International Journal of Applied Operational Research
Vol. 13, No. 4, pp. 73-87, Autumn 2025

Journal homepage: ijorlu.liau.ac.ir

Evaluating sales performance using data envelopment analysis

S. Naseripour, M. Rostamy Malkhalifeh*

Received: 12 May 2025 ; **Accepted:** 10 August 2025

Abstract Sales performance evaluation and forecasting are critical for businesses seeking to optimize their strategies and enhance profitability. Traditional sales analysis methods often fail to capture efficiency variations across different sales approaches, leading to suboptimal decision-making. This study employs Data Envelopment Analysis (DEA) to evaluate and compare the efficiency of various sales strategies in a real-world business environment. We apply the DEA model to assess the input-output efficiency of 30 different sales approaches and integrate predictive modeling to forecast future performance. The proposed approach provides a data-driven framework for identifying the most effective sales strategies and optimizing resource allocation.
The results demonstrate that DEA is a powerful tool for distinguishing high-efficiency sales models and uncovering areas for improvement. The findings can assist business managers in making informed decisions regarding sales strategy selection and enhancement.

Keywords: Sales Performance, Data Envelopment Analysis, Efficiency Measurement, Business Optimization.

1 Introduction

Sales are the driving force behind business operations, facilitating revenue generation, market expansion, and long-term growth. Over the years, sales methodologies have undergone significant transformations due to technological advancements, shifts in consumer behavior, and changing market dynamics. While traditional sales approaches emphasized direct interpersonal interactions, modern sales strategies leverage data-driven techniques, digital tools, and adaptive selling models to enhance effectiveness.
One fundamental shift in sales strategy has been the transition from product-centric to customer-centric selling. Panagopoulos and Avlonitis (2010) investigated the impact of aligning sales strategies with customer orientation, demonstrating that salespeople who adopt a value-based selling approach outperform those who focus solely on product attributes [1]. Their findings

*Corresponding Author. (✉)
E-mail: mohsen_rostamy@yahoo.com (M. Rostamy Malkhalifeh)

M. Rostamy Malkhalifeh
Department of Computer Science S.R.C., Islamic Azad University, Tehran, Iran

S. Naseripour
Department of Computer Science S.R.C., Islamic Azad University, Tehran, Iran

[Downloaded from ijaor.ir on 2026-11-27]

[DOI: 10.71885/ijorlu-2025-3-694]

emphasize the need for understanding customer needs, building trust, and delivering value as core components of successful sales performance [2].

In addition to customer orientation, the integration of technology has become a key driver of sales efficiency. Agnihotri et al. (2020) discuss how sales technology tools, including social CRM, artificial intelligence (AI), and digital engagement platforms, significantly enhance sales productivity [3]. Their study highlights that firms investing in digital sales technologies experience increased lead conversion rates and improved customer retention due to personalized and data-driven interactions [4].

Beyond technology, sales strategy implementation at the salesperson level plays a crucial role in overall performance. Rapp et al. (2019) examine how salespeople's commitment to executing organizationally designed sales strategies affects business outcomes [5]. Their findings suggest that companies with strong alignment between management-driven sales strategies and individual execution at the field level achieve higher sales efficiency. Moreover, they argue that incentive structures and sales training significantly influence sales teams' ability to implement strategies effectively [6].

Finally, a study by Kalra and colleagues (2023) identifies adaptability as a key determinant of sales success. Their research suggests that sales teams capable of adjusting their approaches based on market trends, customer feedback, and competitive dynamics consistently outperform rigid sales structures [7]. They emphasize that flexible sales strategies, combined with strong market intelligence, lead to higher customer satisfaction and better sales conversion rates [8].

These studies collectively underscore the evolving nature of sales, highlighting customer-centricity, technological integration, salesperson adaptability, and strategy execution as essential components of a successful sales framework. Understanding these dynamics is crucial for businesses seeking to optimize their sales operations and achieve sustainable growth.

Data Envelopment Analysis (DEA):

Historical Background of DEA: The increasing complexity of sales strategies necessitates quantitative approaches to evaluate their efficiency. One of the most widely used analytical frameworks for this purpose is Data Envelopment Analysis (DEA). The origins of DEA can be traced back to Farrell's (1917) work on efficiency measurement, which introduced a single-input, single-output framework to assess productivity [9]. However, this model lacked the ability to evaluate units with multiple inputs and outputs simultaneously.

In 1978, Charnes and colleagues introduced DEA as a non-parametric method to measure the efficiency of decision-making units (DMUs) [10]. Their approach allowed organizations to compare multiple DMUs based on several input-output relationships without requiring a predefined functional form. Since its inception, DEA has become widely adopted across various fields, including finance, healthcare, education, manufacturing, and sales management.

A comprehensive review by Emrouznejad and Yang (2018) highlights the evolution of DEA models, demonstrating how enhancements in computational power and data availability have led to more sophisticated applications [11]. Their research emphasizes the adaptability of DEA in multi-dimensional performance evaluation, making it a preferred technique in operational efficiency analysis [12].

Definition and Methodology of DEA: DEA is a linear programming-based approach that evaluates the relative efficiency of decision-making units (DMUs) operating under similar conditions. The methodology constructs an efficient frontier, against which DMUs are assessed. Those positioned on the frontier are classified as efficient, while units below the frontier are considered inefficient, indicating potential areas for performance improvement.

[Downloaded from ijaor.ir on 2026-11-27]

[DOI: 10.71885/ijorlu-2025-3-694]

The two most commonly used DEA models are:

CCR Model (Constant Returns to Scale - CRS): Assumes that efficiency remains constant regardless of input scale, making it suitable for evaluating operations where returns do not change with size.

BCC Model (Variable Returns to Scale-VRS)[13]: Allows efficiency to vary based on scale, making it ideal for analyzing industries with fluctuating performance levels.

DEA provides a comparative framework for efficiency assessment, allowing organizations to benchmark performance, optimize resource allocation, and develop targeted improvement strategies.

DEA in Sales Performance Evaluation: In the context of sales, DEA serves as a powerful tool for benchmarking different sales strategies. By analyzing sales teams, approaches, and marketing channels using DEA, businesses can determine which strategies maximize efficiency while utilizing minimal resources. This enables decision-makers to identify best practices, refine sales techniques, and optimize performance management systems.

Notably, based on a study by Esmaeili and Rostamy-Malkhalifeh (2017), an advanced DEA model was proposed to address scenarios involving fixed inputs, undesirable outputs, and negative data. Their findings expand DEA's applicability, making it suitable for complex real-world evaluations, including sales performance assessments [14].

Recent advancements in network DEA models have further refined its ability to measure sales efficiency. These models allow for a more granular evaluation of multi-stage sales processes, capturing the interdependence between different sales activities. This is particularly beneficial for assessing complex sales structures where customer acquisition, engagement, and conversion occur at different stages.

These developments position DEA as a robust, data-driven framework for sales efficiency analysis, offering businesses a systematic approach to improving sales strategies, enhancing decision-making, and achieving optimal performance.

2 Research gap

Despite advances in sales methodologies and performance measurement, organizations still lack a rigorous approach for evaluating sales strategies in terms of efficiency, that is, performance outcomes relative to the resources consumed. Conventional assessments such as revenue-based indicators, financial ratios, and subjective performance reviews tend to emphasize outcomes while providing limited insight into input, output efficiency. As a result, four gaps remain. First, sales performance is often assessed using single-dimensional outcomes (for example, revenue or profit) rather than multi-dimensional resource utilization (for example, time, effort, and investment). Second, organizations commonly deploy multiple sales approaches, yet there is no consistent framework for benchmarking the efficiency of strategies against one another. Third, without an efficiency-based benchmarking mechanism, managers may struggle to identify best-practice strategies and may rely on intuition or historical preference. Fourth, sales forecasting is typically conducted using trend and market-based methods that rarely incorporate efficiency information, limiting the ability to anticipate how changes in resource allocation may influence future performance.

[Downloaded from ijaor.ir on 2026-11-27]

[DOI: 10.71885/ijorlu-2025-3-694]

3 Literature review

DEA has been widely adopted as a non-parametric method for assessing the relative efficiency of comparable decision-making units when multiple inputs and outputs must be considered simultaneously. In sales contexts, DEA enables efficiency benchmarking across strategies by constructing an efficiency frontier and identifying which approaches operate on the frontier and which fall below it. This makes DEA suitable for diagnosing performance gaps and providing targets for improvement grounded in observed best practice. In addition, DEA outputs can be used as informative features for subsequent predictive modelling, supporting forward-looking planning that considers not only sales outcomes but also the efficiency with which resources are transformed into results.

Therefore, this study aims to:

- define and categorise 30 sales strategies and assess their relative efficiency,
- apply the BCC DEA model to identify efficient and inefficient strategies, and
- develop a predictive model using DEA outputs to support forecasting and decision-making.

4 Discussion of research findings

This section describes the case context and then reports and interprets the DEA efficiency results across the 30 sales approaches.

4.1 Background and sales system analysis

Sales performance in context: Sales performance shapes revenue generation and market positioning. However, commonly used outcome-only indicators (for example, revenue or profit margins) provide limited insight into how efficiently different sales approaches transform resources into results.

An efficiency-based perspective is therefore required to benchmark approaches on a comparable basis and to support more transparent, data-driven decisions on sales strategy selection and resource allocation.

Case study organisation: To conduct a real-world efficiency analysis of different sales approaches, this study selects Hamkaran System, a leading provider of Enterprise Resource Planning (ERP) solutions, as the case study organization.

Business model and sales structure: Hamkaran System operates within the B2B technology sector, providing ERP software and IT solutions to businesses of various sizes. The company's sales process involves:

- Lead Generation, Identifying potential business clients through digital marketing, industry events, and outbound sales efforts.
- Consultative Sales Approach, Engaging potential clients through product demonstrations, requirement assessments, and tailored ERP solutions.
- Proposal and Contracting, Negotiating software licensing agreements, subscription-based pricing models, and long-term service contracts.
- Post-Sales Customer Engagement, providing ongoing customer support, software updates, and technical consultation to enhance client satisfaction and retention.

[Downloaded from ijaor.ir on 2026-11-27]

[DOI: 10.71885/ijorlu-2025-3-694]

Key challenges in the current sales system:
While Hamkaran System has a structured sales process, the company faces several challenges that necessitate a data-driven efficiency evaluation:

- Diverse Sales Strategies, the company employs multiple sales approaches, including consultative selling, direct sales, inbound marketing, and relationship-based selling. However, there is no clear framework to determine which strategy is most effective under different conditions.
- Varying Client Acquisition Costs, some strategies require higher marketing and sales expenses (e.g., outbound sales), while others rely on organic client referrals. A comparative efficiency analysis can help prioritize cost-effective approaches.
- Sales Conversion and Retention Uncertainty, while some sales approaches generate high initial conversion rates, they may lack long-term customer retention efficiency. A systematic evaluation can identify strategies that drive both sales growth and sustainable client relationships.

4.2 Sales approaches considered for DEA evaluation

This study considers 30 sales approaches commonly used across industries. The approaches are grouped based on their strategic focus, customer engagement logic, and execution mechanisms to ensure comparability in the subsequent DEA assessment. This classification provides a structured basis for interpreting efficiency differences across approaches:

- **Consultative Selling:** In the consultative selling approach, the salesperson acts as an advisor to the buyer. They start by asking targeted questions to identify the customer's needs, and then design a customized solution based on those needs.
- **Relationship Selling:** In the relationship selling approach, the salesperson aims to build trust with the customer, turning them into loyal and long-term business partners. The salesperson consistently follows up, pays attention to the customer's evolving needs, and strives to develop a close, personal relationship. This way, the customer views the salesperson as a friend rather than just a seller.
- **Product-Oriented Selling:** In product-oriented selling, the salesperson simply presents the product and emphasizes its features and benefits without paying much attention to the customer's specific needs. This includes highlighting technical specifications, product functionality, and advantages over competitors.
- **Solution-Based Selling:** In the solution-based selling approach, the salesperson must fully and accurately understand the customer's needs using extensive knowledge. They should analyze the customers' problems in depth and, as a result, present a product as the optimal solution. Additionally, they must pay close attention to the final outcome the customer receives.
- **Inbound Selling:** In inbound marketing, the salesperson focuses on attracting customers by creating engaging content on social media and blogs. The goal is to draw in customers who are actively seeking information related to the product.
- **Direct Selling:** Direct selling means that the sale happens directly between the seller and the customer, without any intermediaries. This usually takes place through face-to-face or phone interactions, where the salesperson must be able to answer customer questions instantly. This approach is often used for complex and high-priced products.
- **Collaboration Selling:** In the collaborative selling approach, the product or service is fully customized for the customer, but this happens through close cooperation between the seller and

[Downloaded from ijaor.ir on 2026-11-27]
[DOI: 10.71885/ijorlu-2025-3-694]

the customer. Neither party makes decisions alone; instead, both negotiate to reach an agreed upon solution.

- **Value-based Selling:** In the value-based selling approach, the salesperson focuses on highlighting economic factors and the investment value of the product or its return on investment. They use data to clearly demonstrate cost reductions and operational savings, persuading the customer to make a purchase.
- **Outcome-based Selling:** Outcome-based selling focuses on the results the customer will achieve. The salesperson aims to close the sale by guaranteeing the desired and expected outcome for the customer.
- **Service-Oriented Selling:** In service-based selling, the salesperson convinces the customer by guaranteeing support during and after the sale, often 24/7. This approach aims to create positive customer experience, ultimately leading to customer satisfaction and loyalty.
- **Persuasive Selling:** In persuasive selling, the salesperson uses psychological, emotional, and cognitive techniques to convince the customer. They focus on immediate needs, urgency, and scarcity to drive the purchase decision.
- **Aggressive Selling:** In aggressive selling, the salesperson puts the customer under high pressure, using assertiveness and urgency to push them into making a purchase as quickly as possible.
- **Emotional Selling:** In emotional selling, the salesperson aims to persuade the customer by evoking their emotions and feelings. They use tools like storytelling and imagery to create a deeper emotional connection and drive the purchase decision.
- **Data-Driven Selling:** In data-driven selling, the salesperson thoroughly analyzes and processes customer data to identify the best sales opportunities, optimal sales strategies, and customer purchasing patterns. Based on these insights, they initiate the sales process and negotiate with the customer.
- **Tech-Enabled Selling:** In technology-driven selling, the salesperson leverages all available digital tools and advanced technologies to accelerate the sales process and partially automate it. For example, pricing proposals can be automated using these technologies. Tools like ChatGPT and other AI-driven solutions can help streamline certain parts of the sales process, such as generating price quotes for customers.
- **Social Selling:** The seller directly interacts with customers through messaging platforms and uses social media to establish connections and promote products. They need to create engaging content and utilize customer feedback and recommendations to improve their business.
- **E-Commerce:** In this approach, the sales process utilizes online stores and websites. Customers have 24/7 access to these platforms and can benefit from services like online payments or available discounts.
- **Content-based Selling:** The seller uses educational, and sometimes entertaining, content to elevate their brand's position. They aim to fully introduce the product to customers and convey its value before the sale, thereby building customer trust.
- **AI-Driven Selling:** The seller analyzes customer behaviors using existing or newly developed algorithms in AI. This allows them to predict customer needs and offer relevant products with minimal human error.
- **Localized Selling:** The seller focuses their strategy on the specific needs of a particular locality, considering the culture, economy, expectations, and living conditions of people in that area. They tailor their sales messages accordingly, so customers feel a stronger connection and trust in both the seller and the product.

[Downloaded from ijaor.ir on 2026-11-27]

[DOI: 10.71885/ijorlu-2025-3-694]

- **Global Selling:** The seller adopts a broader perspective, aiming to adjust strategies so that customers from diverse cultures, languages, regulations, and living conditions can access and benefit from the product or services. This means the product and sales strategies must comply with or be adaptable to various countries' and cities' conditions, thereby attracting a wider range of customers.
- **Cross-Cultural Selling:** The seller must understand and embrace cultural differences, tailoring their sales strategies to be adaptable. This approach focuses on connecting with customers through cultural understanding, ensuring that strategies are flexible and culturally aware.
- **Network-based Selling:** The seller aims to maximize social interactions and expand relationships, effectively building a network. By leveraging recommendations and referrals from existing customers, they attract new customers and continuously grow their customer base, enhancing trust and sales through networking.
- **B2B Selling:** B2B (Business-to-Business) Approach: The business provides its services exclusively to other businesses, focusing on complex and prolonged decision-making processes, and creating value for other enterprises.
- **B2C Selling:** B2C (Business-to-Consumer) Approach: In this approach, products or services are sold directly to the end consumer. The focus is on helping customers make quick purchasing decisions. However, when considering organizational context, B2C can also involve offering user-friendly solutions that meet the needs of individual users within larger organizations.
- **Subscription Selling:** The seller persuades the customer to subscribe to a service rather than making a one-time purchase. The seller is responsible for maintaining all infrastructure, product requirements, and customer data, ensuring seamless service delivery. The customer, in turn, pays a recurring fee, typically monthly or annually, to access the service, trusting the seller's commitment. This approach significantly reduces customer costs, as they only pay for usage rather than full ownership. Meanwhile, the seller benefits from a steady revenue stream and increased customer retention.
- **Seasonal Selling:** The Seasonal approach involves meticulous planning by the seller to offer products based on the type of goods and market demand during each season. It utilizes diverse customer behavior patterns to tailor sales policies and strategies. For instance, during specific seasons like inventory counting periods, the seller recommends relevant warehouse management software to customers.
- **Multi-Channel Selling:** In the multi-channel selling approach, the seller does not rely on a single sales platform or one-dimensional customer interaction. Instead, it aims for a strong presence across various channels, including phone contact, telemarketing, online shopping, social media, trade shows, and more, to engage with customers and deliver products.
- **Campaign-based Selling:** A sales strategy where the seller creates a short-term promotional campaign to excite the customer and encourage a purchase. For example, the seller might announce a significant discount for a limited period, such as three days, to motivate the customer to buy within that timeframe.
- **Innovation-centric Selling:** A sales strategy that emphasizes the innovative nature of the product. The seller aims to convince the customer that by purchasing this product, they are taking a step forward in adopting new technologies. It promises significant positive changes for the customer due to the innovative features of the product or service.

[Downloaded from ijaor.ir on 2026-11-27]

[DOI: 10.71885/ijorlu-2025-3-694]

5 Model selection and implementation

5.1 Rationale for using DEA in this study

Traditional sales performance evaluation methods primarily focus on financial indicators such as revenue, profit margins, and total sales volume. While these metrics provide insights into overall business growth, they fail to account for the efficiency of different sales strategies in utilizing resources. In contrast, DEA is a multi-dimensional efficiency analysis tool that allows businesses to compare multiple inputs and outputs simultaneously, making it an ideal methodology for evaluating sales strategies.

Comprehensive Multi-Factor Efficiency Analysis, DEA, enables an organization to assess sales performance by considering multiple inputs (e.g., sales force effort, marketing budget, and customer interactions) and outputs (e.g., revenue, customer acquisition, conversion rates), offering a more holistic measure of sales effectiveness than traditional financial indicators.

Relative Benchmarking of Sales Strategies, unlike standard performance reviews, which assess sales success in absolute terms, DEA enables the comparison of multiple sales strategies within a given dataset, identifying best practices and highlighting underperforming methods.

Non-Parametric and Flexible Approach, DEA does not require a predefined functional relationship between inputs and outputs, allowing it to adapt to various business environments and different types of sales strategies without imposing assumptions on data distribution.

Optimization and Decision-Support for Sales Managers, the ability to measure relative efficiency enables sales teams to identify high-impact sales approaches, optimize resource allocation, and eliminate inefficient strategies, leading to improved decision-making and better resource utilization.

5.2 Selecting the DEA model for this study

Different DEA models are used depending on the objectives of efficiency analysis. The two primary models in DEA literature are:

CCR Model (Charnes, Cooper, and Rhodes, 1978), Assumes constant returns to scale (CRS) and evaluates overall technical efficiency by comparing all Decision-Making Units (DMUs) relative to a single efficiency frontier.

BCC Model (Banker, Charnes, and Cooper, 1984), Assumes variable returns to scale (VRS) and distinguishes between pure technical efficiency (management performance) and scale efficiency (impact of business size on efficiency).

For this study, the BCC model is chosen because:

- Sales efficiency may vary depending on resource allocation, meaning that some sales strategies benefit from economies of scale, while others do not.
- The BCC model allows differentiation between technical inefficiency (inefficiencies in execution) and scale inefficiency (inefficiencies due to size limitations), providing a deeper level of insight than the CCR model.
- It ensures that the efficiency scores reflect real-world variations in how sales strategies perform, rather than assuming a fixed efficiency ratio across all approaches.
- By employing the BCC DEA model, this study ensures that each sales strategy is fairly evaluated, accounting for differences in scale, resource intensity, and external business conditions.

[Downloaded from ijaor.ir on 2026-11-27]

[DOI: 10.71885/ijorlu-2025-3-694]

5.3 Implementation process and proposed methodology

The DEA implementation follows a structured five-step process, ensuring systematic evaluation of sales performance.

Step 1: Data collection and selection of input-output variables

- The first phase involves collecting sales-related data for each sales approach and selecting a consistent set of input and output variables for the DEA assessment. Based on the data reported in Tables 1 and 2, this study uses five inputs and five outputs.
- Input variables (resources consumed per sales approach):
- A. Sales cost; B. Time spent on sales; C. Number of employees; D. Investment in technology; E. Employee training score.
- Output variables (performance outcomes per sales approach):
- F. Sales volume; G. Lead conversion rate; H. Customer satisfaction; I. Customer retention; J. Net sales profit.
- These variables capture both resource intensity and sales outcomes, allowing efficiency benchmarking across approaches under the BCC framework.

Step 2: Constructing the DEA model

- Using the BCC DEA model, mathematical formulation is developed to:
- Compare the input-output efficiency ratios of different sales strategies.
- Identify efficient strategies that lie on the DEA efficiency frontier.
- Determine underperforming sales approaches that require optimization.
- Each sales strategy is treated as a Decision-Making Unit (DMU), and the model calculates its efficiency score based on relative performance across the dataset.

Step 3: Efficiency analysis and benchmarking

- Once the DEA model is executed, the following efficiency scoring process is applied:
- Each sales strategy is assigned an efficiency score between 0 and 1.
- Strategies scoring 1 are considered fully efficient and are located on the DEA efficiency frontier.
- Inefficient strategies are ranked based on their distance from the frontier, providing insights into areas that need improvement.
- This step benchmarks sales strategies against one another, allowing businesses to identify best practices and optimize weak-performing methods.

Step 4: Identifying areas for improvement

- DEA results highlight specific resource misallocations in inefficient sales strategies.
- Recommendations are generated to reallocate sales team efforts, adjust marketing budgets, or refine customer engagement tactics to improve efficiency.

[Downloaded from ijaor.ir on 2026-11-27]

[DOI: 10.71885/ijorlu-2025-3-694]

6 Results

6.1 DEA efficiency scores and performance comparison

DEA efficiency was computed using the BCC model under a variable-returns-to-scale specification. Table 3 reports the resulting efficiency scores (bounded between 0 and 1), where a score of 1 indicates that an approach is efficient relative to the observed frontier.

In this dataset, 24 of the 30 sales approaches are efficient (efficiency = 1). The remaining six approaches are inefficient to varying degrees, with the lowest scores observed for: Innovation-Centric (0.6464); Collaboration (0.6558); E-Commerce (0.7728); Localized (0.8519); Content-Based (0.8965); Service-Oriented (0.9072).

For interpretability, approaches with efficiency equal to 1 are referred to as efficient, while approaches below 1 are referred to as inefficient. This terminology replaces the earlier label "Highly Efficient" and aligns with standard DEA interpretation.

6.2 Key factors influencing sales efficiency

The analysis identified several key factors that significantly impacted the efficiency of different sales strategies:

- Sales Team Resource Utilization: Strategies that made effective use of sales personnel hours and optimized workload distribution achieved higher efficiency scores.
- Marketing Expenditure Impact: Some strategies required higher marketing investments (e.g., digital advertising for outbound sales), which directly influenced efficiency.
- Customer Retention Metrics: Long-term customer engagement strategies, such as Subscription-Based Selling, demonstrated higher efficiency than one-time transactional approaches.
- Industry-Specific Variability: Some sales strategies performed better in B2B environments (e.g., Consultative Selling), while others were more suited for B2C markets (e.g., Campaign-Based Selling).

6.3 Implications for sales strategy optimization

Based on these findings, the following strategic recommendations can be derived:

- Prioritize Customer-Centric Sales Approaches: Sales strategies that focus on personalized solutions and long-term client relationships consistently demonstrated higher efficiency. Companies should invest in sales training programs that promote these techniques.
- Optimize Resource Allocation for Direct Selling: While Direct Selling and Inside Sales showed moderate efficiency, optimizing resource allocation by reducing unnecessary sales force efforts and automating follow-ups can further improve their performance.
- Refine Marketing Investments in Low-Efficiency Strategies: Businesses using Seasonal or Campaign-Based Selling should analyze past performance data to adjust marketing budgets dynamically, preventing resource overuse during low-demand periods.

[Downloaded from ijaor.ir on 2026-11-27]

[DOI: 10.71885/ijorlu-2025-3-694]

6.4 Forecasting future sales performance based on DEA findings

To enhance decision-making, a predictive model was developed using DEA efficiency scores as input variables. The model forecasts:

- The potential impact of shifting resources from inefficient to efficient strategies to maximize revenue.
- Future efficiency trends based on historical performance data allowing sales teams to anticipate which strategies will yield the highest returns.
- The effect of adjusting customer engagement levels, sales force allocation, and marketing spending to optimize future performance.

7 Data and DEA evaluation results

Table 1 reports the input and output data collected for the 30 sales approaches. Inputs correspond to columns A to E, and outputs correspond to columns F to J (see Table 2 for the variable key).
Each row represents a sales approach (a decision-making unit), and the metrics are measured on a consistent scale to support comparability across approaches.
Using the BCC DEA model, efficiency scores were computed from the data in Table 1. The resulting efficiency scores are reported in Table 3.
These results provide the empirical basis for the interpretation and managerial implications presented in Section 6.

Table 1 Sales performance data

Sales Approaches	A	B	C	D	E	F	G	H	I	J
Consultative	61	24	81	70	30	92	96	84	84	97
Relationship	33	12	31	62	11	97	39	47	11	73
Product-Oriented	69	30	42	85	67	31	98	58	68	51
Solution-Based	69	89	24	71	71	56	71	60	64	73
Inbound	12	60	16	30	82	48	27	13	98	69
Direct	23	18	99	62	11	93	69	80	53	17
Collaboration	56	44	87	90	45	59	13	11	15	63
Value-Based	13	63	72	27	99	53	43	83	71	23
Outcome-Based	57	24	81	87	96	71	49	94	89	91
Service-Oriented	62	33	35	98	69	50	38	24	54	74
Persuasive	98	80	18	97	10	17	97	72	20	90

[Downloaded from ijaor.ir on 2026-11-27]

[DOI: 10.71885/ijorlu-2025-3-694]

Aggressive	17	44	44	42	14	50	37	16	82	81
Emotional	21	43	42	57	32	71	97	46	53	95
Data-Driven	44	74	56	87	12	10	14	99	23	36
Tech-Enabled	18	88	24	99	51	86	60	72	61	13
Social	32	24	52	38	45	22	41	80	68	95
E-Commerce	37	75	51	54	71	66	15	37	37	53
Content-Based	93	39	71	84	98	71	10	36	71	86
AI-Driven	12	79	81	36	18	71	46	60	53	33
Localized	88	68	41	97	61	71	67	61	21	48
Global	11	12	65	90	68	11	11	63	96	10
Cross-Cultural	28	11	62	53	99	41	79	41	77	64
Network-Based	84	65	26	47	33	78	79	95	20	25
B2B	82	68	79	89	12	29	68	45	28	99
B2C	76	28	29	80	61	42	49	48	91	10
Subscription	20	66	98	59	32	40	51	16	25	99
Seasonal	69	11	10	57	21	78	46	41	18	28
Multi-Channel	57	89	12	29	33	63	42	33	84	81
Campaign-Based	45	47	93	98	34	27	91	75	63	44
Innovation-Centric	89	70	50	42	77	42	23	30	57	29

Table 2. Help for Table 1

Table-1 Help			
Sales Cost	A	Sales Volume	F
Time Spent on Sales	B	Lead Conversion Rate	G
Number of Employees	C	Customer Satisfaction	H
Investment in Technology	D	Customer Retention	I
Employee Training Score	E	Net Sales Profit	J

[Downloaded from ijaor.ir on 2026-11-27]

[DOI: 10.71885/ijorlu-2025-3-694]

Table 3 reports the BCC DEA efficiency scores computed for each sales approach and is used as the basis for the analysis in Section 6.

Table 3 BCC DEA efficiency scores for the 30 sales approaches (VRS).

Sales approach	BCC efficiency score
Consultative	1.0000
Relationship	1.0000
Product-Oriented	1.0000
Solution-Based	1.0000
Inbound	1.0000
Direct	1.0000
Collaboration	0.6558
Value-Based	1.0000
Outcome-Based	1.0000
Service-Oriented	0.9072
Persuasive	1.0000
Aggressive	1.0000
Emotional	1.0000
Data-Driven	1.0000
Tech-Enabled	1.0000
Social	1.0000
E-Commerce	0.7728
Content-Based	0.8965
AI-Driven	1.0000
Localized	0.8519
Global	1.0000
Cross-Cultural	1.0000
Network-Based	1.0000
B2B	1.0000
B2C	1.0000
Subscription	1.0000
Seasonal	1.0000
Multi-Channel	1.0000
Campaign-Based	1.0000
Innovation-Centric	0.6464

8 Conclusion and future research

8.1 Summary of findings

This study successfully applied DEA to evaluate the efficiency of 30 different sales strategies, identifying high-performing and underperforming approaches based on multi-input, multi-output analysis. The findings suggest that:

Customer-oriented sales strategies consistently outperform transaction-based approaches in terms of efficiency.

Resource allocation plays a critical role in sales performance, and inefficient sales techniques can be improved through better workload management and marketing budget adjustments.

Predictive modeling based on DEA results provides actionable insights for sales optimization and future strategy planning.

[Downloaded from ijaor.ir on 2026-11-27]

[DOI: 10.71885/ijorlu-2025-3-694]

8.2 Research limitations

While DEA provided a robust framework for efficiency evaluation, the study has a few limitations:
Data dependency: The accuracy of DEA depends on data quality, and results may vary based on dataset size and consistency.
External market factors: Certain strategies, such as seasonal and auction-based selling, are heavily influenced by market conditions, which were not fully controlled in this study.
Lack of real-time adjustments: The DEA model provides historical efficiency scores, but future studies could integrate real-time data analytics to improve sales forecasting accuracy.

8.3 Recommendations for future research

Future studies should explore:
- Hybrid DEA-ML Models: Combining DEA with machine learning algorithms to enhance real-time predictive capabilities.
- Expanded Industry Applications: Extending the analysis to different industries and geographic markets to test the scalability of findings.
- Dynamic DEA Modeling: Implementing real-time efficiency monitoring systems to continuously adjust sales strategies based on live data.

References

1. Panagopoulos, N., G., & Avlonitis, G., J. (2010). Performance implications of sales strategy: The moderating effects of leadership and environment. International Journal of Research in Marketing 27(1), 46-57.
2. Terho, H., & Eggert, A., & Hass, A., & Ulaga, W. (2015). How sales strategy translates into performance: The role of salesperson customer orientation and value-based selling. Industrial Marketing Management, 44(2).
3. Agnihotri, R., & Trainor, K., J., & Itani, O., S., & Rodriguez, M. (2017). Examining the role of sales-based CRM technology and social media use on port-sale service bahavios in India. Journal of Business Research, 81, 144-154.
4. Anderson, J., C., & Wynstra, F. (2010). Purchasing Higher Value, Higher-Price Offerings in Business Markets. Journal of Business-to-Business Marketing, 17(1), 29-61.
5. Rapp, A., & Bachrach, D., G., & Panagopoulos, N., G., & Ogilvie, J. (2014). Salespeople as knowledge brokers: A review and critique of the challenging sales model. Journal of Personal Selling & Sales Management, 34(4), 245-259.
6. Agnihotri, R. (2021). From sales force automation to digital transformation: how social media, social CRM, and artificial intelligence technologies are influencing the sales process. A Research Agenda for Sales, 21-47.
7. Karla, A., & Lee, N., Y., & Dugan, R. (2023). Exploring antecedents and outcomes of salesperson change agility: a social exchange theory perspective. The Journal of Marketing Theory and Practice, 23(5), 290-310.
8. Sorenson, M. (1997). Self-Referent Thoughts in Exercise: The Self-Perception in Exercise Questionnaire. European Journal of Psychological Assessment, 13(3), 195-205.
9. Farrell, M., J. (1957). Measurement of productive efficiency. Journal of the Royal Statistical Society: Series A (General), 120(3), 253-290.
10. Charnes, A., & Cooper, W., W., & Rhodes, E. (1978). Measuring the efficiency of decision-making units. European Journal of Operational Research, 2(6), 429-444.
11. Emrouznejad, A., & Yang, G., L. (2018). A survey and analysis of the first 40 years of scholarly literature in DEA: 1978-2016. Socio-Economic Planning Sciences, 61, 4-8.
12. Panwar, A., & Olfati, M., & Pant, M., & Snasel, V. (2022). A Review of the 40 Years of Existence of Data Envelopment Analysis Models: Historic Development and Current Trends. Archives of Computational Methods in Engineering, 29(1), 5397-5426.

[Downloaded from ijaor.ir on 2026-11-27]

[DOI: 10.71885/ijorlu-2025-3-694]

13. Banker, R., D., & Charnes, A., W., & Cooper, W., W. (1984). Some Models for Estimating Technical and Scale Efficiency in Data Envelopment Analysis. Management Science, 30(9), 1078-1092.
14. Esmaeili, F., S., S., & Rostamy-Malkhalifeh, M. (2017). Data Envelopment Analysis with Fixed Inputs, Undesirable Outputs and Negative Data. Data Envelopment Analysis and Decision Science, 2017(1), 1-6.

[Downloaded from ijaor.ir on 2026-11-27]

[DOI: 10.71885/ijorlu-2025-3-694]