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Assessing the Impact of Mergers and Acquisitions on Operational Efficiency: A DEA Approach

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Abstract

The present study examined the impact of mergers and acquisitions (M&As) on the operational efficiency of companies within the manufacturing sector, focusing on a period from 2015 to 2025. Employing a quantitative research methodology, the analysis encompasses a decade of financial data for six manufacturing companies, divided into pre-merger and post-merger phases. this study employs Data Envelopment Analysis (DEA) to evaluate operational efficiency based on one output variable (revenue) and nine input variables, including operating costs, debt level, capital expenditure and others. The findings reveal significant variations in efficiency scores, indicating that M&As have a heterogeneous impact on the operational efficiency of companies. Specifically, the study identifies shifts in the efficiency rankings of companies post-M&A, with some firms demonstrating marked improvements in operational performance. The research underscores the utility of DEA as a tool for analysing and enhancing the success of M&As in the manufacturing sector, highlighting the importance of strategic planning and operational efficiency in achieving favourable M&A outcomes.

***Key words*:** data envelopment analysis, M&A, manufacturing industry, operational efficiency

INTRODUCTION

In the dynamic realm of mergers and acquisitions (M&A), stakeholders are constantly seeking innovative methods to evaluate and enhance the strategic and operational alignment of potential deals. The Data Envelopment Analysis (DEA) model stands out as a sophisticated tool that transcends traditional financial metrics, offering a deeper dive into the operational efficiency of companies involved in M&A transactions. This non-parametric method assesses the performance of decision-making units (DMUs) by comparing them against a best-practice frontier, thus identifying the most efficient entities and setting a benchmark for others. Through the lens of DEA, companies contemplating mergers or acquisitions can meticulously analyze potential targets, evaluating their capability to transform inputs into outputs efficiently relative to peers. The application of the DEA model in M&A activities facilitates a multi-dimensional analysis, incorporating

various inputs (such as capital, labor, and technology) and outputs (like sales, profits, and market share), which are crucial for understanding a company's operational stance. This approach is particularly beneficial in identifying companies that, despite their suboptimal financial performance, possess robust operational processes that could significantly contribute to the efficiency of the combined entity post-merger. By generating efficiency scores, the DEA model quantitatively highlights areas where a company excels or lags, offering actionable insights into potential synergies or redundancies that a merger or acquisition could exploit or eliminate.

Moreover, the DEA model's adaptability to different sectors and its ability to handle multiple inputs and outputs without requiring a predefined functional relationship between them make it an invaluable asset in the heterogeneous world of M&A. It allows for a tailored analysis that respects the unique characteristics and strategic objectives of each deal, enabling a more nuanced decision-making process. In the pre-merger phase, this can guide the selection of targets by aligning operational capabilities with strategic goals, while in the post-merger phase, it can direct integration efforts towards areas promising the greatest efficiency gains and value creation. Furthermore, by establishing a benchmark for operational efficiency, the DEA model aids in setting realistic and achievable post-merger integration goals, facilitating a smoother transition and helping to realize the full potential of the merger or acquisition. This is particularly crucial in a landscape where many M&A transactions fail to meet their stated objectives due to overestimation of synergies or underestimation of integration challenges. Ultimately, the incorporation of DEA into the M&A evaluation process represents a shift towards a more comprehensive, operationally focused perspective on value creation, highlighting its pivotal role in steering companies towards successful mergers and acquisitions that are not just financially, but also operationally sound.

NEED OF THE STUDY

The study is essential to address the critical gap in understanding the impact of mergers and acquisitions (M&As) on the operational efficiency of manufacturing companies. Given the mixed outcomes of M&As reported in existing literature, there is a compelling need for detailed analysis to guide companies in making informed strategic decisions. By leveraging the Data Envelopment Analysis (DEA) model, this research aims to provide empirical insights into how M&As affect operational performance pre and post-integration. Such insights are crucial for manufacturing firms aiming to utilize M&As as a growth strategy effectively, ensuring they achieve the desired operational efficiencies and competitive advantages. Ultimately, this study seeks to contribute to the broader academic and practical understanding of M&As' role in enhancing operational success within the manufacturing sector.

REVIEW OF LITERATURE

Lin et al (2020) study introduced a fresh approach to matching companies for mergers and acquisitions (M&As) using Data Envelopment Analysis (DEA), focusing on technical and scale efficiencies. It proposes a unique combination of inverse and conventional DEA models to better match firms, enhancing their overall performance post-merger. A case study on Turkish energy firms showcases the method's effectiveness, highlighting its potential to improve M&A outcomes.

Aamir et al (2017) studied the effects of mergers and acquisitions on the banking and textile sectors in Pakistan from 2004-2012, using data envelopment analysis to assess the efficiency changes pre and post M&A. It highlights the critical economic roles of these sectors, with banking as a key finance provider and textiles as a major manufacturing and export sector. The results indicate a varied impact on efficiency, with certain banks and textile companies showing improvement post-M&A, while others fail to enhance their performance.

Salleh et al (2016) examined the effects of mergers and acquisitions on the technical efficiency of ASEAN telecommunication companies, utilizing Data Envelopment Analysis (DEA) over a period from 2000 to 2011. It innovatively assesses performance through asset utilization rather than conventional financial metrics. Findings notably highlight a negative correlation between the sequence of M&As and technical efficiency, alongside a negative impact of company size on efficiency.

Chaudhary et al (2016) explored the outcome of Mergers and Acquisitions (M&As) on the efficiency of banks in Pakistan, using the Data Envelopment Analysis (DEA) method under the Constant Returns to Scale (CRS) assumption. By calculating the technical efficiency (TE), pure technical efficiency (PTE), and scale efficiency (SE) for each bank through different models, it reveals a notable decline in efficiency scores post-M&A for the majority of the banks analyzed.

Salleh et al (2013) investigated the technical efficiencies of mergers and acquisitions among Malaysian telecommunications companies, utilizing a dual-phase approach combining the CCR model and regression analysis over the 2005-2010 period. It uncovers nuanced relationships between acquisition sequences, company size, and technical efficiency, revealing both positive and negative correlations. The study highlights a gap in understanding the role of external factors, such as government-linked corporations and regulatory environments, suggesting these as avenues for future inquiry to deepen the understanding of M&A efficiency dynamics.

STATEMENT OF THE PROBLEM

Mergers and acquisitions often don't deliver the expected benefits because companies struggle to properly assess how well different businesses will work together. Traditional methods used to evaluate these deals might miss important details about how efficiently a company operates. This makes it hard to figure out which companies should merge or how to successfully combine them to save money and improve performance. Furthermore, using advanced techniques like Data Envelopment Analysis (DEA) to get a clearer picture is challenging due to limited data and the difficulty in choosing the right factors to analyze. Solving these problems is key for companies to benefit from mergers and acquisitions.

OBJECTIVE OF THE STUDY

- To Assess the Impact of Mergers and Acquisitions on Operational Efficiency Using the Data Envelopment Analysis Approach

RESEARCH METHODOLOGY

This study employs a quantitative research methodology utilizing secondary data to analyze the impact of mergers and acquisitions on the operational efficiency of six manufacturing companies. Data was collected from various sources, including company annual reports, Securities and Exchange Board of India (SEBI) filings, financial websites like Moneycontrol.com. The analysis spans ten years of financial data, segmented into pre-merger (2015-16 to 2019-20) and post-merger (2020-21 to 2024-25) periods. DEA is used in this paper to compute the efficiency and super-efficiency scores of M&A companies. R 4.0.3 version is run using benchmarking and psych package for analysis.

The Data Envelopment Analysis (DEA) model is a non-parametric method used to assess the efficiency of decision-making units (DMUs), such as companies or organizations, by comparing the inputs they use to produce outputs. It operates on the principle of creating an efficiency frontier, against which the performance of each DMU is measured, allowing for the identification of those operating at or near optimal levels of efficiency. The model's flexibility allows for multiple inputs and outputs, making it suitable for evaluating complex processes across diverse sectors.

Variable selection: one output (dependent) and nine input (independent) variables

One output (dependent) Revenue, used as an output variable, quantifies a firm's financial performance by measuring the total income generated from its operations, serving as a key indicator of its efficiency and effectiveness in resource utilization.

1. **Operating Cost:** Measures the total expenses involved in the day-to-day running of the business. This variable is critical for assessing how efficiently a company utilizes its resources to maintain operations.
2. **Debt Level:** Indicates the total amount of long-term and short-term borrowing a company has. High levels of debt can affect a company's efficiency by increasing its financial burden. Analysing the debt level helps understand the financial leverage and its impact on operational efficiency.
3. **Capital Expenditure:** Reflects the funds a company uses to acquire, upgrade, and maintain physical assets such as property, industrial buildings, or equipment. This input is essential for evaluating how effectively a company invests in its operational capacity and long-term growth.
4. **Inventory Level:** Represents the total value of a company’s holdings in raw materials, work-in-progress, and finished goods. Efficient inventory management can reduce holding costs and increase cash flow, making it a key factor in operational efficiency.
5. **Cash and Cash Equivalents:** Consists of a company's most liquid assets, including currency, short-term investments, and other securities easily convertible into cash. This variable is vital for assessing a company's liquidity and its ability to meet short-term obligations without additional financing.
6. **Size of the Firm:** This is typically measured by total assets and it reflects the overall scale of a company's operations, indicating how the magnitude of resources available might influence operational efficiency in a DEA model.

7. **Dividend Payout Ratio (DP Ratio):** As an input, it represents the company's financial strategy regarding dividend distribution, suggesting how this allocation of profits might impact the firm's operational resources and efficiency.

8. **Employee Expenses:** Encompasses all costs related to employing staff, including wages, benefits, and training costs. This input is crucial for understanding how labor costs contribute to the production process and the overall efficiency of the company.

9. **Return on Assets (ROA):** When considered as an input, ROA measures the effectiveness of a company's asset utilization in previous periods, providing insight into how past profitability influences current efficiency levels.

EMPIRICAL ANALYSIS

Efficiency is evaluated based on the ratio of one output (dependent) variable to nine input (independent) variables across pre, post, and overall periods.

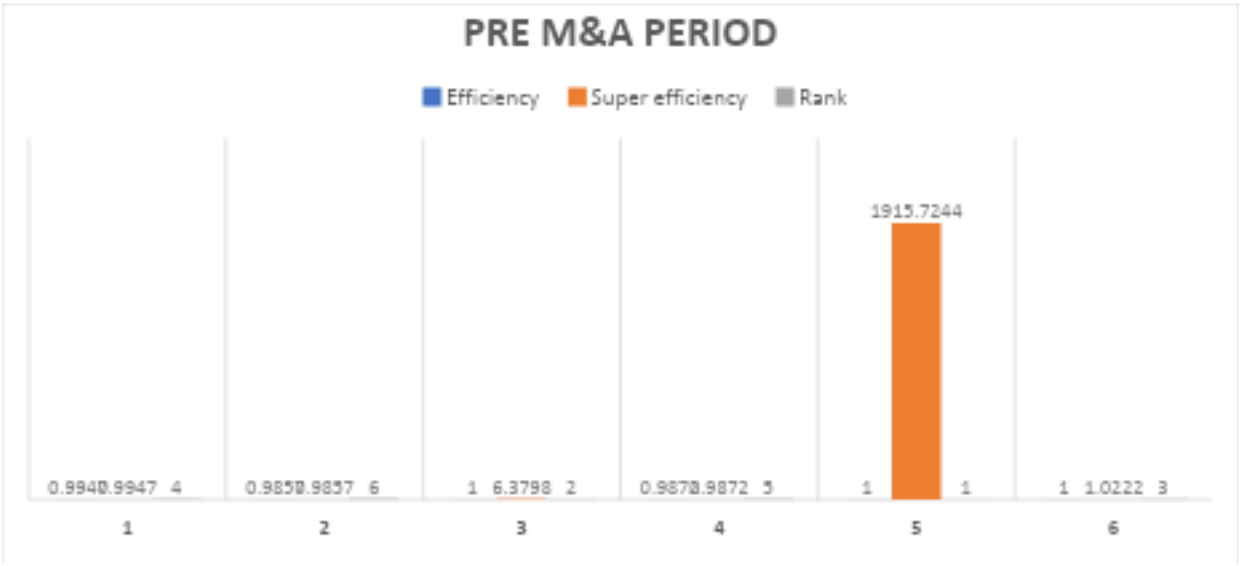
RANKING OF THE COMPANIES

Data Envelopment Analysis (DEA) is a non-parametric linear programming technique used to evaluate and rank companies based on efficiency and super-efficiency scores

Table 1: Ranking of Companies (Pre-M&A Period) based on Efficiency and Super Efficiency Scores

Sl.NO	M&A Companies	Sector	Efficiency	Super efficiency	Rank
1	Kaycee Industries	Electric Equipment	0.9947	0.9947	4
2	Continental Chemicals Ltd	Detergents & Soaps	0.9857	0.9857	6
3	Indo Rana Synthetics Ltd	Textiles & Apparel	1	6.3798	2
4	Danube Industries Ltd	Paper & Forest Products	0.9872	0.9872	5
5	Rapicute Carbides Ltd	Engineering - Industrial Equipment	1	1915.7244	1
6	Indo Tech Transformers Ltd	Electric Equipment	1	1.0222	3

Figure 1 Graphical presentation of Ranking of Companies (Pre-M&A Period) based on Efficiency & Super Efficiency

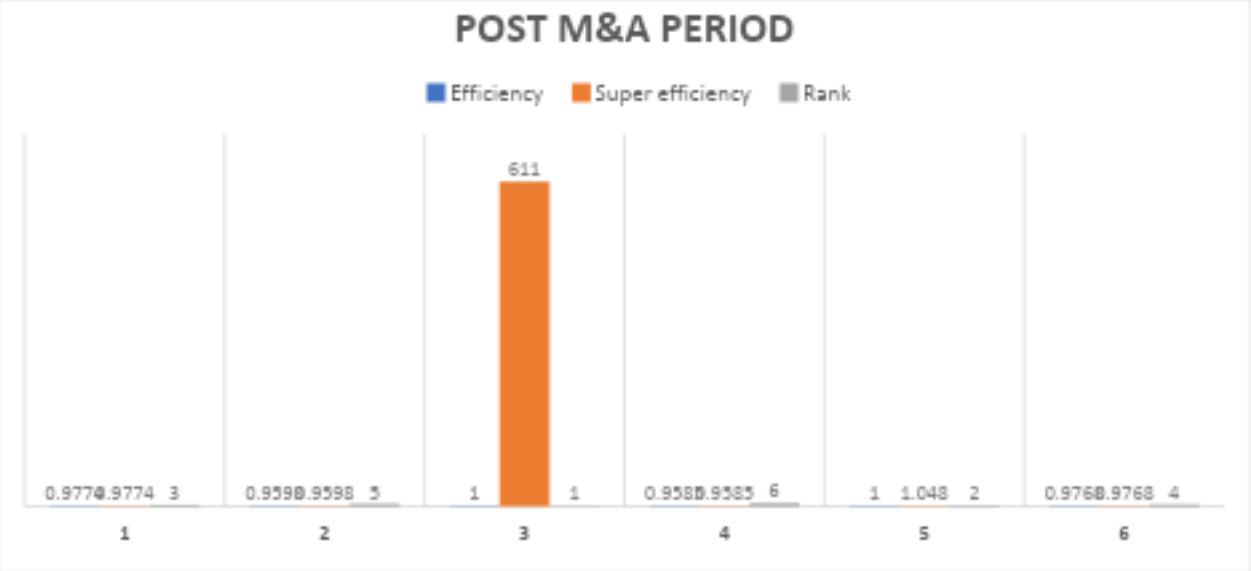


In the pre-merger and acquisition analysis presented in Table 1, the application of efficiency and super-efficiency scores yields insightful distinctions among companies across various sectors. Among the selected companies, Rapicute Carbides Ltd emerges as the standout performer, achieving not only a perfect efficiency score but also an exceptional super efficiency score of 1915.7244, thereby securing the top rank. This indicates a significant differentiation in operational excellence, especially when compared to other companies with perfect efficiency scores but substantially lower super efficiency scores, such as Indo Rana Synthetics Ltd, which ranks second with a super efficiency score of 6.3798.

Table 2: Ranking of Companies (Post M&A Period) based on Efficiency and Super Efficiency Scores

Sl.NO	M&A Companies	Sector	Efficiency	Super efficiency	Rank
1	Kaycee Industries	Electric Equipment	0.9774	0.9774	3
2	Continental Chemicals Ltd	Detergents & Soaps	0.9598	0.9598	5
3	Indo Rana Synthetics Ltd	Textiles & Apparel	1	611	1
4	Danube Industries Ltd	Paper & Forest Products	0.9585	0.9585	6
5	Rapicute Carbides Ltd	Engineering - Industrial Equipment	1	1.048	2
6	Indo Tech Transformers Ltd	Electric Equipment	0.9768	0.9768	4

Figure 2 Graphical presentation of Ranking of Companies (Post-M&A Period) on the basis of Efficiency & Super Efficiency

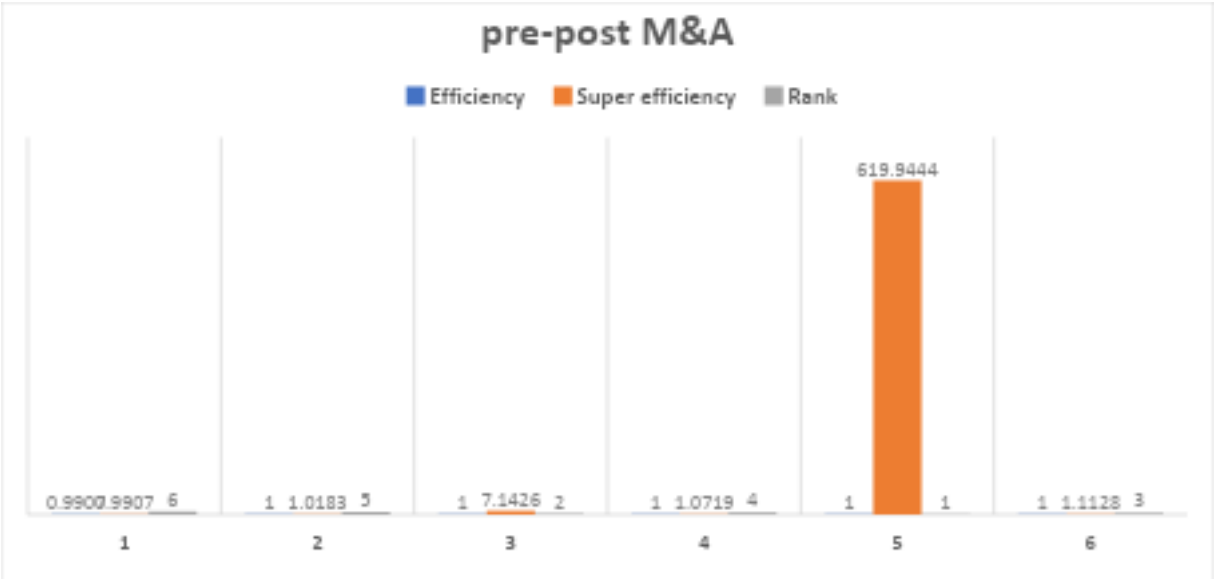


In the post-merger and acquisition period, as depicted in Table 2, the analysis of efficiency and super-efficiency scores discovers notable shifts in company performance across different sectors. During the study period, Indo Rana Synthetics Ltd emerges as the top performer, achieving an impeccable efficiency score of 1 and a remarkable super efficiency score of 611, exhibiting its superior operational capabilities. In contrast, Danube Industries Ltd is positioned at the lower end of the performance spectrum, with an efficiency score of 0.9585 and a matching super efficiency score, indicating a relatively lower level of operational effectiveness compared to its peers.

Table 3: Ranking of Companies (Pre-post M&A Period) based on Efficiency and Super Efficiency Scores

Sl.NO	M&A Companies	Sector	Efficiency	Super efficiency	Rank
1	Kaycee Industries	Electric Equipment	0.9907	0.9907	6
2	Continental Chemicals Ltd	Detergents & Soaps	1	1.0183	5
3	Indo Rana Synthetics Ltd	Textiles & Apparel	1	7.1426	2
4	Danube Industries Ltd	Paper & Forest Products	1	1.0719	4
5	Rapicute Carbides Ltd	Engineering - Industrial Equipment	1	619.944	1
6	Indo Tech Transformers Ltd	Electric Equipment	1	1.1128	3

Figure 3 Graphical presentation of Ranking of Companies (Pre-Post M&A Period) based on Efficiency & Super Efficiency

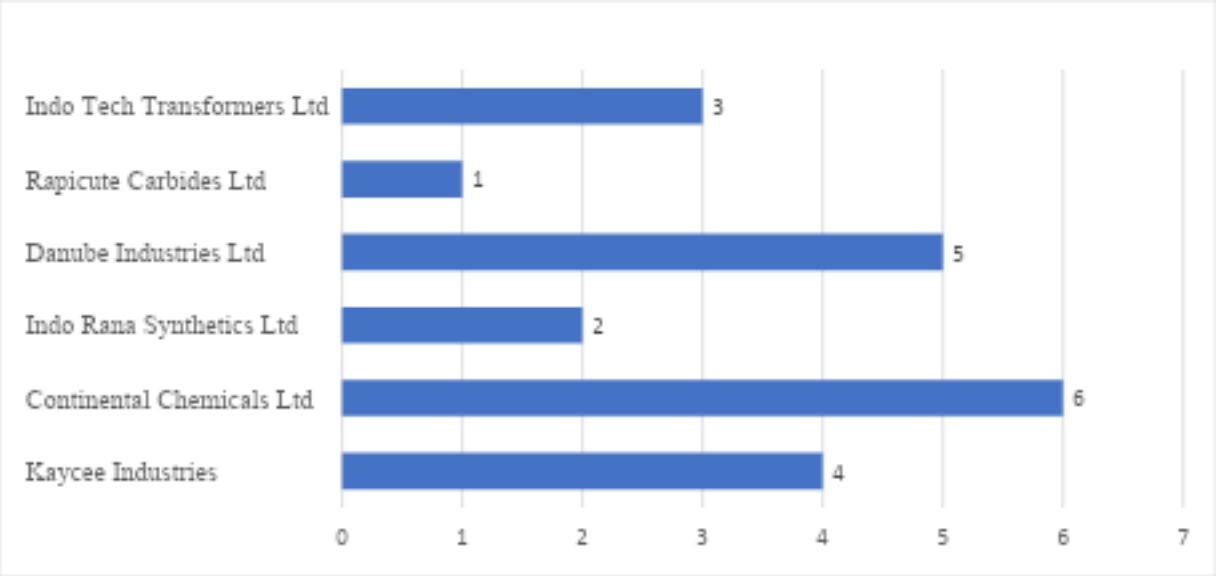


In the detailed evaluation of company performance spanning the pre-post-merger and acquisition period, as outlined in Table 3, Rapicute Carbides Ltd emerges as the leader, boasting a perfect efficiency score and an extraordinary super efficiency score of 619.944, securing the first position. Notably, Indo Rana Synthetics Ltd also achieves a perfect efficiency score but with a super efficiency score of 7.1426, which places it in the second rank, highlighting the significant variation in super efficiency among top-performing companies. Kaycee Industries, with an efficiency score of 0.9907, finds itself at the bottom of the ranking, underscoring the competitive edge that super efficiency analysis provides in evaluating company performance post-mergers and acquisitions.

Table 4: Grand Ranking of Companies Based on Their Ranking Scores Across The Pre, Post and Pre-Post M&A Period

Sl.NO	M&A Companies	PRE	POST	PRE &POST	GRAND RANKING
1	Kaycee Industries	4	3	6	4
2	Continental Chemicals Ltd	6	5	5	6
3	Indo Rana Synthetics Ltd	2	1	2	2
4	Danube Industries Ltd	5	6	4	5
5	Rapicute Carbides Ltd	1	2	1	1
6	Indo Tech Transformers Ltd	3	4	3	3

Figure 4: Graphical presentation of Grand Ranking of Based on Their Ranking Scores Across The Pre, Post and Pre-Post M&A Period



Rapicute Carbides Ltd secures the highest grand ranking, indicating its sustained competitive strength in pre-, post, and pre&post mergers and acquisitions (M&A). Conversely, Continental Chemicals Ltd holds the lowest grand ranking, signaling a significant decline in its overall competitive positioning of M&A. Meanwhile, the remaining companies, including Kaycee Industries, Indo Rana Synthetics Ltd, Danube Industries Ltd, and Indo Tech Transformers Ltd, exhibit varying degrees of fluctuation in their grand rankings, reflecting the diverse impacts of M&A on their competitive landscapes.

FINDINGS OF THE STUDY

The empirical analysis, focusing on the pre-merger, post-merger, and combined periods, highlights significant variances in company performances as measured by efficiency and super-efficiency scores. Before the mergers, Rapicute Carbides Ltd distinguished itself with an unparalleled super-efficiency score of 1915.7244, indicating an exceptional level of operational excellence. In contrast, Indo Rana Synthetics Ltd, although efficient, had a considerably lower super efficiency score of 6.3798, positioning it second, yet far behind Rapicute in terms of operational leverage. Following the mergers, the landscape shifted notably. Indo Rana Synthetics Ltd catapulted to the forefront with a super efficiency score of 611, showcasing a remarkable improvement in operational capabilities, possibly benefiting significantly from the merger. On the other hand, Danube Industries Ltd found itself at a disadvantage, with its efficiency score dropping to 0.9585, indicating a relative decline in operational effectiveness within its sector. The pre-post-merger analysis further cements Rapicute Carbides Ltd's dominance, maintaining its top position with a super efficiency score of 619.944, underscoring the company's consistent operational superiority. Meanwhile, Indo Rana Synthetics Ltd secured the second rank with a super efficiency score of 7.1426, demonstrating its sustained performance excellence across periods. Rapicute Carbides Ltd tops the grand ranking with sustained strength across all M&A phases, while Continental Chemicals Ltd ranks lowest, reflecting significant decline, with other companies displaying diverse impacts on their competitive positions.

These findings illustrate not only the critical role of efficiency and super efficiency scores in assessing company performances in the context of mergers and acquisitions but also the varying impacts of these strategic moves across different companies and sectors. The data reveal that while some companies like Rapicute Carbides Ltd enhance their operational dominance, others may experience shifts in their competitive positioning, emphasizing the nuanced effects of mergers and acquisitions on corporate performance.

CONCLUSION

The empirical analysis presented through the efficiency and super efficiency scores before, after, and across the pre-post-merger and acquisition periods unveils significant insights into the operational dynamics of companies within different sectors. Rapicute Carbides Ltd and Indo Rana Synthetics Ltd have emerged as consistent leaders, showcasing remarkable operational excellence and adaptability in response to M&A activities. The stark contrast in their super efficiency scores, especially noted in Rapicute Carbides Ltd's exceptional performance pre- and post-M&A, underscores the profound impact of strategic integration and operational optimization post-mergers and acquisitions. The lowest ranking, held by Continental Chemicals Ltd, indicates the challenges or difficulties the company faces in adapting to the changes brought about by mergers and acquisitions (M&A). The intermediate rankings of Kaycee Industries, Indo Rana Synthetics Ltd, Danube Industries Ltd, and Indo Tech Transformers Ltd indicate varied responses to M&A activities, highlighting the complex nature of competitive dynamics in the corporate arena.

RESEARCH IMPLICATION

The present study demonstrates that evaluating a company's performance through both efficiency and super efficiency scores is essential for understanding the real impact of mergers and acquisitions (M&As). It shows that the success of M&As can differ greatly across different industries, suggesting that there is no one-size-fits-all approach to M&A strategy. The study also finds that companies with higher super efficiency scores after M&As are likely to achieve a competitive advantage, highlighting the importance of careful strategic planning and maintaining operational efficiency during the M&A process. These insights are crucial for business leaders and policymakers who aim to make the most out of M&As.

LIMITATIONS OF THE STUDY

A notable limitation of this study is its analysis based on a limited number of companies, which may not fully represent the broader spectrum of merger and acquisition outcomes across various sectors. Additionally, the reliance on efficiency and super-efficiency scores may overlook critical aspects of company performance, such as market positioning, brand value, and customer satisfaction. This sector-specific analysis might also restrict the applicability of the findings to different industries with unique competitive environments and market challenges.

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