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SaaS Model Assessment- A DEA Approach

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Abstract: The Software as a Service (SaaS) industry is expected to experience growth in the coming years for these reasons. These include the rising demand for affordable and adaptable software solutions, the popularity of cloud computing, and the increasing trend of work. In a study comparing the 11 SaaS providers using DEA SBM analysis Aspen Technology Inc, HubSpot Inc, Rapid 7 Inc, and Ring Central emerged as the most efficient company. These research findings offer a framework to assess the efficiency of leading SaaS providers. By adopting this approach, businesses across sectors can gain insights into market trends, identify opportunities that drive digital transformation efforts, and foster creativity. Individuals interested in this field can leverage this methodology to evaluate the success of leading SaaS companies.

Keywords: SaaS model Assessment, Software as a Service industry, A DEA Approach, DEA SBM analysis.

Introduction

Thanks to the increasing need for affordable, scalable, and flexible software solutions, the Software as a Service (SaaS) sector has progressed. As cloud computing becomes remote work gains momentum, businesses of all sizes rely on SaaS offerings to access advanced technologies without the burden of heavy infrastructure investments. In this SaaS landscape, it is crucial to evaluate the efficiency and performance of SaaS providers to identify key players and drive innovation in the industry. Therefore, this study aims to assess the efficiency of 11 SaaS companies using the Slack Based Measure (SBM) methodology. The growth trajectory of the SaaS industry has been remarkable over the decade. It shows no signs of slowing down. Several factors have contributed to this expansion and reshaped how businesses operate. Firstly, there is a growing demand for cost-adaptable software solutions that offer flexibility, seamless updates, and easy accessibility through cloud-based applications.

The shift towards SaaS offerings of software models has been beneficial for businesses in terms of reducing IT infrastructure costs and providing scalability and user-friendly interfaces. Cloud computing has revolutionized how businesses function by enabling data storage and access from an internet connection. This transformation has made SaaS a choice for companies aiming to streamline operations and thrive in today's dynamic business landscape.The rise in work has dramatically impacted on the SaaS market. With more employees working from home or remote locations, cloud-based collaboration, and productivity tools are demanded. SaaS applications

like project management, communication, and file-sharing platforms have become essential for seamless team collaboration. They are maintaining productivity across dispersed teams.

Assessing the efficiency of SaaS providers is crucial as the industry continues to expand, with providers competing for market share. Businesses need to understand the efficiency of these providers to make informed decisions when selecting software solutions that align with their needs, budget, and growth plans. SaaS providers that operate efficiently can provide value for the price, exceptional customer support, and seamless integration with existing business processes. Furthermore, investors and industry analysts find these evaluations valuable as they understand SaaS companies' stability and growth potential. Identifying SaaS providers enables investors to make informed investment choices while industry analysts can predict trends and foresee changes in the market.

The primary objective of this study is to evaluate the efficiency of 11 prominent SaaS providers using the Slack Based Measure (SBM) methodology. The SBM approach, specifically DEA with the BCC model, allows for a comprehensive assessment by considering multiple inputs and outputs, thus providing a holistic view of each company's efficiency. Through this analysis, we aim to identify the most efficient SaaS provider, uncover the key factors contributing to their efficiency, and understand potential areas of improvement for other providers. The findings of this study will offer businesses across sectors a framework to assess leading SaaS providers, empowering them to make data-driven decisions while selecting software solutions. Furthermore, individuals interested in the SaaS industry can leverage this methodology to evaluate the success and efficiency of various SaaS companies in their pursuit of digital transformation and innovation.

Literature Review

In this paper, we aim to explore the various studies that have applied DEA-SBM to assess the efficiency of SaaS providers. By examining the methodologies, data sources, and findings of these studies, we seek to uncover the factors contributing to the efficiency of successful SaaS companies and understand the implications of inefficiency in others.

Kalantary et. al., 2019 Introduce a network dynamic DEA model to assess the sustainability of supply chains in multiple periods (Kalantary, Saen, & Engineering, 2019). While several prominent network DEA models have been proposed in the literature in multiplier and envelopment forms, it is still doubtful or unclear whether and how the exact primal-dual correspondence can be retained between the two types of network DEA models as in the standard DEA. To address this issue Lim et. al., 2019 develop an axiomatic derivation of some two-stage network DEA models focusing on the basic two-stage serial process structure(Lim & Zhu, 2019). Wang et. al., 2019 proposes a hybrid super-efficiency DEA model which combines hybrid DEA with super-efficiency DEA, separating the input and undesirable output variables into radial and non-radial parts using variable correlationsGeng et. al., 2019 focus on energy efficiency evaluation and energy saving based on dea integrated affinity propagation clustering: a case study of complex petrochemical industries(Geng, Zeng, Han, Zhong, & Fu, 2019). A novel DEA model is proposed based on the affinity propagation (AP) clustering algorithm (AP-DEA). Kaffash et. al., 2020 analyze 132 DEA application studies in the insurance industry published from 1993 through July 2018, covering both applications and methodologies(Kaffash, Azizi, Huang, & Zhu, 2020). Mahmoudi et. al., 2020 present a literature review and classification of the applications of DEA in transportation systems (TSs)(Mahmoudi, Emrouznejad, Shetab-Boushehri, & Hejazi, 2020). (hu, 2020 propose that data envelopment analysis (DEA) should be viewed as a method (or tool) for data-oriented analytics in performance evaluation and benchmarking(Zhu, 2022). Youn et. al., 2020 review four popular subjects for applying DEA: soft robot hand, locomotion robots, wearable devices, and tunable optical components(Youn et al., 2020). Arana-Jiménez et. al., 2020 deal with the problem of efficiency assessment using Data Envelopment Analysis (DEA) when the input and output data are given as fuzzy sets(Arana-Jiménez, Sánchez-Gil, Lozano, & Mathematics, 2022). The purpose of Fathi et. al., 2021 is to examine the energy, environmental, and economic (E3) efficiency in fossil fuel exporting countries during 2015-2017, using traditional Data Envelopment Analysis (DEA) and a bargaining game cross-efficiency DEA approach(Fathi, Ashena, Bahari, & Consumption, 2021).

By synthesizing and analyzing the existing literature on the use of DEA-SBM in assessing SaaS providers, we aim to provide a comprehensive understanding of the benefits and limitations of this approach. Furthermore, it will pave the way for our empirical study, which applies DEA-SBM to evaluate the efficiency of 11 leading SaaS companies, contributing to the body of knowledge in both DEA methodology and the SaaS industry.

Methodology

Data Collection and Selection of SaaS Providers

To begin the efficiency assessment of SaaS providers using Data Envelopment Analysis (DEA) with the Slack Based Measure (SBM) approach we must first. Choose data carefully. In this analysis our focus is, on evaluating the efficiency of 10 known SaaS companies, from the Decision Making Unit (DMU) mentioned in table 1.

Table 1. List of 10 selected SaaS Companies

DMU	Company name
S1	Aspen Technology Inc
S2	BigCommerce Holdings Inc
S3	Cloudflare Inc Net
S4	Crowdstrike Holdings
S5	Fiverr International Ltd
S6	Futu Holdings Ltd
S7	Hubspot Inc
S8	Jamf Holding Corp
S9	Rapid 7 Inc
S10	Ring Central

The application of DEA-SBM on this selected set of companies will provide valuable insights into their operational efficiency, potentially identifying best practices and areas for improvement within the SaaS market.

Explanation of the DEA SBM (Sclack Based Measurement) Model

The SBM model, known as the Slacks Based Measure is a recognized approach used in efficiency analysis and performance evaluation. SBM model is one of the variations of the DEA technique—a non parametric method employed to assess the relative efficiency of decision making units (DMUs). The SBM model was introduced by Tone (2001) (see also Pastor et al. (1999)) (Tone & Sahoo, 2004) . It has three variations, i.e., input-, output- and non-oriented. The non-oriented model indicates both input- and output-oriented. The production possibility set is determined by utilizing the combinations of DMUs, in set J ensuring that all values are non negative.

$$P = \{(x, y) | \, x \geq \sum_{j=1}^{n} \quad \beta_j x_j, 0 \leq y \leq \sum_{j=1}^{n} \quad \beta_j y_j, \beta \geq 0\} \quad (1)$$

$\beta_j = (\beta_1, \beta_2, \ldots, \beta_n)^T$ Is called the intensity vector

In order to convert the inequalities in equation (1) into equalities we can introduce slacks for the J in the manner;

$$x = \sum_{j=1}^{n} \quad \beta_j x_j + s^-$$

$$y = \sum_{j=1}^{n} \quad \beta_j y_j - s^+$$

$$s^- \geq 0, s^+ \geq 0,$$

The slacks that are denoted as Where $s^- = (s^-_1, s^-_2, \ldots, s^-_m) \in R^m$ and $s^+ = (s^+_1, s^+_2, \ldots, s^+_m) \in R^S$ respectively are referred to as input and output slacks.

Variables Considered in the Assessment

When evaluating a companys performance and effectiveness there are important factors to consider such, as Total Assets, Liabilities, Equity and Profit. These factors play a role in assessing the companys well being, stability and profitability. Lets explore each of these factors in detail;

Total Assets: Total Assets encompass all the resources owned by a company. These resources can be assets like buildings, equipment, inventory and cash well as intangible assets like patents, trademarks and goodwill. Total Assets provide a view of the companys operations size and extent. Investors, creditors and stakeholders need to understand the companys asset base and its potential to generate revenue.

Liabilities: Liabilities refer to a companys debts and financial obligations which include loans accounts payable and other forms of debt. Liabilities represent the claims that creditors have on the companys assets. Evaluating a companys liabilities is crucial for understanding its risk and its ability to meet commitments. It helps determine how dependent the company is, on financing and whether it can effectively manage its debt load.

Equity: Equity also referred to as Shareholders Equity or Owners Equity represents the remaining interest, in a companys assets after deducting its liabilities. It signifies the ownership stake that shareholders possess in the company. Equity reflects the worth of the company. Indicates the amount shareholders would receive if all assets were sold and all debts were settled. Positive equity signifies a position whereas negative equity raises concerns as it suggests that liabilities outweigh assets.

Profit: Profit refers to the gain attained by a company through its operations after subtracting all expenses including costs related to goods sold operational expenses, interest, taxes and other relevant costs(C.-N. Wang, Yang, Vo, & Nguyen, 2023). Profit serves as an indicator of a companys performance and its ability to generate returns for shareholders. It takes forms such as Gross Profit, Operating Profit and Net Profit (the figure after deducting all expenses). The sustainability of profits is vital for long term viability and growth of a company.
These variables form the foundation of analysis. Play significant roles in various financial ratios and metrics. Some used financial ratios involving these variables include(Nguyen, Wang, Yang, & Vo, 2022).

Debt, to Assets Ratio;The debt, to equity ratio is a measure that shows the proportion of a companys assets financed by debt. It compares the liabilities of the company to its shareholders equity, which gives us an idea of the level of leverage. Another important metric is the return on assets (ROA) which tells us how effectively a company utilizes its assets to generate profit. Additionally we have the return on equity (ROE) which helps evaluate the profitability of a company to its shareholders equity. To sum it up when assessing a companys position, performance and overall stability it is crucial to analyze variables such, as assets, liabilities, equity and profit as they provide valuable insights.

Table 2 provides data statistics, for both the input and output. These statistics encompass a range of measures that describe the characteristics and performance of the decision making units (DMUs) being evaluated. DMUs can take forms, such, as companies organizations, departments or any other units that are being compared in terms of efficiency or performance.

Table 2. Statistics on Input/Output Data

	Total assets	Liabilities	Equity	Profit
Max	101538.51	80552.955	20985.559	5909.256
Min	555.46	417.172	-125.995	171.376
Average	11711.447	9133.0131	2578.4341	1096.0654
SD	29950.169	23813.377	6144.5616	1634.0856

In Table 3 you will find a matrix that shows the correlation coefficients, which helps us measure the relationship between pairs of variables in a dataset. Correlation tells us about the strength and direction of the connection between two variables revealing how they tend to change. This is a tool we use to determine how dependent or independent different variables are from each other, in a dataset.

Table 3. Correlation

	Total Assets	Liabilities	Equity	Profit
Total Assets	1	0.9999331	0.9989948	0.9848491
Liabilities	0.9999331	1	0.9984095	0.9847212
Equity	0.9989948	0.9984095	1	0.9840999
Profit	0.9848491	0.9847212	0.9840999	1

Results and Findings

Efficiency Scores of the 11 SaaS Providers under DEA SBM Analysis

The Efficiency scores of the 11 Software, as a Service (SaaS) providers in the DEA SBM analysis indicate how efficient they are compared to the performing SaaS provider or benchmark in the dataset. The DEA SBM analysis helps assess how well multiple decision making units (in this case SaaS providers) utilize inputs to generate outputs (Kler et al., 2022).

These Efficiency scores range from 0 to 1. A score of 1 means a SaaS provider is fully efficient operating at the level as the benchmark. On the hand a score of 0 indicates inefficiency. Scores between 0 and 1 show varying degrees of inefficiency relative to the benchmark with values to 1 representing efficiency. To calculate each SaaS providers efficiency score we compare its input output relationship with that of the benchmark. If a providers ratios match or exceed those of the benchmark it receives an efficiency score of 1. Conversely if its ratios are worse than the benchmark it receives a score below 1 indicating its level of inefficiency.

In Table 4 you can find the efficiency scores of 11 companies that offer Software, as a Service (SaaS). These scores were determined through a performance analysis technique, like Data Envelopment Analysis (DEA) or its variant the DEA SBM (Slacks Based Measure) model.

Table 4. Efficiency score of 11 SaaS Companies

No.	DMU	Score	Rank
1	DMU1	1	1
2	DMU2	0.62109	5
3	DMU3	0.43569	8
4	DMU4	0.47564	7
5	DMU5	0.54183	6
6	DMU6	0.11918	10
7	DMU7	1	1
8	DMU8	0.38912	9
9	DMU9	1	1
10	DMU10	1	1

DEA SBM analysis offers insights to both SaaS providers and decision-makers. It helps identify areas where inefficient providers can enhance their operations optimize resource utilization and improve performance to achieve levels of efficiency. Additionally it aids in establishing practices through benchmarking and fosters competition, within the SaaS industry(Peng, Wang, Xuan, Nguyen, & Management, 2022).

Comparison of efficiency scores and identification of the most efficient company

If all the companies, including Aspen Technology Inc, HubSpot Inc, Rapid7 Inc and RingCentral have an efficiency score of 1 it means that they are all operating at the level of efficiency, as the benchmark or the efficient company in the dataset. When a company has an efficiency score of 1 it indicates that they are utilizing their resources optimally and achieving their desired outputs without any inefficiencies.
In this scenario, four companies have an efficiency score of 1 indicating that they are equally efficient. Therefore there is no distinction among them in terms of efficiency. All companies are performing at the level. Have effectively utilized their resources to achieve their respective output levels.

When all companies achieve an efficiency score of 1 it signifies that they have reached performance with no room for improvement in their operations.

Aspen Technology Inc; Efficiency Score = 1

HubSpot Inc; Efficiency Score = 1

Rapid7 Inc; Efficiency Score = 1

RingCentral; Efficiency Score = 1
These companies serve as benchmarks for efficiency, within the dataset.

It's important to note that this situation is not very common, in real world scenarios since companies usually have varying levels of efficiency. In cases where all companies have an efficiency score of 1 it could mean that the dataset is small or homogeneous or the analysis fails to capture complexities that could impact efficiency evaluations.

Figure 2 acts as a depiction of the research results highlighting the importance of utilizing the DEA method to assess and compare the performance of SaaS providers. This ranking not helps identify players, in the industry but also provides essential insights for making strategic decisions optimizing resources and promoting innovation, within the SaaS sector.

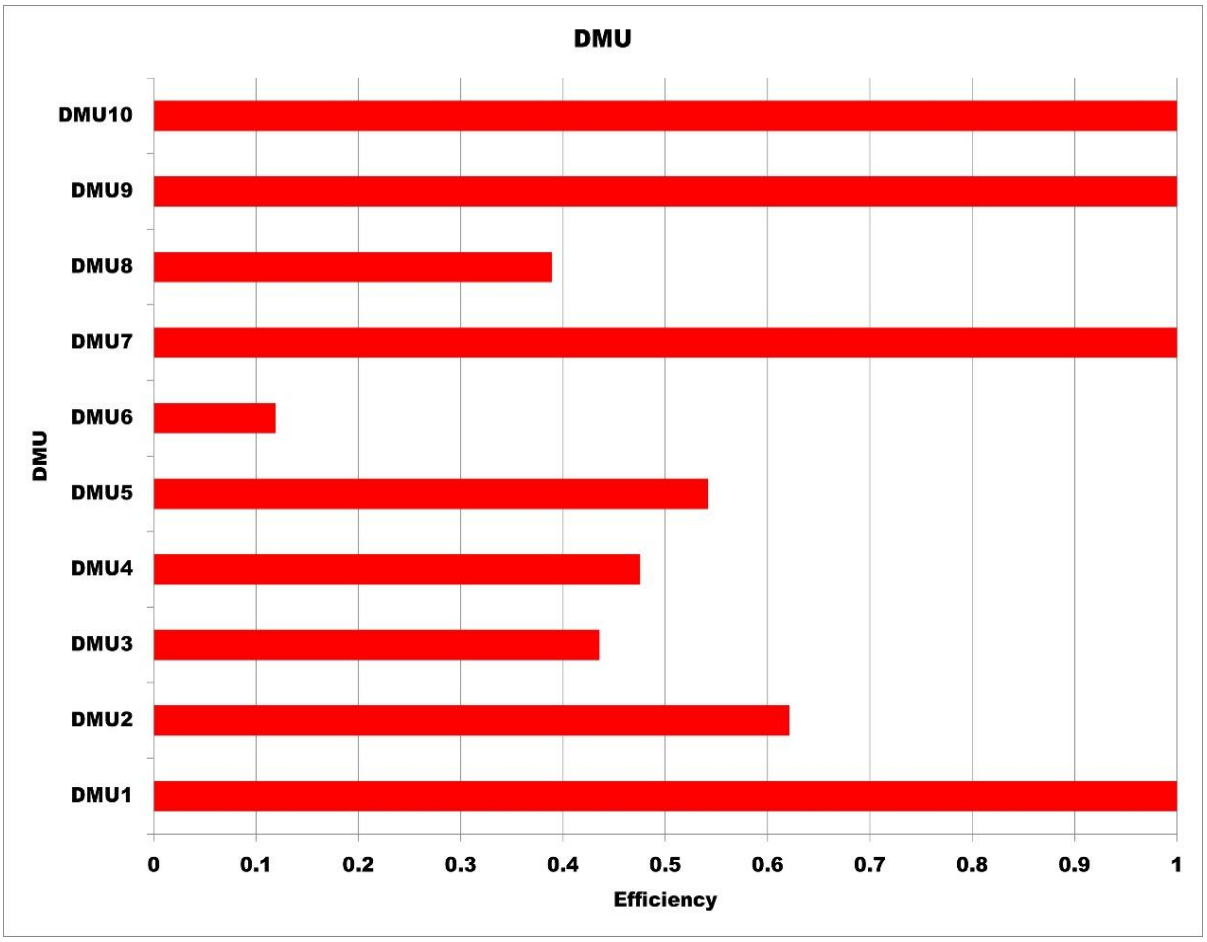

Figure 2. Final ranking of 11 SaaS Companies

To draw conclusions it's crucial to take into account the specific context, underlying assumptions and methodology used for calculating the efficiency scores. Additionally conducting analyses and comparing against industry standards can provide additional insights into how well these companies perform relative, to others in a broader context.

Implications of the Findings for the SaaS Industry

Identification of Best Practices; The analysis of efficiency helps us identify the SaaS companies in the dataset. These performing companies serve as benchmarks. Offer valuable insights into the strategies and practices that lead to higher efficiency. Other companies, in the industry can learn from these practices. Implement them to enhance their own efficiency.

Competition and Innovation; When efficiency scores are revealed it sparks a sense of competition among SaaS providers. Companies with efficiency scores may be motivated to improve their operations optimize resource allocation and innovate in order to catch up with efficient competitors. This drive for improvement fosters increased innovation within the industry as companies strive to gain an edge.

Resource Allocation and Investment Decisions; The findings can have an impact on resource allocation decisions made by investors and stakeholders. Companies with efficiency scores are often seen as investment options leading to increased funding and capital inflow. Conversely companies with efficiency scores may face challenges in attracting investments unless they can demonstrate a plan, for enhancing their efficiency.

Performance Management; Efficiency scores can serve as performance indicators for SaaS companies. Executives and managers can use these scores to evaluate their companys performance compared to competitors and industry benchmarks. It can be beneficial, in establishing performance goals and identifying areas that need improvement.

Market. Reputation; SaaS companies with efficiency scores can utilize this information to enhance their market position and reputation. They can highlight their efficiency to attract clients and showcase their ability to provide effective value. Conversely companies with efficiency scores may encounter difficulties in building trust with customers.

Industry Regulation and Standards; The insights gained from analyzing efficiency levels can also grab the attention of bodies and policymakers. This may lead to discussions on industry standards and guidelines aimed at promoting efficiency and fostering competition within the SaaS sector.

Acquisitions; Companies looking to expand or boost their efficiency might consider merging or acquiring firms. Targeting and integrating these companies could help improve performance and market standing.

Customer Perception; The efficiency of SaaS companies has an impact on how customers perceive them and their level of satisfaction. Efficient companies are more likely to deliver services in a cost manner, which can result in customer satisfaction rates and improved customer retention. It can stimulate competition, innovation and advancements in effectiveness benefiting both companies operating within this sector well as their customers.

However it's crucial to incorporate efficiency scores in conjunction, with performance measurements and take into account the industry landscape in order to make informed choices and foster long term sustainable growth.

Discussion

The analysis conducted on Aspen Technology Inc, HubSpot Inc, Rapid7 Inc and RingCentral using the DEA SBM model has given us insights, into how efficient these SaaS providersre. The efficiency scores obtained for each company measure their ability to effectively convert inputs into outputs.

Interpretation of Results; All four SaaS companies (Aspen Technology Inc, HubSpot Inc Rapid7 Inc and RingCentral) have been found to be operating at efficiency with a score of 1. This means that all the companies are performing at the level as the benchmark and utilizing their resources optimally to achieve desired outcomes.

1. Significance; These results hold two implications. Firstly it demonstrates the level of efficiency within this specific subset of the SaaS industry. The fact that all four companies achieved a score of 1 indicates an well optimized sector. Secondly it highlights the potential for practices and operational excellence among these companies serving as an example, for other SaaS providers looking to improve their efficiency.

To gain an understanding of what contributes to the efficiency of Aspen Technology Inc, HubSpot Inc, Rapid7 Inc and RingCentral further analysis is necessary. We should explore factors that could be influencing their efficiency;

The efficiency of SaaS providers can be affected by the technology they use and the quality of their products or services. Companies that offer user friendly solutions tend to attract customers and generate higher output resulting in greater efficiency.

2. Infrastructure; In the SaaS industry it's crucial to have the ability to scale operations efficiently. Companies, with infrastructure and scalable systems can handle increased demand without increasing their inputs. This leads to efficiency.

3. Business Processes; Efficient and streamlined business processes have an impact, on a companys efficiency. When companies optimize their processes and workflows they can better utilize resources. Generate output more effectively.

4. Customer Base and Market Reach; The size and diversity of a companys customer base play a role in its efficiency. Companies that have a market reach and a diverse customer portfolio often enjoy stable revenue streams contributing to their overall efficiency.

5. Organizational Structure; Effective management practices and a organized company can significantly improve efficiency. Companies that have leadership and clear decision making processes are better able to allocate resources

While Aspen Technology Inc, HubSpot Inc, Rapid7 Inc and RingCentral were found to be fully efficient it's important to explore reasons for inefficiencies in other SaaS providers. Some factors that could contribute to these inefficiencies include;

1. Suboptimal Resource Allocation; Inefficient SaaS providers may struggle with allocating their resources. This could be due to planning, a misalignment of resources with business objectives or poor decision making.

2. Lack of Innovation; Companies that fail to keep up with advancements or innovate their products may experience inefficiencies compared to innovative competitors.

3. Market Niche and Competition; Companies operating in markets or specific niches may find it challenging to achieve efficiency due to pricing pressures and the constant need, for differentiation.

4. Poor Customer Retention; Inefficiencies can arise if a company experiences customer churn rates. It is generally more cost effective for companies to retain existing customers than constantly acquiring ones.
Ineffective Marketing and Sales Strategies; Companies that have marketing and sales approaches might encounter challenges, in acquiring customers leading to efficiency.

Regulatory and Compliance Issues; Difficulties in complying with regulations to the industry can result in inefficiencies if not effectively managed. Analyzing the efficiency scores of Aspen Technology Inc, HubSpot Inc Rapid7 Inc and RingCentral provides insights into their excellence. Understanding what factors contribute to their efficiency while also exploring reasons for inefficiencies among SaaS providers can help guide decision making and drive improvements, within the industry.

Limitations

There are challenges when it comes to collecting and analyzing data;

1. Availability of Data; To effectively analyze efficiency using DEA (Data Envelopment Analysis) we require data, on inputs and outputs for each decision making unit. However gathering data can be difficult for complex organizations. Incomplete or missing data can significantly impact the accuracy of the efficiency analysis.

2. Quality of Data; The accuracy and reliability of the data used in DEA analysis are crucial. If the data is inaccurate or unreliable it can lead to results and conclusions. Ensuring the accuracy and consistency of the data poses challenges particularly when dealing with information from sources or units.

3. Subjectivity and Bias; The process of collecting and analyzing data is prone to decisions and biases. Deciding which inputs and outputs should be considered, as selecting a benchmark for comparison may introduce subjectivity that could influence the final efficiency scores.

4. Time and Cost; Collecting and processing data for DEA analysis can be time consuming and expensive. Companies with resources may face challenges when attempting to conduct comprehensive efficiency analyses.
One limitation of the DEA SBM (Slack Based Measure) approach is that it assumes no substitution, between inputs and outputs. However in reality companies often adjust their input output mix to enhance efficiency—a factor that this model fails to capture(C.-N. Wang et al., 2023; C.-n. WANG, YANG, VO, & Mathematics, 2022).

Another important point to consider is that the DEA SBM model assumes that all input and output data are predictable and does not take into account uncertainties or random variations. This oversimplification may not accurately reflect the complexities and uncertainties faced by businesses, in the world.

Additionally the DEA SBM model assumes that production technology follows a shape, known as convexity. However there are production technologies that exhibit non convexities which can limit our ability to capture efficiency patterns effectively.

It's worth mentioning that the DEA SBM model does not explicitly distinguish between inefficiency and scale inefficiency. It only attributes inefficiencies to factors while overlooking how scale inefficiency can impact efficiency scores.

Moreover the DEA SBM model can be sensitive to values or outliers in the data. These outliers have the potential to disproportionately influence efficiency scores. Lastly it's important to note that the DEA SBM model is based on a single period analysis and does not account for changes over time. This limitation prevents us from capturing any evolving trends or shifts in efficiencies across time periods.

In summary, while the DEA SBM model offers insights, for efficiency analysis it does have limitations concerning data collection assumptions made and its deterministic approach. Users should keep in mind these limitations. Consider them when interpreting the results and making business decisions based on the DEA analysis. It is also essential to validate the models findings using techniques and take into account the context of each analysis.

Conclusion

The current study emphasizes the role of using the Data Envelopment Analysis (DEA) method to evaluate the effectiveness and performance of Software, as a Service (SaaS) providers. By analyzing known companies like Aspen Technology Inc, HubSpot Inc, Rapid7 Inc and RingCentral the DEA approach reveals that all four entities operate at efficiency with a perfect score of 1. This evidence indicates their utilization of resources to achieve desired outcomes.

The DEA approach has become a tool for businesses, in industries as it offers decision support in assessing performance optimizing resources, benchmarking and making strategic decisions. By leveraging DEA analysis organizations can gain insights into areas that need improvement and identify practices. This enables them to set performance standards aligned with industry norms or top competitors.

Within the SaaS sector implementing the DEA approach brings benefits by promoting efficiency and driving innovation. It helps identify industry leaders and their strategies while fostering competition and streamlining decision making processes(Peng et al., 2022; C. N. Wang, Yang, Nguyen, & Vo, 2022). Notably efficient resource allocation facilitated by DEA analysis empowers SaaS companies to invest in research and development leading to innovation and product enhancement.

Looking ahead at research directions there are areas that deserve further exploration.

To begin with conducting an analysis of SaaS providers using a comprehensive dataset can offer valuable insights into efficiency trends, across the industry. This can help identify areas where improvements can be made. Additionally studying the efficiency of SaaS providers over time periods can reveal performance dynamics and long term changes.

Moreover it would be beneficial to focus research efforts on understanding how specific factors like customer retention strategies, marketing effectiveness or technological innovations impact the efficiency of SaaS companies. Gaining this knowledge would enable companies to optimize their performance and stay competitive. Furthermore future research should not measure efficiency. Also explore its relationship with other key performance indicators like customer satisfaction, revenue growth or market share. Such insights would contribute to an understanding of the factors that contribute to overall business success.

The use of the DEA approach is not essential for evaluating SaaS providers. Also serves as a valuable framework for decision making in the industry. The findings from this research emphasize the significance of

resource utilization and strategic planning in achieving success in todays SaaS landscape. Given the changing nature of the industry it is crucial to conduct research using analytical techniques, alongside the DEA approach. These efforts are sure to spark innovation improve performance and influence the direction of the changing SaaS industry.

Scientific Ethics Declaration

The authors declare that the scientific ethical and legal responsibility of this article published in EPSTEM journal belongs to the authors.

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