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IMPLEMENTATION OF DATA ENVELOPMENT ANALYSIS (DEA) ON MEASURING THE EFFICIENCY OF GAS STATION SERVICES

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Abstract
Along with the increasing number of transportation vehicles in Indonesia, the growth of the gas station business is also increasing from year to year. This requires companies in the oil and gas industry to improve their performance, and gas stations must have the right strategy to improve efficiency. This study aims to identify input and output factors that affect the level of gas station efficiency, determine the work efficiency of each gas station in carrying out the service process to consumers, and determine inefficient gas station repair planning strategies. The research method used in this study is quantitative. The data that has been collected from the results of primary data for the period January-August 2023. Then the result is obtained that The relative efficiency level of gas stations is 52% of gas stations whose performance is efficient. At the same time, 48% of gas stations are included in the inefficient category.

Keywords: Data Envelopment Analysis, Efficiency, Performance Measurement.

INTRODUCTION

In the current era of competition, various Indonesian service industries compete to improve performance and achievement so that maximum results are obtained (Candana, 2021). One way to increase efficiency that relevant agencies can do is to increase customer service efficiency as part of a service. The service industry can also be measured by indicators of productivity, service quality, and efficiency (Johnston, 2005; Karim, 2022).

Daily human activities are inseparable from the critical role of various needs, including fuel oil. Fuel use in Indonesia continues to increase as the number of motorized vehicles increases. The government said that the increase in fuel energy demand in Indonesia reached 8% per year (Minardi & Ridha, 2021). The number of cars in Indonesia continues to grow from year to year. According to data from the Korps Lalu Lintas Polri, the number of motorized vehicles registered as of January 25, 2023, reached 152,926,741 units (Statistik, 2022). Transportation in Indonesia has been significantly developed, especially in Surabaya. 10.91% of the vehicles in East Java originate from Surabaya City, the most significant number in East Java. With an average vehicle growth of 6.4% per year, the number of motorized vehicles in Surabaya City until 2040 can reach 10,082,873 units of motorized vehicles (Toiba, 2015). As a result, fuel needs continue to increase along with the increasing performance of fuel sales (Clerides & Zachariadis, 2008).

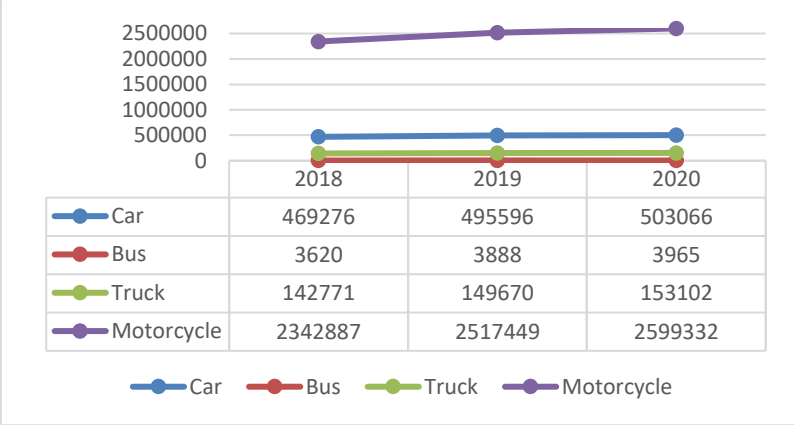

Figure 1. Number of Motorized Vehicles by Type in Surabaya 2018-2020
Source : (Statistik, 2022)

Gas station service is a process that serves the community's interests in the transportation field. Several fuel provider companies in Indonesia, namely Pertamina, Vivo, BP AKR, Shell, and Exxon, provide fuel of similar quality at competitive prices, causing competition (Gandhi, Sensuse, & Sucahyo, 2019). The opening of competition in fuel retail (gas stations) requires gas stations to take strategic steps to improve performance. One of the efforts to improve the performance of gas stations is by looking at the efficiency value of each gas station based on gas station ownership.

A company is said to be efficient if with a certain amount of input, it can produce more output, or at a certain amount of output, it can use less information. Efficiency includes the overall performance of each unit of resources used (input) and the results of performance (output), which can then be a reference in building company strategy. The goal of every company is to maximize business output and minimize inputs to get a higher level of efficiency (Onasis & Robin, 2016). Efficiency is defined as the ratio of output to input, and more output per unit of input indicates greater efficiency, while maximum output per unit of information reflects optimal efficiency (Othman, Mohd-Zamil, Rasid, Vakilbashi, & Mokhber, 2016).

Each gas station has different sales performance, depending on the amount of distribution or distribution of fuel and the number of motor vehicles passing through the gas station, affecting revenue (Abdi, 2020). Efficiency measurement is one of the main steps that must be taken by a gas station unit in order to improve performance. By knowing the efficiency level of all existing gas stations, it can be seen which gas stations need special attention to improve efficiency so that it will be able to improve the efficiency of the gas station as a whole by seeing whether each gas station unit or DMU is running efficiently or there is no change from year to year. Because of the research results, many gas stations still need more internal and external control, so they are less efficient (Yunita & Pranata, 2023). In Surabaya, it is still rare for gas stations to have implemented a self-service transaction system that utilizes automatic machines in refueling. Although many gas stations have already implemented payments using credit or debit cards, this still needs to be improved because we often need more officers, causing long lines at refueling stations (ATMAJAYA, 2021). Therefore, every gas station must have the right and appropriate strategy to increase efficiency as the key to increasing productivity.

Based on the background of the research problems previously described, the formulation of this research problem is as follows:

1. Do input and output factors affect the level of service efficiency?
2. How is the work efficiency of each gas station in providing services to consumers?
3. How is the improvement planning for inefficient service stations?

The purpose of this research is to identify input and output factors that affect the service efficiency level to determine each gas station's work efficiency in providing services to

consumers. In addition, it is also an improvement plan for inefficient gas stations. The efficiency improvement in this research uses the DEA (Data Envelopment Analysis) method because it can accommodate many inputs and outputs in many dimensions.

RESEARCH METHOD

The type of data used in this research is quantitative, namely in numbers obtained from official sources (Sugiyono, 2020). This study obtained quantitative data from PT Pertamina's primary data. The data sources used in this research are secondary data and other sources. The data used in this study are variables that significantly influence each gas station's production process (Sugiono, 2019). The data that has been collected from the results of primary data for the period January-August 2023.

The calculation of efficiency in this study uses input and output variables that mutually influence the service performance level of gas stations in Surabaya. The determination of input and output variables that will be used refers to previous studies relevant to the research theme related to evaluating the efficiency of gas station performance in Surabaya. The variables of each DMU that will be taken data are as follows :

Tabel 1. Input and output data

Simbol i	Input	Simbol o	Output
i = 1	Number of operators	o = 1	Sales RON 90
i = 2	Site area	o = 2	Sales RON 92
i = 3	Number of RON 90 nozzles	o = 3	Customer Satisfaction Index
i = 4	Number of RON 92 nozzles		
i = 5	Number of motorcycle customers		
i = 6	Number of car customers		

Meanwhile, the Decision Making Unit (DMU) is all PT Pertamina gas stations in Surabaya. In addition, the selection of DMU in this study is based on fulfilling one of the requirements of the DEA concept, namely that the DMU must be homogeneity, where the DMU being analyzed must have the same input and output variables and operate in the same scope. The DMUs used in this study can be seen in Table 3 below :

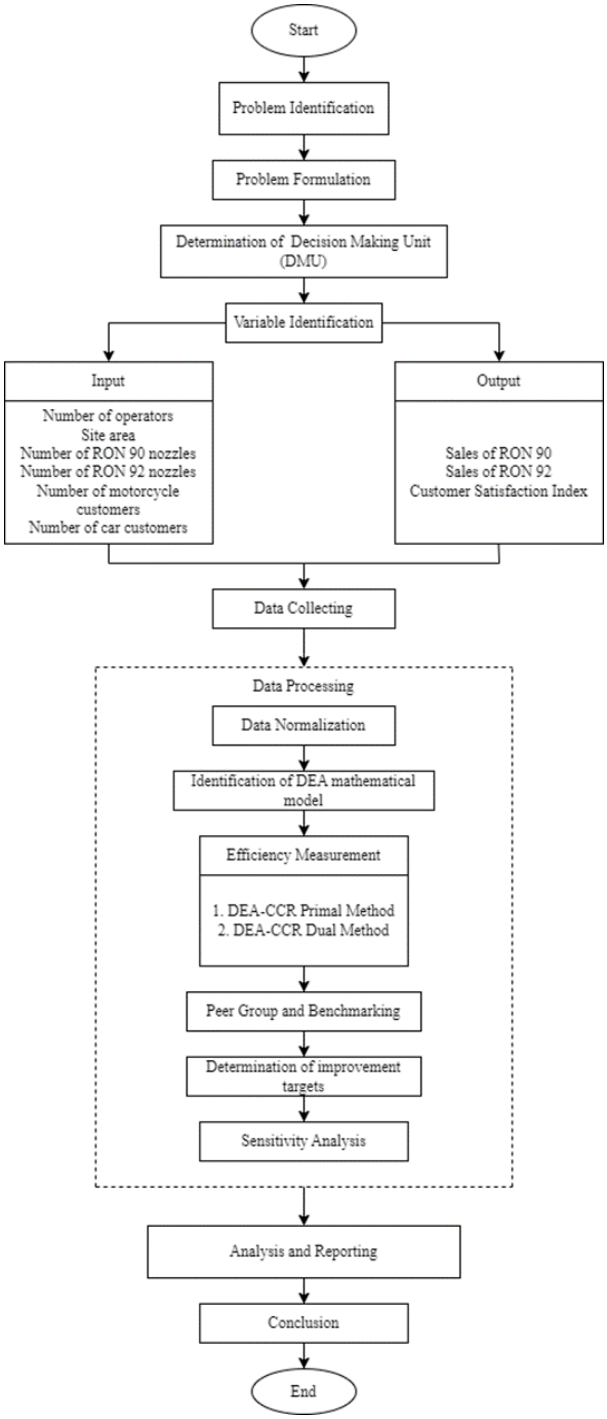

Figure 2. Research Process Flowchart

RESULT AND DISCUSSION

After knowing each DMU's input and output values, the first stage is to normalize each weight to equalize the value range of each input and output variable, which has different units. The measurement of the efficiency level in 94 gas station units in the Surabaya area was conducted using MaxDEA software. The model used in this calculation is the DEA-CCR model, which maximizes the objective function based on output orientation. The result of the efficiency level measurement can be seen in the table below :

Tabel 2. Summary DEA Solver

Property	Value
Model Type	Envelopment Model
Number of DMUs	94
Number of Inputs	6
Number of Outputs	3
Distance	Radial (CCR 1978; BCC 1984)
Orientation	Output-oriented
Returns to Scale	Va riable
Frontier Type	Convex: Data Envelopment Analysis, DEA
Slack Computation	1 Stage
Extended Options	
Elapsed Time	0.28 Seconds

Efficiency Analysis

Gas station performance is considered efficient if the efficiency value is 1. The results of the DEA analysis of 94 gas station in Surabaya resulted in an average efficiency of 0.9799. This shows that, on average, the performance of gas stations in Surabaya has yet to be efficient. Of the 94 gas stations in Surabaya, 52% are already efficient. However, 48% are categorized as inefficient.

Of the 48% of service stations in Surabaya that fall into the inefficient category, several parameters are input variables that require changes to be optimized. 34% of service stations need optimization on operators, and 16% need to optimize the land area owned. Meanwhile, the number of nozzles owned by gas stations must be reviewed, where 29% of gas stations must maximize the number of RON 90 nozzles, and 28% of gas stations must optimize the number of RON 92 nozzles. Regarding consumers, 32% of gas stations need to optimize motorcycle consumers, and 19% need to maximize car consumers.

Changes in the output parameters above will provide changes in potential sales at 33% of gas stations, especially for RON 90 products, and at 38% of gas stations, especially for RON 92 products.

Gas Station Operators Analysis

A total of 34% of gas station have an inefficient number of operators. The average gas station in Surabaya has 15 operators. This number is too many and needs to be reduced. The average ideal number of operators is 13 people. The number of operators depends on the number of nozzles in the gas station. A gas station dispenser machine is usually a multiple of 4. With 12 nozzles, there are four people per shift. There is one operator as a backup if someone is absent. This efficient condition is by the design of gas stations, which have an average of 3 fuel dispensers. If there are too many operators but the number of nozzles is small, the operators are more idle.

Site Area Analysis

A total of 16% of gas stations have non-optimal land area. The average size of gas stations in Surabaya is 2,916 m2. This is too many and needs to be reduced. The ideal middle place is 2,771 m2. Too large gas stations shows that land utilization is not optimal. When purchasing land, there should be no need to buy land that is too large, which impacts spending more money. In addition, more lighting is required at night. It will increase the electricity costs incurred by the gas station.

Nozzle Analysis

29% of gas stations have a non-optimal number of RON 90 nozzles. The average gas station in Surabaya has 5 RON 90 nozzles. This is too many and needs to be reduced. The average ideal number is four nozzles.

Meanwhile, 28% of gas stations have a non-optimal number of RON 92 nozzles. The average gas station in Surabaya has 4 RON 92 nozzles. This is too many and needs to be reduced. The average ideal number is three nozzles. This aligns with the analysis of the number of operators, which must be reduced by 13% to be optimal.

Customer Analysis

19% of service stations in Surabaya serve more car customers than the optimal condition. 21% of consumers can be reduced to optimal. Meanwhile, 32% of service stations in Surabaya serve more motorcycle customers than the optimal condition. 20% of motorcycle consumers can be reduced to optimal. From the analysis, it can be seen that consumers only buy according to their purchasing power. Consumer optimization can be achieved if consumers buy according to the fuel tank's capacity (full tank). This is in line with optimizing the number of nozzles and the number of operators that must be suppressed.

Sales of RON 90 and RON 92 Analysis

By modifying the above variables, it will change the sales of RON 90 at 33% of gas stations in Surabaya. This change will increase the sales of RON 90 by 14%. Meanwhile, modifying the variables above will change the sales of RON 92 at 38% of gas stations in Surabaya. This change will increase the sales of RON 92.

Customer Satisfaction Index

Modifying the above variables will increase the customer satisfaction index by 2% from 4,3 to 4,4. The increase in the customer satisfaction index shows that if the gas station optimizes the variables analyzed above, customers will feel satisfied with the performance offered by the gas station in general

CONCLUSION

By analyzing several parameters that become customer service variables at gas stations located in Surabaya, several points can be concluded as follows The relative efficiency level of gas stations is 52% of gas stations whose performance is efficient. At the same time, 48% of gas stations are included in the inefficient category.

From 48% of gas stations in Surabaya categorized as inefficient, several parameters are input variables that require changes to be optimized. 34% of service stations need optimization on operators, and 16% need to optimize the land area owned. Meanwhile, the number of nozzles owned by gas stations must be reviewed, where 29% of gas stations must maximize the number of RON 90 nozzles, and 28% of gas stations must optimize the number of RON 92 nozzles. Regarding consumers, 32% of gas stations need to optimize motorcycle consumers, and 19% need to maximize car consumers.

Improvement planning for gas stations that are not inefficient will provide changes in potential sales at 33% of gas stations, especially for RON 90 products, and at 38% of gas stations, especially for RON 92 products.

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