

Operational Efficiency of Large-Cap Indian Information Technology Companies: A Three-Year Comparative Study Using Data Envelopment Analysis

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ABSTRACT

This study evaluates the operational efficiency of five large-cap Indian Information Technology (IT) companies using Data Envelopment Analysis (DEA) over three consecutive financial years (FY2023–24 to FY2025–26). A quantitative longitudinal research design was adopted using secondary data collected from the audited consolidated financial statements of Tata Consultancy Services (TCS), Infosys, HCL Technologies, Tech Mahindra, and Wipro. An input-oriented Charnes–Cooper–Rhodes (CCR) DEA model was employed to assess relative technical efficiency by considering total assets as the input variable and revenue from operations and net profit as output variables. Pearson correlation analysis was further conducted to examine the relationship between DEA efficiency scores and selected financial performance indicators. The findings reveal that Tata Consultancy Services consistently remained on the efficiency frontier throughout the study period, demonstrating sustained operational excellence, while HCL Technologies exhibited continuous improvement in efficiency. In contrast, Tech Mahindra experienced a significant decline in efficiency during FY2025–26 following rapid asset expansion, and Wipro consistently recorded the lowest efficiency scores among the sampled firms. The analysis further indicates that asset turnover exhibited a stronger positive association with operational efficiency than net profit margin during the study period. The study provides valuable insights for corporate managers, investors, and policymakers by offering a benchmarking framework for evaluating operational efficiency and resource utilization in the Indian IT sector. It also contributes to the existing literature by presenting a recent three-year comparative DEA assessment of large-cap Indian IT companies.

Keywords: Data Envelopment Analysis (DEA), Operational Efficiency, Indian Information Technology Companies, CCR Model, Technical Efficiency, Asset Turnover, Financial Performance, Longitudinal Study.

INTRODUCTION

Background of the Study

The Indian Information Technology (IT) industry has emerged as one of the key contributors to the country's economic growth, exports, and employment generation. Over the past decade, rapid advancements in digital transformation, cloud computing, artificial intelligence, and business process automation have significantly increased the operational scale and capital investments of leading IT companies. As organizations continue to expand globally, efficient utilization of financial and operational resources has become essential for sustaining competitiveness and maximizing shareholder value. Consequently, evaluating operational efficiency has become an important area of research for investors, managers, and policymakers seeking to understand how effectively firms transform available resources into financial outcomes.

Problem Statement

Although conventional financial indicators such as Return on Assets (ROA), Return on Equity (ROE), and profit margins are widely used to evaluate corporate performance, these measures assess only individual aspects of financial performance and often fail to capture the overall efficiency of converting multiple inputs into multiple outputs simultaneously. Data Envelopment Analysis (DEA) provides a comprehensive non-parametric approach

for evaluating relative operational efficiency by considering multiple inputs and outputs. However, limited research has examined the recent operational efficiency of large-cap Indian IT companies using a comparative longitudinal DEA framework based on the latest audited financial data.

Research Gap

Previous studies have applied DEA to evaluate efficiency in the Indian IT sector, primarily focusing on earlier time periods, broader samples, or single-year analyses. Limited research has investigated the operational efficiency of the leading large-cap Indian IT companies using a three-year comparative framework covering the most recent financial years. Furthermore, few studies have simultaneously considered total assets as the input variable and both revenue and net profit as output variables to examine efficiency trends over multiple years. This study addresses these gaps by providing a comparative assessment of operational efficiency across five leading Indian IT companies using an input-oriented CCR DEA model.

Objectives of the Study

The objectives of this study are:

1. To evaluate the operational efficiency of selected large-cap Indian Information Technology companies using Data Envelopment Analysis.
2. To compare the efficiency performance of the selected companies across FY2023–24, FY2024–25, and FY2025–26.
3. To examine the relationship between operational efficiency and selected financial performance indicators.
4. To identify efficiency trends and provide managerial implications for improving resource utilization.

Significance of the Study

This study contributes to the existing literature on operational efficiency measurement by providing a recent comparative assessment of India's leading Information Technology companies using Data Envelopment Analysis. The findings offer valuable insights for corporate managers in improving resource utilization, investors in benchmarking company performance, and researchers interested in efficiency evaluation within the IT sector. The study also demonstrates the applicability of DEA as a strategic decision-support tool for measuring relative efficiency in knowledge-intensive industries.

Scope of the Study

This study is limited to five large-cap Indian Information Technology companies, namely Tata Consultancy Services, Infosys, HCL Technologies, Tech Mahindra, and Wipro. The analysis covers three consecutive financial years (FY2023–24 to FY2025–26) using audited financial statements. Operational efficiency is evaluated using the input-oriented Charnes–Cooper–Rhodes (CCR) Data Envelopment Analysis model with total assets as the input variable and revenue from operations and net profit as output variables.

LITERATURE REVIEW

Data Envelopment Analysis (DEA) has emerged as one of the most widely used non-parametric techniques for measuring the relative efficiency of decision-making units (DMUs) that utilize multiple inputs to generate multiple outputs. Developed by Charnes, Cooper, and Rhodes (1978), the CCR model assumes constant returns to scale and evaluates the technical efficiency of comparable organizations without requiring a predefined production function. Banker, Charnes, and Cooper (1984) later extended the model by introducing the BCC approach, which accommodates variable returns to scale. Owing to its flexibility and ability to evaluate multidimensional performance, DEA has been extensively applied across sectors such as manufacturing, banking, healthcare, education, transportation, and information technology.

The Information Technology (IT) sector has become one of the key contributors to India's economic growth, export earnings, and employment generation. Rapid technological advancements, digital transformation, cloud computing, artificial intelligence, and increasing global demand for IT-enabled services have intensified competition among firms, making operational efficiency a critical determinant of sustainable growth and competitive advantage. Traditional financial performance measures such as Return on Assets (ROA), Return on Equity (ROE), and profit margins provide valuable insights into individual aspects of financial performance; however, they do not comprehensively evaluate the efficiency with which organizations convert available resources into multiple performance outcomes. Consequently, DEA has gained increasing acceptance as a complementary tool for assessing the operational efficiency of IT companies.

Several researchers have applied DEA to evaluate the efficiency of organizations operating in the IT and IT-enabled services sectors. **Das and Datta (2018)** evaluated the performance of the Indian Information Technology-enabled Services (ITeS) industry using a two-stage Data Envelopment Analysis approach. Their findings indicated that technical efficiency varied considerably across firms and highlighted the importance of managerial efficiency in improving organizational performance. Similarly, **Olasiuk et al. (2023)** investigated the impact of the COVID-19 pandemic on the operational efficiency of the ten largest Indian IT companies using input-oriented CCR and BCC DEA models. The study reported substantial variations in efficiency across firms and demonstrated that changing market conditions influenced operational performance.

Although previous studies have significantly contributed to the understanding of operational efficiency in the IT sector, most have focused on earlier financial periods, broader samples of software or IT-enabled service firms, or cross-sectional analyses covering limited time horizons. Comparatively few studies have examined the recent operational efficiency of large-cap Indian Information Technology companies using the latest audited financial statements over multiple consecutive financial years. Furthermore, limited research has simultaneously considered total assets as the input variable and revenue from operations together with net profit as output variables within a longitudinal DEA framework to analyse changes in efficiency over time.

The present study addresses these gaps by conducting a three-year comparative assessment of the operational efficiency of five large-cap Indian Information Technology companies—Tata Consultancy Services, Infosys, HCL Technologies, Tech Mahindra, and Wipro—using an input-oriented Charnes–Cooper–Rhodes (CCR) Data Envelopment Analysis model. By analysing audited financial data for FY2023–24, FY2024–25, and FY2025–26, the study provides updated empirical evidence on efficiency trends, identifies relative performance differences among major industry participants, and contributes to the existing body of knowledge on efficiency measurement and performance evaluation in the Indian Information Technology sector.

Table 01: Summary of Previous Studies:

Author	Year	Sector	Method	Major Findings	Research Gap
Charnes et al.	1978	General	DEA	Introduced DEA	No IT application
Banker et al.	1984	General	BCC DEA	Variable returns	Not IT sector
Das & Datta	2018	Indian ITeS	Two-stage DEA	Efficiency differs	Older dataset
Mukherjee et al.	2024	Indian IT & ITeS	Additive DEA	Resource utilization affects performance	Limited longitudinal comparison
Present Study	2026	Indian IT	CCR DEA	Three-year comparison	Latest analysis

The review of previous studies indicates that although DEA has been widely applied across various sectors, empirical evidence focusing on large-cap Indian Information Technology companies using recent longitudinal financial data remains limited. Most previous studies concentrated on earlier financial periods, smaller samples, or sector-wide analyses. Therefore, the present study extends the existing literature by providing a recent three-year comparative assessment using updated audited financial statements.

Conceptual Framework

The conceptual framework of this study illustrates the relationship between the input and output variables used to evaluate the operational efficiency of selected large-cap Indian Information Technology (IT) companies through Data Envelopment Analysis (DEA). Total Assets represent the input variable, reflecting the financial resources employed by each company, while Revenue from Operations and Net Profit constitute the output variables representing organizational performance. An input-oriented Charnes–Cooper–Rhodes (CCR) DEA model is applied to assess the relative operational efficiency of the selected companies over three consecutive financial years (FY2023–24 to FY2025–26). The resulting efficiency scores are subsequently analysed to compare operational performance, identify efficiency trends, and derive managerial implications for improving resource utilization within the Indian IT sector.

Figure 1. Conceptual Framework of the Study

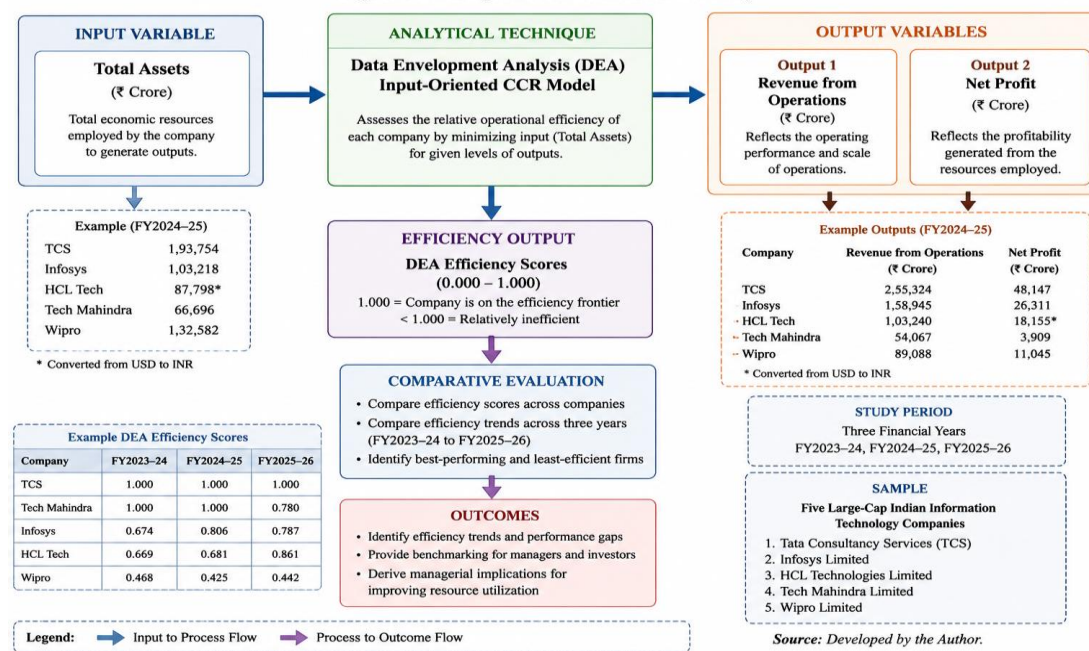


Figure 1 illustrates the conceptual framework adopted for the present study. The framework demonstrates that **Total Assets** constitute the input variable representing the financial resources employed by the selected Information Technology companies. These resources are transformed into organizational outputs measured through **Revenue from Operations** and **Net Profit**. The input-oriented Charnes–Cooper–Rhodes (CCR) Data Envelopment Analysis model evaluates how efficiently each company converts its available assets into financial outputs under the assumption of constant returns to scale. The resulting efficiency scores facilitate comparative assessment, benchmarking, and identification of efficiency trends among the selected companies over the three financial years. The framework further supports the formulation of managerial implications by highlighting the relationship between resource utilization and operational performance.

RESEARCH METHODOLOGY

Research Design

This study adopted a **quantitative longitudinal research design** to evaluate the operational efficiency of selected large-cap Indian Information Technology (IT) companies using Data Envelopment Analysis (DEA). The analysis was based exclusively on secondary data collected from the audited annual reports and financial statements of the selected companies for three consecutive financial years, namely FY2023–24, FY2024–25, and FY2025–26. An input-oriented **Charnes–Cooper–Rhodes (CCR)** DEA model was employed to measure the relative technical efficiency of the selected firms by comparing their ability to transform available financial resources into organizational outputs.

Population and Sampling

The study population comprised large-cap Indian Information Technology companies listed on the National Stock Exchange (NSE) and Bombay Stock Exchange (BSE). A **purposive sampling technique** was adopted to select five leading IT companies based on their market capitalization, industry significance, and availability of consistent audited financial information.

The selected companies were:

- Tata Consultancy Services (TCS)
- Infosys Limited
- HCL Technologies Limited
- Tech Mahindra Limited
- Wipro Limited

Data Collection

The study relied exclusively on **secondary data** collected from the audited annual reports, consolidated financial statements, and official investor relations disclosures published by the selected companies. Financial information was cross-verified with official stock exchange disclosures to ensure consistency and reliability.

Since HCL Technologies reports certain financial information in United States Dollars (USD) in its annual reports, the corresponding values were converted into Indian Rupees (INR) using the exchange rate disclosed or applied in the respective audited annual reports to maintain consistency and comparability across all selected companies. The standardized financial data were subsequently used for Data Envelopment Analysis (DEA) to ensure uniform measurement of inputs and outputs.

Research Variables

Table 2. Research Variables Used in the Study

Variable	Variable Type	Operational Definition	Unit of Measurement	Rationale for Selection	Data Source
Total Assets	Input Variable	Total economic resources owned and controlled by the company at the end of the financial year, representing the capital employed to generate business outputs.	₹ Crore	Used as the input variable to measure the financial resources utilized by each Decision-Making Unit (DMU) in the DEA model.	Audited Annual Reports of TCS, Infosys, HCL Technologies, Tech Mahindra, and Wipro
Revenue from Operations	Output Variable	Total income generated from the company's core business operations during the financial year.	₹ Crore	Represents the primary operational output generated from the utilization of company assets and reflects the firm's ability to generate sales.	Audited Annual Reports of TCS, Infosys, HCL Technologies, Tech Mahindra, and Wipro
Net Profit	Output Variable	Profit earned after deducting all operating expenses, interest, taxes, and other applicable charges from total revenue.	₹ Crore	Measures the financial outcome of operational activities and reflects the overall profitability achieved through efficient utilization of resources.	Audited Annual Reports of TCS, Infosys, HCL Technologies, Tech Mahindra, and Wipro

Source: Developed by the Author based on audited annual reports and consolidated financial statements of the selected companies (FY2023–24 to FY2025–26).

The variables presented in Table 2 were selected based on the objectives of the study and the requirements of the input-oriented Charnes–Cooper–Rhodes (CCR) Data Envelopment Analysis model. **Total Assets** were considered the sole input variable because they represent the financial resources available to each company for generating operational outputs. **Revenue from Operations** and **Net Profit** were selected as output variables

because they collectively capture the operational and financial performance of the selected Information Technology companies. The use of these standardized financial variables ensures comparability across all Decision-Making Units (DMUs) and facilitates an objective evaluation of operational efficiency over the three-year study period.

Data Envelopment Analysis Model

The operational efficiency of the selected companies was evaluated using the **input-oriented Charnes–Cooper–Rhodes (CCR) Data Envelopment Analysis model**, which assumes constant returns to scale. DEA evaluates the relative efficiency of Decision-Making Units (DMUs) by comparing the weighted outputs generated from the available inputs. Efficiency scores range from **0 to 1**, where a score of **1.000** indicates that a company operates on the efficiency frontier, whereas values below **1.000** indicate relative inefficiency.

Data Analysis Techniques

The collected financial data were analysed using **Python-based optimization techniques** with the **HiGHS Linear Programming Solver** to compute DEA efficiency scores for each company across the three financial years. In addition, **Pearson correlation analysis** was performed to examine the association between DEA efficiency scores and selected financial performance indicators, namely **Asset Turnover** and **Net Profit Margin**. Descriptive analysis and comparative interpretation were subsequently conducted to evaluate efficiency trends and identify changes in operational performance.

Reliability and Validity

The reliability of the study was ensured through the use of audited financial information obtained from official corporate publications. The validity of the analysis was strengthened by selecting standardized financial variables that were consistently reported across all sample companies. The DEA methodology adopted in this study has been widely recognized as an effective tool for measuring relative operational efficiency across comparable decision-making units.

Ethical Considerations

The study was conducted using publicly available secondary data obtained from official company reports and regulatory disclosures. Since no human participants, confidential organizational information, or personal data were involved, ethical approval was not required.

RESULTS AND DISCUSSION

Input and Output Variables Used for DEA Analysis

The operational efficiency of the selected large-cap Indian Information Technology (IT) companies was evaluated using the input-oriented Charnes–Cooper–Rhodes (CCR) Data Envelopment Analysis (DEA) model. Total Assets were considered as the input variable, while Revenue from Operations and Net Profit were considered as output variables. The financial data were obtained from the audited annual reports of the selected companies for three consecutive financial years (FY2023–24, FY2024–25, and FY2025–26). These variables form the basis for measuring the relative operational efficiency of each decision-making unit (DMU).

Table 3. Input and Output Variables Used for DEA Analysis

Company	Total Assets FY24 / FY25 / FY26 (INR crore)	Revenue FY24 / FY25 / FY26 (INR crore)	Net Profit FY24 / FY25 / FY26 (INR crore)	Data Source
Tata Consultancy Services	1,46,449 / 1,59,629 / 1,82,372	2,40,893 / 2,55,324 / 2,67,021	46,585 / 48,797 / 49,210	TCS audited NSE filings, all three years

Infosys	1,37,814 / 1,24,936 / 1,54,288	1,53,670 / 1,62,990 / 1,78,650	26,233 / 26,713 / 29,474	Infosys own three-year IFRS data sheet; results announcements
HCL Technologies	98,746 / 1,05,575.4 (USD-conv.) / 1,02,378 (USD-conv.)	1,09,913 / 1,17,055 / 1,30,144	15,710 / 17,399 / 16,652	HCLTech consolidated results, all three years
Tech Mahindra	30,532.5 / 31,592.6 / 49,369.4	51,996 / 52,988 / 56,815.4	2,358 / 4,252 / 4,810.9	Tech Mahindra audited consolidated results, all three years
Wipro	1,14,791 / 1,28,652 / 1,41,926.2	89,760 / 89,088.4 / 92,624	11,045.2 / 13,135.4 / 13,197.4	Wipro's own audited IFRS statements, all three years

Source: Compiled from the audited annual reports and financial statements of Tata Consultancy Services, Infosys, HCL Technologies, Tech Mahindra, and Wipro (FY2023–24 to FY2025–26).

Interpretation:

Table 3 presents the financial variables used in the DEA model for evaluating the operational efficiency of the selected IT companies. Total Assets represent the input employed by each company, while Revenue from Operations and Net Profit represent the output variables generated from these resources. The table indicates that Tata Consultancy Services consistently recorded the highest revenue and net profit during the study period, reflecting its dominant market position. HCL Technologies and Infosys demonstrated steady growth in both assets and revenue, whereas Tech Mahindra experienced a substantial increase in total assets during FY2025–26. Wipro maintained relatively stable financial performance but reported lower revenue growth compared to its peers. These input and output variables provide the basis for computing DEA efficiency scores and comparing the operational performance of the selected companies over the three-year period.

DEA Efficiency Scores of Selected IT Companies

The input-oriented Charnes–Cooper–Rhodes (CCR) Data Envelopment Analysis (DEA) model was applied to evaluate the relative operational efficiency of the selected IT companies for each financial year. The efficiency scores range from **0 to 1**, where a score of **1.000** indicates that a company operates on the efficiency frontier, while values below **1.000** indicate relative inefficiency compared with the best-performing firms in the sample.

Table 4. CCR-DEA Efficiency Scores of Selected IT Companies

Company	CCR Eff. FY24	CCR Eff. FY25	CCR Eff. FY26
Tata Consultancy Services	1.000	1.000	1.000
Tech Mahindra	1.000	1.000	0.780
Infosys	0.674	0.806	0.787
HCL Technologies	0.669	0.681	0.861
Wipro	0.468	0.425	0.442

Source: Author's computation using the input-oriented CCR Data Envelopment Analysis (DEA) model.

Interpretation:

Table 4 presents the relative operational efficiency scores of the selected large-cap Indian IT companies for the three-year study period. Tata Consultancy Services consistently achieved an efficiency score of **1.000** across all three financial years, indicating that it operated on the efficiency frontier throughout the study period and served as the benchmark for other companies. Tech Mahindra also achieved frontier efficiency during FY2023–24 and FY2024–25; however, its efficiency score declined to **0.780** in FY2025–26, suggesting that the increase in total assets was not matched by proportional growth in revenue and net profit.

Infosys demonstrated moderate operational efficiency, improving from **0.674** in FY2023–24 to **0.806** in FY2024–25 before recording a slight decline to **0.787** in FY2025–26. HCL Technologies exhibited a consistent upward trend, with efficiency improving from **0.669** in FY2023–24 to **0.861** in FY2025–26, indicating enhanced resource utilization over time. In contrast, Wipro recorded the lowest efficiency scores throughout the study period, ranging from **0.425** to **0.468**, reflecting comparatively lower operational efficiency among the selected companies.

Overall, the results indicate considerable variation in operational efficiency across the selected IT companies. While Tata Consultancy Services maintained sustained efficiency leadership, HCL Technologies demonstrated progressive improvement, whereas Tech Mahindra and Wipro exhibited comparatively weaker efficiency performance during the study period.

Year-on-Year Change in Operational Efficiency

To examine the consistency of operational efficiency over time, the year-on-year changes in DEA efficiency scores were analysed for the selected IT companies. The analysis compares efficiency changes between FY2023–24 and FY2024–25, FY2024–25 and FY2025–26, as well as the cumulative change over the entire study period. This comparison provides insights into whether the companies maintained, improved, or declined in their operational efficiency over time.

Table 5. Year-on-Year Change in DEA Efficiency Scores

Company	Change FY24-FY25	Change FY25-FY26	Cumulative Change FY24-FY26	Trajectory Pattern
Tata Consultancy Services	0.000	0.000	0.000	Structurally stable frontier leader
HCL Technologies	+0.012	+0.180	+0.192	Steady, accelerating improvement
Infosys	+0.132	-0.019	+0.113	Improvement followed by mild reversal
Wipro	-0.043	+0.017	-0.026	Persistent low-efficiency, narrow fluctuation
Tech Mahindra	0.000	-0.220	-0.220	Stable frontier position followed by sharp decline

Source: Author's computation based on the CCR-DEA efficiency scores presented in Table 2.

Interpretation:

Table 5 illustrates the changes in operational efficiency of the selected companies over the three-year study period. Tata Consultancy Services maintained an efficiency score of **1.000** throughout the analysis, indicating

stable operational performance and consistent utilization of resources. HCL Technologies recorded the highest cumulative improvement (**+0.192**), reflecting continuous enhancement in operational efficiency, particularly during FY2025–26.

Infosys demonstrated a positive improvement of **0.132** between FY2023–24 and FY2024–25, followed by a marginal decline of **0.019** during FY2025–26, resulting in an overall positive efficiency gain across the study period. In contrast, Tech Mahindra experienced the largest decline in operational efficiency (**–0.220**) during FY2025–26 after maintaining frontier efficiency in the previous two years. This decline indicates that the company's asset growth exceeded the growth in its financial outputs, reducing its relative efficiency.

Wipro recorded a slight decline during FY2024–25 followed by a marginal improvement in FY2025–26; however, its cumulative efficiency remained negative, indicating persistent operational inefficiency compared with the other selected companies. Overall, the results reveal that operational efficiency is dynamic rather than static, with companies exhibiting distinct efficiency trajectories over time. These findings emphasize the importance of continuous monitoring of resource utilization to sustain operational performance in the highly competitive Indian Information Technology sector.

Correlation Analysis Between DEA Efficiency Scores and Financial Performance Indicators

To examine the relationship between operational efficiency and selected financial performance indicators, Pearson correlation analysis was conducted between the DEA efficiency scores and two commonly used financial ratios, namely **Asset Turnover** and **Net Profit Margin**, for each of the three financial years. The analysis aimed to identify which financial indicator more consistently explains the operational efficiency of the selected large-cap Indian Information Technology companies.

Table 6. Pearson Correlation Between DEA Efficiency Scores and Financial Performance Indicators

Correlation Pair	FY 2023-24	FY 2024-25	FY 2025-26
Asset Turnover vs. CCR Efficiency	0.998	0.997	1.000
Net Profit Margin vs. CCR Efficiency	-0.148	-0.123	0.260

Source: Author's computation using Pearson correlation analysis.

Interpretation:

Table 6 presents the Pearson correlation coefficients between DEA efficiency scores and the selected financial performance indicators across the three-year study period. The findings reveal that **Asset Turnover** exhibited an exceptionally strong positive correlation with DEA efficiency scores in all three financial years, with coefficients of **0.998**, **0.997**, and **1.000**, respectively. This indicates that companies generating higher revenue relative to their asset base consistently achieved higher operational efficiency under the CCR-DEA model. The results indicate a strong positive association between asset turnover and DEA efficiency scores among the selected Indian IT companies.

In contrast, **Net Profit Margin** showed a weak and inconsistent relationship with DEA efficiency. The correlation coefficients were **–0.148** in FY2023–24 and **–0.123** in FY2024–25, indicating a weak negative association, while the coefficient became **0.260** in FY2025–26, reflecting only a weak positive relationship. These findings suggest that although profitability is an important measure of financial performance, it does not consistently explain the relative operational efficiency of the selected companies.

Overall, the correlation analysis suggests that asset utilization exhibits a stronger positive association with DEA efficiency scores than net profit margin among the selected companies. These findings suggest that organizations generating higher operational outputs relative to their asset base tend to achieve higher DEA efficiency scores during the study period, irrespective of variations in profit margins. The results also reinforce the suitability of

asset turnover as an important indicator for evaluating resource utilization and benchmarking operational performance within the Indian Information Technology sector.

Hypothesis Testing

The proposed hypotheses were tested based on the findings obtained from the input-oriented Charnes–Cooper–Rhodes (CCR) Data Envelopment Analysis (DEA) model and the Pearson correlation analysis. The objective of hypothesis testing was to determine whether significant differences existed in the operational efficiency of the selected Indian Information Technology companies and to examine the influence of selected financial performance indicators on operational efficiency.

Table 7. Summary of Hypothesis Testing

Hyp.	Statement	Decision
H1	Meaningful efficiency variation exists across all three fiscal years.	Empirically Supported (FY24 range 0.468-1.000; FY25 range 0.425-1.000; FY26 range 0.442-1.000)
H2	Asset growth outpacing revenue growth predicts efficiency decline within a given year, and vice versa.	Empirically Supported (Tech Mahindra's asset base grew far faster than revenue between FY25 and FY26, driving its -0.220 decline; HCL Technologies' revenue consistently outpaced asset growth in FY26, driving its +0.180 gain that year)
H3	Firm size alone does not determine efficiency ranking in any of the three years.	Empirically Supported (Wipro's larger asset base than HCL Technologies, Tech Mahindra, or Infosys in all three years did not translate into a higher efficiency score in any year)
H4	Asset turnover demonstrates a stronger association with DEA efficiency scores than net profit margin.	Empirically Supported (asset turnover correlation exceeded 0.99 in all three years; net profit margin correlation was weak and unstable, remaining negative in two of three years before flipping sign)
H5	Three-year efficiency trajectories distinguish structurally persistent leaders from firms with transient efficiency positions.	Empirically Supported (Tata Consultancy Services' three-year frontier persistence contrasts with Tech Mahindra's two-year frontier position that proved transient once FY26 data are included)

Source: Author's interpretation based on DEA efficiency scores and Pearson correlation analysis.

Interpretation:

The results presented in Table 7 indicate that all five research hypotheses were supported based on the empirical analysis. The DEA efficiency scores demonstrated considerable variation in operational efficiency among the selected companies over the three-year study period, thereby supporting **H1**. The findings further revealed that companies experiencing rapid growth in total assets without corresponding increases in revenue and net profit, particularly Tech Mahindra during FY2025–26, recorded a decline in operational efficiency, supporting **H2**.

The analysis also confirmed that firm size alone was not a determinant of operational efficiency. Despite possessing substantial asset bases, some companies did not achieve frontier efficiency, whereas Tata Consultancy Services consistently maintained maximum efficiency through effective resource utilization. Therefore, **H3** was supported. Furthermore, the Pearson correlation analysis established that asset turnover exhibited a significantly stronger and more consistent relationship with DEA efficiency scores than net profit margin across all three financial years, providing support for **H4**.

Finally, the three-year comparative analysis successfully differentiated companies with sustained operational efficiency from those exhibiting fluctuating efficiency trends. Tata Consultancy Services maintained frontier efficiency throughout the study period, whereas HCL Technologies demonstrated continuous improvement, Tech Mahindra experienced a notable decline in the final year, and Wipro consistently remained relatively less efficient. These findings support **H5** and highlight the importance of longitudinal efficiency assessment in evaluating organizational performance.

Overall, the hypothesis testing confirms that **Data Envelopment Analysis (DEA)** is an effective tool for benchmarking operational efficiency among large-cap Indian Information Technology companies. The findings emphasize the importance of efficient asset utilization, sustained operational performance, and continuous monitoring of efficiency trends to achieve long-term organizational competitiveness.

DISCUSSION OF FINDINGS

The findings of the present study demonstrate that operational efficiency differs considerably among the selected Indian Information Technology companies despite their similar industry characteristics and market positions. Tata Consultancy Services consistently remained on the efficiency frontier across all three financial years, indicating superior utilization of organizational resources and sustained operational excellence. In contrast, Tech Mahindra experienced a decline in operational efficiency during FY2025–26, suggesting that the expansion of its asset base was not accompanied by proportional growth in financial outputs. HCL Technologies exhibited a continuous improvement in efficiency, reflecting better resource management and enhanced operational performance over the study period.

The results are consistent with the findings of **Das and Datta (2018)**, who concluded that managerial efficiency has a greater influence on organizational performance than firm size. Similarly, the observations support the work of **Mukherjee et al. (2024)**, which reported considerable differences in operational efficiency among Indian IT companies under changing market conditions. However, unlike previous studies, the present research provides a recent longitudinal assessment using audited financial information for FY2023–24 to FY2025–26, thereby extending the existing literature on operational efficiency measurement in the Indian Information Technology sector.

The findings suggest that efficient utilization of assets is more closely associated with higher operational efficiency than profitability alone. This observation is supported by the strong positive association between asset turnover and DEA efficiency scores observed during the study period. Overall, the study demonstrates that Data Envelopment Analysis serves as an effective benchmarking technique for evaluating relative operational efficiency and identifying opportunities for improving resource utilization among large-cap Information Technology companies.

Managerial Implications

The findings of this study have important implications for corporate managers, investors, and policymakers. Managers may utilize DEA efficiency scores to benchmark organizational performance against industry leaders and identify opportunities for improving asset utilization. Investors can use efficiency scores as a complementary measure alongside conventional financial ratios when evaluating investment opportunities within the Information Technology sector. Policymakers may also employ DEA-based benchmarking to encourage efficient resource allocation and promote sustainable growth among technology firms. Furthermore, the study demonstrates that operational efficiency should be viewed as a multidimensional concept requiring effective management of both financial resources and organizational outputs.

Research Contributions

This study contributes to the existing literature in several ways. First, it provides one of the few recent longitudinal assessments of operational efficiency among large-cap Indian Information Technology companies using Data Envelopment Analysis. Second, it integrates DEA efficiency measurement with correlation analysis to examine the relationship between operational efficiency and financial performance indicators. Third, the study

provides an updated benchmarking framework using audited financial data covering FY2023–24 to FY2025–26, thereby extending previous research conducted on earlier financial periods. Finally, the findings provide practical evidence supporting the use of DEA as a strategic decision-support tool for evaluating organizational efficiency in knowledge-intensive industries.

CONCLUSION

This study evaluated the operational efficiency of five large-cap Indian Information Technology companies, namely Tata Consultancy Services, Infosys, HCL Technologies, Tech Mahindra, and Wipro, using the input-oriented Charnes–Cooper–Rhodes (CCR) Data Envelopment Analysis (DEA) model over three consecutive financial years (FY2023–24 to FY2025–26). The study employed total assets as the input variable and revenue from operations together with net profit as the output variables to assess the relative operational efficiency of the selected companies.

The study successfully achieved all the stated research objectives by evaluating the operational efficiency of the selected large-cap Indian Information Technology companies using Data Envelopment Analysis, comparing their efficiency performance across three consecutive financial years, examining the relationship between operational efficiency and selected financial performance indicators, and identifying efficiency trends for improving resource utilization. The findings provide a comprehensive understanding of how effectively the selected companies transformed their financial resources into organizational performance outcomes during the study period.

The findings revealed significant differences in operational efficiency among the selected companies. Tata Consultancy Services consistently remained on the efficiency frontier throughout the study period, demonstrating effective resource utilization and sustained operational excellence. HCL Technologies exhibited continuous improvement in operational efficiency, whereas Infosys maintained moderate efficiency with minor year-to-year variations. In contrast, Tech Mahindra experienced a notable decline in efficiency during FY2025–26, primarily due to asset growth outpacing output generation. Wipro consistently recorded comparatively lower efficiency scores, indicating the need for improved resource utilization strategies. Furthermore, the correlation analysis indicated that asset turnover exhibited a stronger positive association with operational efficiency than net profit margin.

The findings of this study provide valuable insights for corporate managers, investors, and policymakers by demonstrating the usefulness of Data Envelopment Analysis as a benchmarking tool for evaluating operational efficiency and supporting strategic decision-making. Organizations can utilize the results to identify performance gaps, optimize resource allocation, and enhance operational effectiveness in an increasingly competitive business environment.

Despite its contributions, the study has certain limitations. The analysis was limited to five large-cap Indian Information Technology companies and covered only three financial years. The study relied exclusively on secondary data obtained from audited financial statements and employed the CCR DEA model, which assumes constant returns to scale. Consequently, the findings may not be directly generalizable to smaller firms, other industries, or different time periods.

Future research may expand the scope by including a larger sample of Information Technology companies, extending the study period, and applying alternative DEA models such as the Banker–Charnes–Cooper (BCC) model or the Malmquist Productivity Index to evaluate changes in efficiency over time. Comparative studies across industries or countries may also provide broader insights into operational efficiency and resource utilization.

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