did not significantly affect the decline in the performance of the construction company. Where construction companies can survive with their abilities, and still maintain their performance. Our findings suggest that company efficiency plays an important role in evaluating company performance and that efficient companies can serve as a role model for company performance improvement strategies, such as when the economy is disrupted by the current pandemic

Keywords:
Data Envelopment Analysis (DEA), construction company, performance, efficiency, Covid-19

1. Introduction

Performance is an important way to gauge a company's success. The main company's objective is to maximize profit by utilizing the resources (inputs) available to achieve the highest potential output. When evaluating performance, measuring efficiency can help determine whether the result produced is best in terms of resource usage. Many studies have been undertaken to determine performance appraisal by measuring the level of efficiency. Several countries, namely Canada (Pilateris & McCabe, 2003), South Korea (You & Zi, 2007), China (Xue et al., 2008; Zheng et al., 2011), Portugal (Horta et al., 2010; Horta & Camanho, 2014), Greece (Tsolas, 2011, 2013), Iran (Peng Wong et al., 2012), and Spain (Kapelko et al., 2014; Kapelko & Oude Lansink, 2015), have used efficiency levels to assess the performance of construction companies. This is due to the importance of construction companies in the construction industry.

The construction industry is the main economic pillar in many countries, which contributes greatly to GDP and employment rate (Wang et al., 2021). The importance of the construction industry in the economy of both developed and developing countries has increased in recent years (Horta & Camanho, 2014). Based on Badan Pusat Statistik (2020) data, in the last 5 years (2015-2019) the construction sector was able to contribute an average of 10.45% to the national GDP (Gross Domestic Product). The increase in the number of construction companies in Indonesia, which continues to rise year after year, reflects the development of the industry in Indonesia. Construction companies numbered 134,029 in 2015, with a significant rise to 203,403 by 2021.

In Indonesia, construction companies are graded according to their financial status, technical ability, and experience (small, medium, and big company). It is driven by unique construction projects undertaken by specific teams

integrating different types of companies. The construction projects are typically characterized by the involvement of many agents, including the owner, architectural and engineering companies, general contractors, subcontractors, and construction materials suppliers (Horta & Camanho, 2014). The highly competitive environment of the construction industry has caused performance improvement to be an increasingly relevant objective. The construction companies are aware of the challenges imposed by this environment and attempt to implement systematic methods to measure performance and search for best practices to achieve competitive advantage and prosperity in the long run (Horta & Camanho, 2014). However, performance measurement of construction companies has not been widely implemented in Indonesia. The government has not fully implemented the use of performance measurement to leverage the performance improvement of construction companies.

We have been experiencing unpleasant circumstances for the past few years. New regulations have been issued to rearrange human behavior, and new terms like social distancing, tracing, quarantine, self-isolation, using a mask, and a slew of other terms have evolved as new habits across the globe, including in the construction sector. The world has faced several pandemic conditions decades ago, but humans have always been able to adapt and rebuild. The announcement of this disease outbreak in 2020, known as Corona Virus Disease 2019 (COVID-19), affected every country on the planet. The pandemic outbreak disrupted company business all around the world, particularly construction companies. In recent survey on the implications of COVID-19 on the workers, 15.6 percent of 1,112 workers were laid off, with 1.8 percent receiving financial compensation and 13.8 percent receiving no compensation. Employees were also affected by a drop in work income, with 31% of workers' salaries falling below 50% and 8.6% falling above 50% (Ngadi et al., 2020).

Given the relevance of the above problems, the researchers wish to conduct a study to analyze the performance of construction company using data envelopment analysis. Therefore, this study was conducted on 18 listed construction company in Indonesia. Starting with collecting data from Indonesian Stock Exchanges, and led to an understanding of the performance of construction companies. This research can help develop a strategy to improve the performance of construction companies by analyzing two different conditions, normal conditions and pandemic conditions.

1.1. Objective

The goal of this study was to determine the efficiency value of a construction company using the Data Envelopment Analysis (DEA) method and to discover what factors influence the efficiency value of a construction company. By answering the aforementioned research objectives, the research will contribute to the understanding of how a construction company should implement a strategy to improve business performance, as well as provide a new perspective for future research.

2. Literature Review

Over the last few decades, various performance measurement approaches have been utilized to improve performance. The concept of performance measurement was first discussed in the 1950s. It all starts with the recognition that company performance is equated to organizational efficiency, which measures how well an organization uses limited resources and ways to fulfill its objectives without requiring excessive effort from its workers. Performance measurement, according to (Neely et al., 1995), is described as a procedure that evaluates the efficiency and effectiveness of completed tasks. Meanwhile, according to Ozcan (2008) means that performance is the right combination of efficiency and effectiveness. Bartoli & Blatrix (2015) believe that the definition of performance should be achieved through such things as piloting, evaluation, efficiency, effectiveness, and quality.

It is apparent from the numerous definitions of performance given above that the concept of performance has evolved throughout this way from year to year. As a result, it may be inferred that an organization's performance is inextricably linked to its efficiency and effectiveness in attaining its objectives. According to Ramanathan (2003), efficiency is defined as the ratio of input to output. The value of efficiency is frequently used in evaluating an organization's performance. Effectiveness is described by Myers (2003) as "doing something right," whereas efficiency is defined as "doing things the right way." In other words, effectiveness is intimately linked to the achievement of goals or objectives, whereas efficiency is defined as an organization's capacity to use its resources and facilities to achieve those goals. In order to measure company success, this study will employ the efficiency perspective.

In the construction industry, measuring the performance of construction organizations has become a research issue. When it comes to evaluating firm performance as a measure of the company's quality, there are two major theories: financial performance and non-financial performance. Several studies have been published, including (Bassioni et al.,

2004; Bilal et al., 2019; Chen et al., 2013; Deng & Smyth, 2014; Elyamany et al., 2007; Hıdıroğlu, 2019; Horta et al., 2010; Kangari et al., 1992; Kapelko & Oude Lansink, 2015; Peng Wong et al., 2012; Tripathi & Jha, 2018; Xue et al., 2008; Yang et al., 2010; You & Zi, 2007; Yusof & Bakar, 2012) which focuses on discussing the company's performance by looking at the company's financial performance. Construction company performance evaluations can provide an assessment of the company's position. This appraisal is significant for a company's owners, shareholders, and financial institutions because it clearly describes the company's genuine status. If the company's position is strong, the agency's interest in it will grow, and vice versa (Elyamany et al., 2007).

Performance measurement utilizing the Data Envelopment Analysis (DEA) method has been widely used in studies and literature. Horta et al. (2010) used this method to measure construction companies in the construction industry. They combined the DEA with key performance indicators (KPIs) from the Portuguese construction industry. Tsolas (2011) used the DEA method in conjunction with Ratio Analysis to assess the profitability and effectiveness of a sample of construction enterprises listed on the Athens stock exchange. DEA is employed in one of the research stages in this study to see how efficient the profitability aspect is. The DEA approach will be used in this study to evaluate the performance of construction companies by calculating relative efficiency. Before and during the Covid-19 pandemic, research will be performed to examine if there are any trends in the performance of construction companies.

3. Methods

The concept of DEA, according to Ramanathan (2003), is an efficiency evaluation method that uses a linear program to assess organizational work units known as Decision Making Units (DMUs). The DEA method evaluates the relative efficiency of a homogeneous set of DMU. The DEA approach generates a relative efficiency value rather than an absolute value. As a result, the efficiency value of a DMU can change if the assessed DMU changes.

The determination of the Decision-Making Unit is a key stage in using the DEA method that affects the final result (DMU). DMUs can be a collection of companies, departments, divisions, or administrative units with the same goals and objectives and have common inputs and outputs (Al-Shammari, 1999). Except for intensity and magnitude, Ramanathan (2003) noted that the DMU to be measured must be homogeneous, have the same tasks and goals, and have identical inputs and outputs. The number of DMUs to be examined must also be considered when choosing DMUs. According to Darrat et al. (2002), the number of DMUs is more than the multiplication of the number of inputs and outputs, resulting in more discriminatory computation results. Cooper et al. (2007) made the same statement, that the number of DMUs measured must fulfill equation (1).

$$n \geq \max\{i \times o, 3(i + o)\} \tag{1}$$

n = number of DMU
i = number of input
o = number of output

Following the selection of the DMU groups and the number of them, the variables that potentially represent the DMUs' inputs and outputs will be sorted. According to Ramanathan (2003), there are no unique guidelines for selecting variables in the DEA technique. For the selection of input variables, resources owned and used in the production process can be used, as well as conditions that can affect the DMU's performance. Meanwhile, variables that can represent how much profit can be obtained from the outputs of the DMU production process are utilized to determine output variables.

Two types of orientations can be utilized to measure efficiency using DEA. First, the calculation is input-orientated, which means that the efficiency calculation is based on minimizing the number of inputs while retaining the value of the output. Second, the calculation is output-oriented, which means that efficiency calculations are more concerned with improving the value of the output produced while maintaining input utilization. Figure 1 shows a graph that depicts the difference between the two DEA orientations.

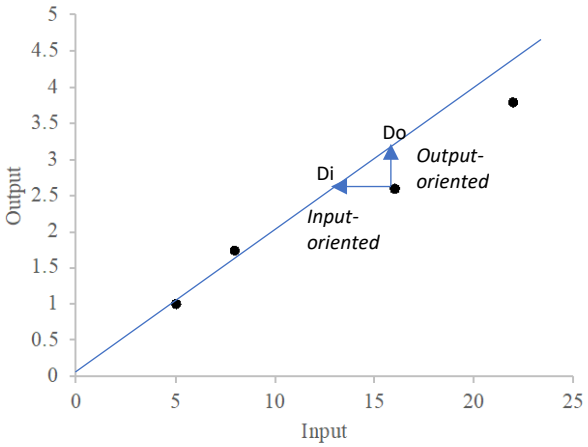

Figure 1. Differences in DEA technique orientation

The DEA approach contains two primary calculating methods for measuring efficiency. First, the DEA CCR model (Charnes, Cooper, and Rhodes) is a calculation model that was first introduced in 1978. The first model that underlies the DEA concept was developed by Charnes et al. (1978). The CCR model assumes that the proportion of input and output ratios of each DMU is always constant (constant return to scale / CRS). The second is the DEA BCC model (Banker, Charnes, and Cooper), which was established in 1984 and is a development of the DEA CCR model, which is said to be a refinement of the previous calculating method's flaws.

4. Data Collection

4.1. Decision-Making Units

In this study, data was collected from the Indonesian stock exchange. The data collected is in the form of annual financial reports of construction companies listed on the stock exchange. The data collection period starts in 2017 and until 2021. The length of the period can represent 2 conditions (normal and pandemic) experienced by construction companies. Data from financial statements taken include income statements, statements of financial position (balance sheet), cash flow statements, and notes to financial statements. The DMU chosen as the subject of the assessment is a construction company listed on the Indonesian stock exchange. As stated in Table 1, there are 18 construction companies listed on the Indonesian stock exchange that match the research requirements. The construction firms were chosen for their identical functions, inputs, and outputs in order to meet the homogeneity.

Table 1. List of DMU

#DMU	Company name	Code	Ownership
U01	Adhi Karya (Persero) Tbk, PT	ADHI	State owned
U02	PP (Persero) Tbk, PT	PTPP	State owned
U03	Wijaya Karya (Persero) Tbk, PT	WIKA	State owned
U04	Waskita Karya (Persero) Tbk, PT	WSKT	State owned
U05	Acset Indonusa, PT	ACST	Private
U06	Bukaka Teknik Utama Tbk, PT	BUKK	Private
U07	Cahayasakti Investindo Sukses Tbk, PT	CSIS	Private
U08	Nusa Konstruksi Enjiniring Tbk	DGIK	Private
U09	Indonesia Pondasi Raya Tbk, PT	IDPR	Private
U10	Jaya Konstruksi Manggala Pratama Tbk, PT	JKON	Private
U11	Nusa Raya Cipta Tbk, PT	NRCA	Private
U12	Paramita Bangun Sarana Tbk, PT	PBSA	Private
U13	PP Presisi Tbk, PT	PPRE	Private
U14	Surya Semesta Internusa Tbk, PT	SSIA	Private
U15	Tira Austenite Tbk	TIRA	Private
U16	Totalindo Eka Persada Tbk, PT	TOPS	Private
U17	Total Bangun Persada Tbk, PT	TOTL	Private
U18	Wijaya Karya Bangunan Gedung Tbk, PT	WEGE	Private

4.2. Variables

There are no specific rules for selecting inputs and outputs. According to Ramanathan (2003), inputs are the resources used by the DMU or conditions that affect the DMU's performance, whereas outputs are the benefits generated as a result of the DMU's operating activities. The use of variables that have been used in previous studies can reduce the possibility of inaccuracies in variable selection.

Park et al. (2011) use the value of company capitalization, the number of workers as input variables, and sales and net income as outputs. Kim & Kang (2008) use company capitalization, the number of workers as inputs, while sales and net income as outputs. Kim & Nam (2010) use fixed assets, labor costs, and material costs as input variables and sales and net income as output variables. Nguyen & Giang (2007) use capitalization, number of workers as input variables, and business income as output variables. El-Mashaleh et al. (2001) used the number of employees and operating costs as inputs while operating income as output.

We utilized a variety of input and output configurations to solve the issue. The profit-based model is the one we'll examine. The output variable in this model is a company's total sales and profit/loss. This model will evaluate a company's efficiency in converting inputs into revenue and profit. The DEA method uses a comparison or ratio between output and input to determine efficiency. A DMU's output variables can be chosen from the parameters provided by the production process, while the input variables can be resources or conditions that affect the production process. The type of production process, the scope of operation, and other aspects of the selected DMU group all influence the variable selection. It's important to remember, nevertheless, that the selected variables must be able to demonstrate the DMU's efficiency for each task (Table 2).

Table 2. Variables

Variable	Symbol	Definition
Input	x_1	Net fixed asset
	x_2	Operating expenses
	x_3	Permanent employees
Output	y_1	Revenue
	y_2	Profit before tax

5. Results and Discussion

5.1. Numerical Results

18 contractors have met the DMU requirements and will be evaluated from among all construction companies listed on the Indonesian stock exchange. DMUs have been further classified based on ownership into two types: state-owned company and private-owned company. This distinction in company classification is used to demonstrate the impact of ownership on company performance. DMU data distribution of construction companies based on ownership is shown in table 3. Even though there are more private companies than state-owned companies, state-owned companies generate 70-80 percent of construction revenue. This can be interpreted that the performance of state-owned companies can be used to represent the performance of construction companies in general, and can thus influence the performance of the construction industry (Table 3).

Table 3. DMUs Classification

# DMU	Ownership	Number
U01 – U04	State-owned	4
U04 – U18	Private	14

Table 4 shows descriptive statistics for input and output variables based on the difference in their minimum, maximum, and standard deviation values. The average data for each variable has decreased during the pandemics of 2020 and 2021. This event demonstrates the effect of reducing the company's available resources and the output produced by the company (Table 4-6).

Table 4. Variable Descriptive Statistics (in million rupiahs)

Year	Statistic	x_1	x_2	x_3	y_1	y_2
2017	Minimum	13,202	17,235	18	51,132	-11,260
	Maximum	5,789,644	2,103,899	3,218	45,212,898	4,201,572
	Rata-rata	1,315,753	371,590	1,020	7,650,529	613,923
	Std. Dev	1,745,171	507,948	924	12,015,609	1,027,947
2018	Minimum	11,875	31,314	15	31,315	-146,309
	Maximum	7,687,529	1,667,746	3,169	48,788,951	4,619,568
	Rata-rata	1,637,589	366,340	1,050	8,675,636	631,252
	Std. Dev	2,410,789	431,661	942	13,305,591	1,177,792
2019	Minimum	10,447	19,161	17	67,879	-1,131,849
	Maximum	8,663,216	1,371,547	5,566	31,387,390	2,621,015
	Rata-rata	1,766,295	369,891	1,236	7,503,555	344,968
	Std. Dev	2,625,683	403,129	1,393	10,012,077	757,529
2020	Minimum	26,215	10,265	26	80,189	-9,495,726
	Maximum	7,819,655	1,702,238	5,425	16,536,382	410,794
	Rata-rata	1,710,876	363,035	1,146	4,577,428	-548,542
	Std. Dev	2,474,122	442,658	1,328	5,868,538	2,263,789
2021	Minimum	30,015	14,337	18	83,521	-1,086,241
	Maximum	8,832,862	2,305,101	5,263	17,809,718	482,094
	Rata-rata	1,602,540	360,592	1,084	4,516,061	-20,071
	Std. Dev	2,480,245	544,308	1,295	5,807,670	363,731

Table 5. DMUs Efficiency Value

DMU	2017	2018	2019	2020	2021	Mean
U01	0.854	0.607	0.962	0.874	0.923	**0.844**
U02	0.531	0.807	1	1	1	**0.868**
U03	0.817	0.975	0.566	0.54	0.514	**0.682**
U04	1	0.961	1	0.873	0.751	**0.917**
U05	0.642	0.547	1	0.566	0.627	**0.676**
U06	0.317	0.591	1	1	0.909	**0.763**
U07	1	1	1	1	1	**1**
U08	0.208	0.252	0.296	0.352	0.373	**0.296**
U09	0.21	0.276	0.212	0.176	0.241	**0.223**
U10	0.256	0.198	0.338	0.417	0.483	**0.338**
U11	0.626	0.481	1	1	1	**0.821**
U12	0.641	0.828	0.57	0.867	0.458	**0.673**
U13	0.662	0.725	1	1	1	**0.877**
U14	0.118	0.104	0.179	0.235	0.18	**0.1632**
U15	0.235	0.407	0.263	0.207	0.267	**0.276**
U16	1	1	1	0.869	1	**0.974**
U17	0.514	1	0.514	0.721	0.662	**0.682**
U18	1	1	1	1	1	**1**
Mean	**0.591**	**0.653**	**0.717**	**0.705**	**0.688**	**0.671**

The outcomes of computing DEA scores are shown in Table 5. During the 2017-2021 time period, two companies have continuously outperformed other construction company, reaching an average efficiency value of 1, respectively U07 and U18. The construction company's overall efficiency is 0.671, which demonstrates that construction companies are still inefficient. Several DMUs demand special attention because their DEA value has declined, particularly during the pandemic years 2020 and 2021. DMU U04, for example, has experienced the greatest value fall. The results of this DEA are confirmed by statistics on the company's revenue and profit values, which follow the same pattern as the DMU efficiency value. Improvements must be made to make it more efficient, either by reducing

inputs or increasing output. Construction firms that have a low average efficiency value of less than 0.5, respectively U08, U09, U10, U14, and U15, require special attention in order to apply the right strategy to improve their performance (Table 6).

Table 6. DMU efficiency by group

Ownership	Statistic	
State-owned	Min	0.514
	Max	1.000
	Mean	0.828
	Std Dev	0.180
Private	Min	0.104
	Max	1.000
	Mean	0.626
	Std Dev	0.327

5.2. Graphical Results

As shown in Table 6, the average performance of state-owned company outperforms that of private companies. The range of efficiency values is also wide enough. In general, state-owned companies outperform private companies. To see the differences in performance of the two types of companies in greater detail, see Figure 2, which provides an overview of the differences in performance by year during the research period. Figure 2 illustrates the impact of pandemic conditions that began in 2020. The pandemic conditions slightly impacted the performance of state-owned construction companies, resulting in a one-of-a-kind phenomenon. On the other hand, private companies are better able to survive and maintain their performance even during a pandemic.

Strategies for improving the performance of construction companies are obtained based on the results of calculations over 5 years. First, companies must reduce operating costs and optimize the use of permanent employees, such as by implementing results-oriented work, in order to increase work productivity. Second, the company must encourage increased revenue; increasing revenue can be accomplished by obtaining new work contracts on construction projects. The increase in company income will boost the company's profit.

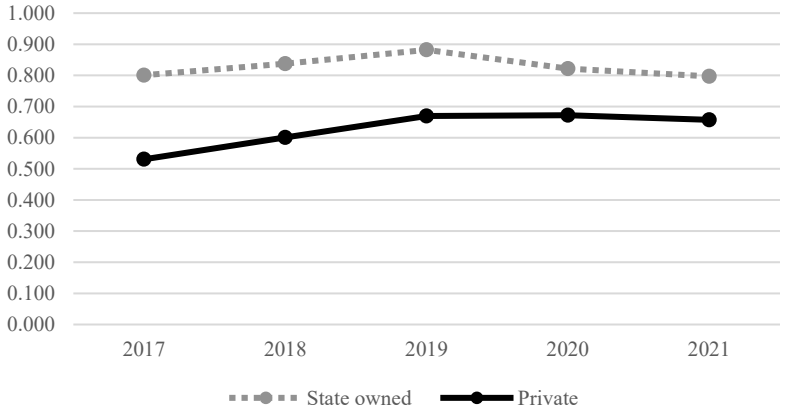

Figure 2. Efficiency value trends

6. Conclusion

The pandemic condition, according to the reference obtained, affects various sectors of the country's economy, including the construction sector. However, based on the findings of this study, conducted on 18 construction companies from 2017 to 2021 using the Data Envelopment Analysis (DEA) method, the pandemic condition has no significant impact on the decline in the performance of construction companies. This is because construction companies are still attempting to survive and maintain their performance with their respective abilities. The study findings show that the performance of state-owned construction companies is declining due to the pandemic, whereas

private construction companies are quite good at maintaining their performance. Nonetheless, government-owned construction companies have a higher efficiency value than private construction companies.

This performance calculation can be used as input for the government to develop a policy strategy to improve construction company performance. Companies with poor performance must be assisted in order to improve their performance, which will have an impact on improving work quality and the construction industry's performance.

The following are some ideas for further research. It would be preferable to include data samples from companies that are not publicly traded on the stock exchange in future research. To be able to compare the performance of companies listed and unlisted on the stock exchange. Furthermore, it can compare the performance of construction firms based on construction fields such as oil and gas, infrastructure, transportation, and others.

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