

# BENCHMARKING THE OPERATIONAL EFFICIENCY OF SELECTED MALAYSIAN RETAIL WAREHOUSES USING INPUT-ORIENTED CCR AND SUPER-EFFICIENCY DEA MODELS

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**Abstract:** Retail warehouse plays an important role in supporting the Malaysian supply chain, but the complexity of this facility has made some individual performance indicators insufficient to capture the entire operational efficiency. This study evaluates the relative operational efficiency of 10 selected Malaysian retail warehouses using an integrated Data Envelopment Analysis (DEA) framework in two phases. Secondary cross-sectional data were obtained from publicly available annual reports, sustainability reports, and corporate publications. Three inputs—labour, warehouse space, and energy consumption, and two outputs—inventory turnover and revenue were incorporated into an input-oriented CCR model. The Super-Efficiency model was subsequently applied to differentiate and rank the CCR-efficient warehouses. The results identified five out of ten warehouses as relatively efficient. Subsequently, Bonia Corporation Berhad recorded the highest Super-Efficiency score of 10.5578, followed by Padini Holdings Berhad and 99 Speedmart Distribution Center with scores of 5.6417 and 2.9486 respectively. The findings demonstrate the usefulness of combining CCR and Super-Efficiency models for efficiency evaluation and benchmarking.

**Keywords:** *retail warehouse; operational efficiency; data envelopment analysis; CCR model; super-efficiency model.*

## Introduction

Warehousing is an essential component of retail supply chains because it supports receiving, storage, inventory control, order picking and product distribution. Due to Malaysian retail and e-commerce sectors, the storage business in the country has experienced a great growth (Mohamud et al., 2023). Company layout, operational design and resource utilisation can consequently influence the speed, accuracy and cost of retail distribution activities. Efficient retail warehouses managements enable retailers to improve product availability, reduce unnecessary resource consumption and promote customer satisfaction.

The evaluation of warehouse performance is nevertheless challenging because operational performance depends on several resources and outcomes simultaneously. Traditional indicators such as revenue per employee, inventory turnover or company utilisation measure only individual aspects of performance. Thus, these indicators may provide contradictory conclusions. Kusrini et al. (2022) demonstrated that company efficiency should be evaluated across several operational dimensions, including productivity, utilisation, quality, cost and cycle time. Therefore, a multidimensional method is required to evaluate on multiple resources and multiple performance outcomes.

Data Envelopment Analysis (DEA) provides such a method by constructing an empirical efficiency frontier from the observed performance of comparable decision-making units (DMUs). Charnes et al. (1978) introduced the CCR model to evaluate the relative efficiency of DMUs that use multiple inputs to produce multiple outputs. Lee et al. (2023) also specifically highlighted that DEA is a non-parametric mathematical method that is frequently employed to assess the relative efficiency of such above scenario to ascertain efficiency levels for benchmarking purposes.

Despite these advantages, there remains limited empirical evidence on comparing the operational efficiency of Malaysian retail companies using company-related resource indicators. The conventional CCR model assigns the same score of 1.0000 to all efficient DMUs and therefore cannot distinguish their relative positions. This limits its usefulness when managers need to identify the strongest benchmark among several efficient companies. To overcome this limitation, the Super-Efficiency model can be applied and allows efficient DMUs to receive scores exceeding 1 and enables them to be ranked (Andersen & Petersen, 1993).

Since the retail warehouse sector is a key part in Malaysian supply chain, evaluating and improving warehouse efficiency is very crucial to enhance overall operational performance and maintain competitiveness in the retail sector. Therefore, this study evaluates the operational efficiency of 10 selected retail warehouses, using the data available from Bursa Malaysia, including annual reports, sustainability reports and corporate publications. The first objective is to measure operational efficiency using an input-oriented CCR DEA model, while the second objective is to rank the CCR-efficient warehouses using the Super-Efficiency model. The study provides empirical evidence on the comparative performance and efficiency of various retail warehouses in Malaysia. Besides, it is anticipated that the results would help decision-makers to maximize resources, enhance efficiency, and promote sustainable retail warehouse management in Malaysia.

## Literature Review

### Retail Warehousing and Operational Performance

Retail warehouses connect suppliers, retail outlets and customers by coordinating the receipt, storage, picking and distributing inventory. Based on Saleheen et al. (2014) and Kusrini et al. (2022), retail warehouses are facilities that are specifically designed to store products and supplies that are needed by retail outlets and consumers. Besides, retail organizations need to successfully manage its internal resources to fulfil the rising demand of their customers and control operational expenses (Soltani and Soltani, 2026). The efficiency of these activities depends on the interaction between warehouse capacity, workforce utilisation, energy requirements, inventory movement and service outcomes. An effective company layout can reduce travel distance, facilitate material flow and improve the responsiveness of company operations (Mohamud et al., 2023).

Company performance measurement has traditionally relied on indicators such as labour productivity, storage utilisation, order accuracy, inventory accuracy and order-cycle time. However, Staudt et al. (2015) argued that company performance is multidimensional and cannot be represented adequately through a single indicator. Kusrini et al. (2022) similarly evaluated receiving, put-away, storage, order-picking and shipping activities through a combination of financial, productivity, utilisation, quality and cycle-time indicators. Their findings showed that DEA-based benchmarking can identify operational improvement opportunities for inefficient companies.

Lau (2013) used DEA to measure the distribution efficiency of a retail network. This study demonstrates that DEA can be used at different organisational levels. However, the interpretation must correspond to the level at which the data are collected. Company-level employees, revenue and energy usage cannot automatically be interpreted as company-specific measures unless those values are explicitly separated in the original corporate reports. Subsequently, Gafner et al. (2021) also applied DEA to 12 grocery retail companies over seven years using four inputs and six outputs. The study combined window analysis, super-efficiency and slack-based measurement to examine changes in company efficiency and establish improvement targets. While previously, Agarwal and Mehrotra (2009) used the method of Regression, Data Envelopment Analysis and Sensitivity Analysis to study on how efficiently some of the top organized India retail companies have been performing relative to each other over the years as well as identifying factors that help to increase the efficiency of a retail company.

### Data Envelopment Analysis

DEA is a linear-programming method for measuring the relative efficiency of DMUs that employ multiple inputs to produce multiple outputs. The CCR model developed by Charnes et al. (1978) assumes constant returns to scale, which means a proportional change in inputs is expected to produce a proportional change in outputs. A CCR efficiency score incorporates both managerial and scale effects and is therefore commonly interpreted as overall technical and operational efficiency.

The Banker–Charnes–Cooper (BCC) model subsequently introduced variable returns to scale and enabled overall technical efficiency to be decomposed into pure technical and scale efficiency (Banker et al., 1984). The distinction is important when the units under evaluation operate at different organisational scales. In the current dataset, the selected retail warehouses differ considerably in their number of employees, company space, energy consumption and

revenue. Consequently, the CCR results may partially reflect scale differences rather than managerial performance alone.

An input-oriented model determines the proportional reduction in inputs that a DMU could achieve while maintaining its existing outputs. This orientation is suitable when management has greater control over labour, floor space and energy consumption than over market-driven outcomes such as revenue. On the other hand, an output-oriented model would instead examine the potential expansion of outputs while holding inputs constant.

### CCR and Super-Efficiency DEA Model

The CCR model is a foundational DEA model that assumes Constant Return to Scale (CRS) and evaluates technical efficiency. Efficiency in the CCR framework is computed to be the ratio of weighted sum of outputs divided by the weighted sum of inputs, resulting in efficiency scores between 0 and 1 (Lee and Kim, 2014). In addition to efficiency measurement, the CCR model is also a useful diagnostic tool as it helps in recognizing slack variables and target values of inefficient units (Lau, 2013). When applied to the retail warehouse performance, the managers were able to compare the underperforming warehouse to an Efficiency Reference Set of the efficient peers, supporting the operational improvement and optimisation of resources. According to Lau (2013) and Adna et al. (2025), the CCR model provides vital diagnostic data via target assessment, allowing decision makers to accurately calculate how much an inefficient unit must reduce its input consumption to catch up to its efficient peers.

The conventional CCR model may classify several DMUs as efficient because all frontier units obtain a score of 1.0000. Andersen and Petersen (1993) developed the Super-Efficiency model to differentiate these units. When evaluating an efficient DMU, the model removes that DMU from its own reference set and reconstructs the frontier using the remaining units. An input-oriented super-efficiency score greater than 1.0000 indicates the extent to which the evaluated DMU remains beyond the frontier constructed by its peers.

Super-efficiency improves the discriminatory capability of DEA and has been used in company-efficiency research to rank frontier units (Gafner et al., 2021). Nevertheless, an exceptionally high super-efficiency score may indicate an extreme observation, weak comparability or an outlier rather than superior managerial performance alone. Subsequently, Sanusi et al. (2025) conclude that the Super-Efficiency score is the indication of the units' performance in comparison to all other peers, frequently resulting in values exceeding 1.0000 for highly efficient DMUs. In this manner, researchers and practitioners can differentiate between warehouses that show marginal efficiency and those that show superior operational performance.

## Methodology

### Research Design and DMUs

This study employed a quantitative, cross-sectional efficiency-evaluation design. Secondary data were obtained from publicly available sources by Bursa Malaysia. The 10 selected warehouses were treated as the Decision-Making Units (DMUs) in this study. The selected DMUs were Padini Holdings Berhad, AEON Co. (M) Bhd., 7-Eleven Malaysia Holdings Berhad, Eco-Shop Marketing Berhad, 99 Speedmart, Mr. DIY Group (M) Berhad, Parkson Holdings Berhad, myNews Holdings Berhad, Senheng New Retail Berhad, and Bonia Corporation Berhad. The selection of 10 DMUs is based on the rule of thumb by Golany and Roll (1989) who stated that the number of DMUs should be at least twice the total number of

inputs and outputs (Number of DMU  $\geq 2 \times$  [Number of Inputs + Number of Outputs]) in order to ensure the model maintains sufficient discriminatory power. Therefore, for this case study that having 3 inputs and 2 outputs, the selection of 10 DMUs satisfy the rule and the model are able to make comparative analysis meaningful.

### Input and Output Variables

In this study, three inputs variables and two output variables were selected. These inputs reflect the main capital attainable and accessible to a warehouse which are crucial for handling the complex collection of operations. Meanwhile, the outputs are the metrics that assess the warehouse's efficacy in rapidly shifting products and generating economic value. Table 1 below shows the input and output variables for this study, while Table 2 shows the numerical dataset obtained for the DMUs. The data collected are subsequently analysed using the CCR DEA model executed in LINGO 22.0 software.

**Table 1: Input and Output Variables**

| Type   | Variable           | Operational interpretation                                              |
|--------|--------------------|-------------------------------------------------------------------------|
| Input  | Labour             | Number of employees reported for the relevant operating entity          |
|        | Company space      | Floor area associated with company or distribution operations           |
|        | Energy consumption | Reported electricity or energy usage                                    |
| Output | Inventory turnover | Frequency with which average inventory was converted into cost of sales |
|        | Revenue            | Sales revenue reported by the operating entity                          |

**Table 2: Input and Output Data for DMUs**

| DMUs  | Retail Company                    | Inputs |                                  |                          | Outputs                    |                  |
|-------|-----------------------------------|--------|----------------------------------|--------------------------|----------------------------|------------------|
|       |                                   | Labour | Company Space (ft <sup>2</sup> ) | Energy Consumption (kWh) | Inventory Turnover (Times) | Revenue (RM'000) |
| DMU1  | Padini Holdings Berhad            | 3,400  | 45,962                           | 1,071,330                | 3.62                       | 1,918,847        |
| DMU2  | AEON Co. (M) Bhd.                 | 9,423  | 1,645,671                        | 403,840,020              | 4.17                       | 4,261,525        |
| DMU3  | 7-Eleven Malaysia Holdings Berhad | 11,367 | 174,182                          | 261,384,764              | 5.19                       | 2,925,548        |
| DMU4  | Eco-Shop Marketing Berhad         | 7,420  | 18,675                           | 78,792,000               | 5.35                       | 2,404,020        |
| DMU5  | 99 Speedmart Distribution Centre  | 1,879  | 15,489.27                        | 299,160,390              | 7.06                       | 9,981,642        |
| DMU6  | Mr. DIY Group (M) Berhad          | 9,098  | 1,722,010                        | 251,222,778              | 2.33                       | 4,651,416        |
| DMU7  | Parkson Holdings Berhad           | 1,557  | 9,278.82                         | 45,626,470               | 3.68                       | 2,805,074        |
| DMU8  | myNews Holdings Berhad            | 1,932  | 108,715                          | 4,982,830                | 5.42                       | 804,198          |
| DMU9  | Senheng New Retail Berhad         | 1,836  | 126,412                          | 18,921,045               | 4.09                       | 1,216,852        |
| DMU10 | Bonia Corporation Berhad          | 759    | 1,038                            | 1,303,000                | 1.74                       | 413,665          |

### Input-Oriented CCR Model

The Input-Oriented CCR DEA model focuses on the decrease in input consumption without considering the advancement of the existing output. This is suitable to fit retail warehouse operations since the management typically has a greater control over the use of resources. The efficiency score of the selected retail warehouses was calculated using the given Input-Oriented CCR model:

$$\text{Minimize } \theta_p = \frac{\sum_{r=1}^s u_r y_{rp}}{\sum_{i=1}^m v_i x_{ip}}$$

subject to

$$\frac{\sum_{r=1}^s u_r y_{rj}}{\sum_{i=1}^m v_i x_{ij}} \leq 1, \forall j = 1, 2, \dots, n$$

$$u_r \geq 0 \quad \forall r$$

$$v_i \geq 0 \quad \forall i$$

where  $x_{ij}$  represents the amount of input  $i$  used by DMU  $j$ ,  $y_{rj}$  represents the amount of output  $r$  produced by DMU  $j$ ,  $v_i$  and  $u_r$  represent the weight assigned to input  $i$  and output  $r$  respectively, and  $\theta_p$  is the input-oriented efficiency score of DMU  $p$ .

A DMU is considered efficient when  $\theta_p = 1.0000$  and all input and output slacks are zero. A value below 1 indicates inefficiency and the potential for input reduction while maintaining the observed output levels.

### Super-Efficiency Model

The CCR model is limited in the ability to rank the efficient DMUs, as all efficient units obtained the same score of 1.0000. Therefore, the Super-Efficiency model is used to overcome this limitation by allowing the efficiency score to exceed 1.0000, enabling a complete ranking among efficient DMUs. The Super-Efficiency model used in this study is formulated as follows:

$$\text{Minimize } \theta_p^{SE} = \frac{\sum_{r=1}^s u_r y_{rp}}{\sum_{i=1}^m v_i x_{ip}}$$

subject to

$$\frac{\sum_{r=1}^s u_r y_{rj}}{\sum_{i=1}^m v_i x_{ij}} \leq 1, \forall j = 1, 2, \dots, n, \quad j \neq p$$

$$u_r \geq 0 \quad \forall r$$

$$v_i \geq 0 \quad \forall i$$

The key difference in this model is that the evaluated DMU is excluded from the constraint set, allowing more accurate comparison and ranking among the efficient DMUs.

## Results and Discussion

The result of this study focuses on the differences between efficient and inefficient retail warehouses, patterns within each efficient unit, and performance gaps between retail warehouses. Table 3 below shows the efficiency scores of each retail warehouse using the input-oriented CCR DEA model. Five DMUs were identified operating on the efficiency frontier (efficiency score of 1.0000), while the remaining five DMUs were relatively inefficient relative to the retail warehouses on that frontier (score below than 1.0000).

**Table 3: CCR Efficiency Score of Retail Warehouses**

| DMU   | Retail Warehouse                  | CCR Efficiency Score | Performance |
|-------|-----------------------------------|----------------------|-------------|
| DMU1  | Padini Holdings Berhad            | 1.0000               | Efficient   |
| DMU2  | AEON Co. (M) Bhd.                 | 0.2086               | Inefficient |
| DMU3  | 7-Eleven Malaysia Holdings Berhad | 0.1837               | Inefficient |
| DMU4  | Eco-Shop Marketing Berhad         | 0.3564               | Inefficient |
| DMU5  | 99 Speedmart Distribution Centre  | 1.0000               | Efficient   |
| DMU6  | Mr. DIY Group (M) Berhad          | 0.2956               | Inefficient |
| DMU7  | Parkson Holdings Berhad           | 1.0000               | Efficient   |
| DMU8  | myNews Holdings Berhad            | 1.0000               | Efficient   |
| DMU9  | Senheng New Retail Berhad         | 0.8268               | Inefficient |
| DMU10 | Bonia Corporation Berhad          | 1.0000               | Efficient   |

For further evaluation towards the efficiency frontier, the Super-Efficiency model was applied and the results are shown in Table 4 below.

**Table 4: Super-Efficiency Score of Retail Warehouses**

| DMU   | Retail Warehouse                 | Super-Efficiency Score |
|-------|----------------------------------|------------------------|
| DMU1  | Padini Holdings Berhad           | 5.6417                 |
| DMU5  | 99 Speedmart Distribution Centre | 2.9486                 |
| DMU7  | Parkson Holdings Berhad          | 1.2894                 |
| DMU8  | myNews Holdings Berhad           | 1.2195                 |
| DMU10 | Bonia Corporation Berhad         | 10.5578                |

Table 4 demonstrate a specific performance ranking among the efficient retail warehouse. Bonia Corporation Berhad achieved the highest Super-Efficiency score of 10.5578, significantly exceeding other efficient warehouse. This indicates that DMU10 uses its labour, warehouse space and energy consumption very efficiently in generating inventory turnover and revenue.

The combined CCR and Super-Efficiency DEA results provide a comprehensive evaluation of the operational performance of the selected retail warehouse. Table 5 shows the overall CCR and Super-Efficiency DEA results according to its rank.

**Table 5: Overall CCR and Super-Efficiency Results and Ranking of Retail Warehouses**

| DMU   | Retail Warehouse                  | CCR Efficiency Score | Super-Efficiency Score | Performance | Rank |
|-------|-----------------------------------|----------------------|------------------------|-------------|------|
| DMU10 | Bonia Corporation Berhad          | 1.0000               | 10.5578                | Efficient   | 1    |
| DMU1  | Padini Holdings Berhad            | 1.0000               | 5.6417                 | Efficient   | 2    |
| DMU5  | 99 Speedmart Distribution Centre  | 1.0000               | 2.9486                 | Efficient   | 3    |
| DMU7  | Parkson Holdings Berhad           | 1.0000               | 1.2894                 | Efficient   | 4    |
| DMU8  | myNews Holdings Berhad            | 1.0000               | 1.2195                 | Efficient   | 5    |
| DMU9  | Senheng New Retail Berhad         | 0.8268               | –                      | Inefficient | 6    |
| DMU4  | Eco-Shop Marketing Berhad         | 0.3564               | –                      | Inefficient | 7    |
| DMU6  | Mr. DIY Group (M) Berhad          | 0.2956               | –                      | Inefficient | 8    |
| DMU2  | AEON Co. (M) Bhd.                 | 0.2086               | –                      | Inefficient | 9    |
| DMU3  | 7-Eleven Malaysia Holdings Berhad | 0.1837               | –                      | Inefficient | 10   |

According to Table 5, Bonia Corporation Berhad (DMU10) had the highest overall performance across all retail warehouses, while 7-Eleven Malaysia Holdings Berhad (DMU3) was at the bottom of the rank with the lowest CCR efficiency score. This reveals that there is significant efficiency in managing the use of resources.

The high Super-Efficiency score of 10.5578 for Bonia Corporation Berhad occurs because it uses significantly fewer resources than the other warehouses. Table 2 shows that Bonia operates with the smallest inputs: only 759 employees, 1,038 ft<sup>2</sup> of company space and 1,303,000 kWh of energy consumption. Since the DEA model measures efficiency by dividing outputs by inputs, dividing by such small input numbers naturally creates a much larger score. Operationally, this result shows that Bonia Corporation Berhad runs a very small and controlled setup, rather than producing massive sales. On the other hand, the low efficiency rating could be the result of excessive labour utilization, underutilization of warehouse space, or high energy consumption in comparison to the output of revenue and inventory turnover.

## Conclusion

This study applied input-oriented CCR and Super-Efficiency DEA models to evaluate the relative operational efficiency of 10 selected Malaysian retail warehouses. The results of the CCR efficiency evaluation showed a significant difference in performance across the retail warehouses, with exactly half of the assessed DMUs achieving efficient scores. Meanwhile, among the inefficient warehouses, Senheng New Retail Berhad operated closest to the frontier, whereas 7-Eleven Malaysia Holdings Berhad recorded the lowest CCR efficiency score.

The findings demonstrate how DEA can combine multiple operational resources and outcomes within a single benchmarking framework. Nevertheless, the results represent relative efficiency within the selected sample and should not be interpreted as absolute evidence of managerial performance. The extreme Super-Efficiency score obtained by Bonia, the limited sample size, differences in retail formats and uncertainty surrounding measurement units can reduce the

reliability of strong managerial conclusions. For recommendations, future analysis should consider to expand the number of DMUs, use actual company-level observations, apply both CCR and BCC models, and report input and output slacks. These improvements would produce more defensible efficiency estimates and more practical recommendations for retail warehouse management.

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