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ISBN: 979-8-218-59250-9

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From Lead Response to Revenue Generation: Machine Learning Insights into Digital Sales Process Optimization using Decision Tree Regression, XG Boost Regression

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Published By
Sciforce Publications
April 20 , 2025

Sciforce Publications
www.sciforce.org

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Abstract: This study examines the impact of digital transformation on B2B sales processes through machine learning analysis of key performance indicators. The research uses decision tree regression and XGBoost regression algorithms to predict sales conversion rates based on marketing spend, customer engagement scores, lead response time, sales rep performance, and digital touchpoints. Data analysis of 100 observations reveals significant relationships between digital transformation variables and sales outcomes. Marketing spend shows a strong correlation with sales conversion rate (0.96), while digital touchpoints show a moderate influence (0.30). The machine learning models achieved exceptional performance, with XGBoost regression demonstrating superior generalization capabilities (R^2 = 0.96313 on test data) compared to decision tree regression (R^2 = 0.95862). While increased marketing investment is directly related to improved conversions, these findings highlight how difficult digital transformation is requiring integrated strategies that align operational capabilities with customer-centric digital initiatives. The study highlights the challenges that organizations face during digital transformation, including organizational resistance, cultural barriers, and the need for updated management practices. These findings provide valuable insights for businesses leading digital transformation, emphasizing the importance of balancing innovation with operational sustainability while leveraging artificial intelligence and automation to improve performance and customer engagement in dynamic market environments.

Key words: Digital Transformation, B2B Sales, Machine Learning, XG boost Regression, Sales Conversion Rate, Customer Engagement.

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INTRODUCTION

Digital transformation is reshaping the landscape of B2B sales processes, enabling businesses to adopt innovative technologies that enhance efficiency and customer engagement. This transformation involves not only the digitalization of traditional practices but also the integration of advanced tools like artificial intelligence and automation. As companies navigate this shift, they face challenges such as organizational resistance and the need for updated managerial practices. Understanding these dynamics is crucial for leveraging digital transformation to achieve sustained Stay ahead of competitors in the current dynamic market. [2] Digitalization is reshaping sales practices, influencing how organizations operate and interact with customers.

This transformation is driven by technological advancements that not only enhance the efficiency of sales processes but also redefine the role of salespeople. Understanding these changes is crucial for businesses to maintain a competitive advantage in a rapidly changing market.systematic literature review presented in this paper explores the triggers it's about digital transformation in sales and how it's impacting the sales function and environment in businesses. [3] The rise of new market entrants and changing customer expectations necessitate a proactive approach to digital service innovation, ensuring that organizations can meet the demands of both B2B and B2C markets.

As organizations navigate this complex landscape, they face challenges such as cultural resistance, leadership alignment, and the need for new skill sets. Successfully addressing these challenges is essential for leveraging digital technologies to improve customer experiences and operational efficiency. [4] The sales landscape in B2B sectors is changing dramatically as a result of changing consumer expectations and technological advances. This paper explores the complexities of this transformation, focusing on the interplay between human elements and digital tools. By examining various dimensions and factors influencing sales processes, it aims to provide A thorough understanding of how businesses can be successfully led this change and enhance their sales functions. [5]

By analyzing current trends, opportunities, and barriers in retail digital transformation, this paper provides useful insights for organizations to navigate the complex landscape of retail technology integration. [6] The paper highlights the importance of striking a balance between innovation and operational sustainability while taking into account the critical elements of data security, privacy, and performance optimization in a dynamic retail environment. [7] Digital business transformation is a challenging endeavor, especially for large organizations that have developed a diverse range of products and services over time, often rooted in a traditional, non-digital culture.

These offerings are typically managed within siloed departments, connected by complex and intricate processes, systems, procedures, and data – commonly referred to as a “spaghetti structure.” This complexity prevents employees from delivering consistent value and leads to a disjointed and frustrating experience for customers [8]. [9] In contrast, the external marketing manager adopts an external approach that focuses on consumer segmentation, market analysis, and positioning tactics to successfully communicate with target audiences and respond to market competition.

A comprehensive assessment of digital transformation should include both internal and external perspectives to better understand the organization's progress and ensure that internal strengths and external market positioning are strategically aligned in the rapidly evolving digital environment. Digital transformation systems are generating large amounts of data, creating fertile ground for innovation, especially through the use of AI. The big data that is being generated gives organizations access to valuable Data that can be used efficiently by AI algorithms. Artificial intelligence (AI)-powered systems can analyze this data to discover hidden patterns, gain deeper insights, and predict future trends. This ability to extract valuable information from vast amounts of information datasets empowers organizations to make informed decisions, streamline operations, and drive significant change [10].

The transformative impact within organizations and in the competitive environment is largely driven by the inherent nature of digital technologies. We are now approaching a critical turning point where the influence of these technologies is being felt more intensely, enabling previously unimaginable advances [11]. [12] Since The widespread use of the Internet in the early 2000s, the various opportunities provided by digital technology, and their effects on people, organizations, and society has steadily expanded. Over time, the nature of these technologies has also evolved. For example, in 2005, Gartner identified key strategic technologies such as instant messaging, the widespread use of wireless local area networks, and Internet Protocol telephony. [13]

Tata Steel's digital transformation efforts are led by its Marketing and Sales (M&S) division, aiming to leverage digital technologies to address challenges and better serve customer needs. A dedicated task force has been established under the leadership of The Head of Digital Projects serves as the division's representative for business specialties and new projects. This team collaborates closely with several key business units such as Industrial Products, Branded Products & Retail, and Automotive & Specialties, Projects & Exports. [14] We outline four central themes Provides a foundation for understanding digital technology business strategy and shaping future insights.

These themes include: (1) the breadth of digital business strategy, (2) its scale, (3) its velocity, and (4) the sources from which it creates and captures business value. After discussing each of these areas in detail, we explore the related success indicators and their potential impact on performance. In addition, we highlight how the articles in this special issue contribute to understanding digital strategies and point the way toward future research opportunities. [15] The body of academic and industrial research on digital transformation in SMEs is expanding, although it remains fragmented. Most existing work focuses on individual components including initiatives such as e-commerce adoption, social media campaigns, or region-specific case studies. [16]

As traditional models are replaced by digital technologies, organizations face a combination of significant opportunities and major challenges. Embracing digital transformation has become a strategic imperative, essential for survival and long-term success. [17] Entering the digital age brings profound changes throughout the organization, enabling new value creation. Digital transformation goes beyond simple digitization; it involves rethinking and redesigning processes to reshape the organization's business model and approach to value creation. By using digital technologies, organizations can improve their interactions with suppliers, customers, and competitors. These technologies can help the organization gain a competitive advantage by transforming it to better leverage existing strengths or develop new capabilities. [18] Given the vast potential offered by digital transformation strategies, this study will explore how digitalization is impacting changes in distribution channels and revenue models.

It will also explore the difficulties that organizations face when incorporating digital technologies into their business models. In addition, this study seeks to provide insightful information to organizations on the benefits of digitally transforming their business models. [19] The digital revolution of the insurance industry refers to a cultural, organizational and operational change driven by the strategic and progressive incorporating digital technology, practices and capabilities into every function at every level. As defined by Cap Gemini Consulting, it involves the use of digital tools to bring about significant improvements in organizational performance, efficiency and market competitiveness.

[20] From an academic perspective, digital transformation remains a fragmented field due to its broad and diverse scope, encompassing areas such as social, industrial, economic, and personal transformation. Recent research on digital business transformation has largely focused on examining its key drivers, associated challenges, and the reasons behind past implementation failures.

MATERIALS AND METHOD

Marketing Spend: Marketing spend refers to the total budget a company allocates to promotional activities aimed at attracting and retaining customers. This includes spending on digital advertising, content creation, social media campaigns, events, SEO, and more. It is a critical investment in building brand visibility and driving lead generation. Analyzing marketing spend helps companies assess the return on investment and determine the effectiveness of various marketing strategies.

Customer Engagement Score: Customer Engagement Score is a composite metric used to assess how actively and meaningfully customers interact with a brand. It is typically derived from data points such as website visits, app usage, email responses, social media engagement, and support queries. A higher score indicates a stronger relationship between the customer and the brand, which indicates greater loyalty and the potential for conversion. Businesses use this score to personalize personalized experiences and improve marketing efforts.

Lead Response Time: The average time it takes to complete a deal is called lead response time or marketing representative to follow up with a potential customer after the first point of contact. A shorter response time often leads to a higher probability of conversion, as speed demonstrates credibility and keeps prospects engaged. Measuring and improving lead response time is essential for companies aiming to increase their sales performance and gain a competitive advantage in fast-moving markets.

Sales Rep Performance: Sales rep performance refers to how effectively a sales rep converts leads into customers. It typically considers metrics such as the number of conversions, sales revenue generated, and time it takes to close a deal. A high-performing rep indicates that they are using their time and resources wisely to close deals. This metric is important for identifying high performers, improving sales strategies, and aligning team efforts with overall business goals.

Digital Touchpoints: Digital touchpoints refer to the various interactions a customer has with a brand through online platforms. These include website visits, mobile app usage, social media engagements, emails, and online ads. Each touchpoint contributes to shaping the customer’s perception and journey. An increased number of meaningful digital touchpoints often improves brand familiarity and trust, ultimately influencing purchase decisions and supporting a seamless, all-encompassing customer experience.

Sales Conversion Rate: The percentage of leads or prospects that convert into paying customers is called the sales conversion rate, and it is a key performance indicator. It shows how successful a company's sales are process, from initial contact to closing the deal. A high conversion rate indicates that the company is successfully identifying and nurturing qualified leads. This metric is essential for assessing campaign success, forecasting revenue, and making strategic improvements to marketing and sales activities.

Instructions for machine learning

Decision tree regression: Decision tree regression is a type of supervised machine learning approach for predicting continuous numerical outcomes. It works by dividing data into ever-smaller subsets using decision rules derived from input features. The tree is constructed by selecting a feature and a split point that minimizes a certain error amount, usually the mean square error (MSE). A feature threshold is used to make a selection at each internal node of the tree, and the process continues iteratively until a stopping criterion, such as maximum depth or minimum, is reached samples per node, is met. The final prediction is made at the leaf nodes, where the model outputs the average value of the target variable for the training samples in that region. Decision tree regressions are intuitive and easy to interpret, but can suffer from overfitting if the tree grows too deep. Regularization techniques such as pruning, depth control, or setting a minimum number of samples per leaf are often used to improve generalization performance. This method is most useful when the relationship between the features and the target variable is nonlinear and complex.

XG Boost Regression: A machine learning approach called XG Boost Regression uses gradient boosting to predict a sequence of variables. It creates a series of decision trees, each of which learns from previous mistakes.XGBoost is known for its high speed and accuracy, thanks to features such as regularization, parallel processing, and efficient handling of missing data. It is widely used for structured data tasks and often performs well in data science competitions.

RESULT AND DISCUSSION

The dataset provides a comprehensive look at how various factors impact sales conversion rates in a digital business environment. Variables such as marketing spend, customer engagement, lead response time, sales rep performance, and digital touchpoints are included. The data reveals that higher sales conversion rates are often associated with faster lead response times, more efficient sales reps, and increased digital engagement. However, some outliers show higher marketing spend and engagement without proportional changes, indicating declining revenue or inefficiency. This underscores the complexity of digital transformation – highlighting the need for integrated strategies that align operational capabilities, data usage, and customer-centric digital efforts to drive business growth.

TABLE 1. Descriptive Statistics

	Marketing Spend	Customer Engagement Score	Lead Response Time	Sales Rep Efficiency	Digital Touchpoints	Sales Conversion Rate
count	100.000	100.000	100.000	100.000	100.000	100.000
mean	21204.380	71.610	16.970	0.740	24.410	9.689
std	5073.865	18.253	9.570	0.164	8.850	2.092
min	12452.000	41.000	3.000	0.500	8.000	5.360
25%	17330.250	57.000	9.000	0.580	17.500	8.043
50%	20885.000	72.000	16.000	0.740	25.000	9.665
75%	26354.000	89.000	25.250	0.880	30.250	11.565
max	29013.000	99.000	34.000	1.000	39.000	13.280

Table 1 provides descriptive statistics for the six key variables used in the analysis. The average marketing spend is ₹21,204, with a standard deviation of ₹5,074, indicating moderate variation in investment levels. The customer engagement score has a mean of 71.6, indicating generally high engagement, although it varies considerably (std = 18.25). The lead response time averages 17 hours, with a wide range from 3 to 34 hours, indicating discrepancies in follow-up speed. Sales representative effectiveness is relatively high (mean = 0.74), ranging between 0.5 and 1.0. Digital touchpoints average 24.4, with values ranging from 8 to 39. Finally, the sales conversion rate has a mean of 9.69%, indicating a variation in performance across observations, ranging from 5.36% to 13.28%. Overall, the statistics ideally represent a diverse dataset for predictive modeling.

Effect of Process Parameters

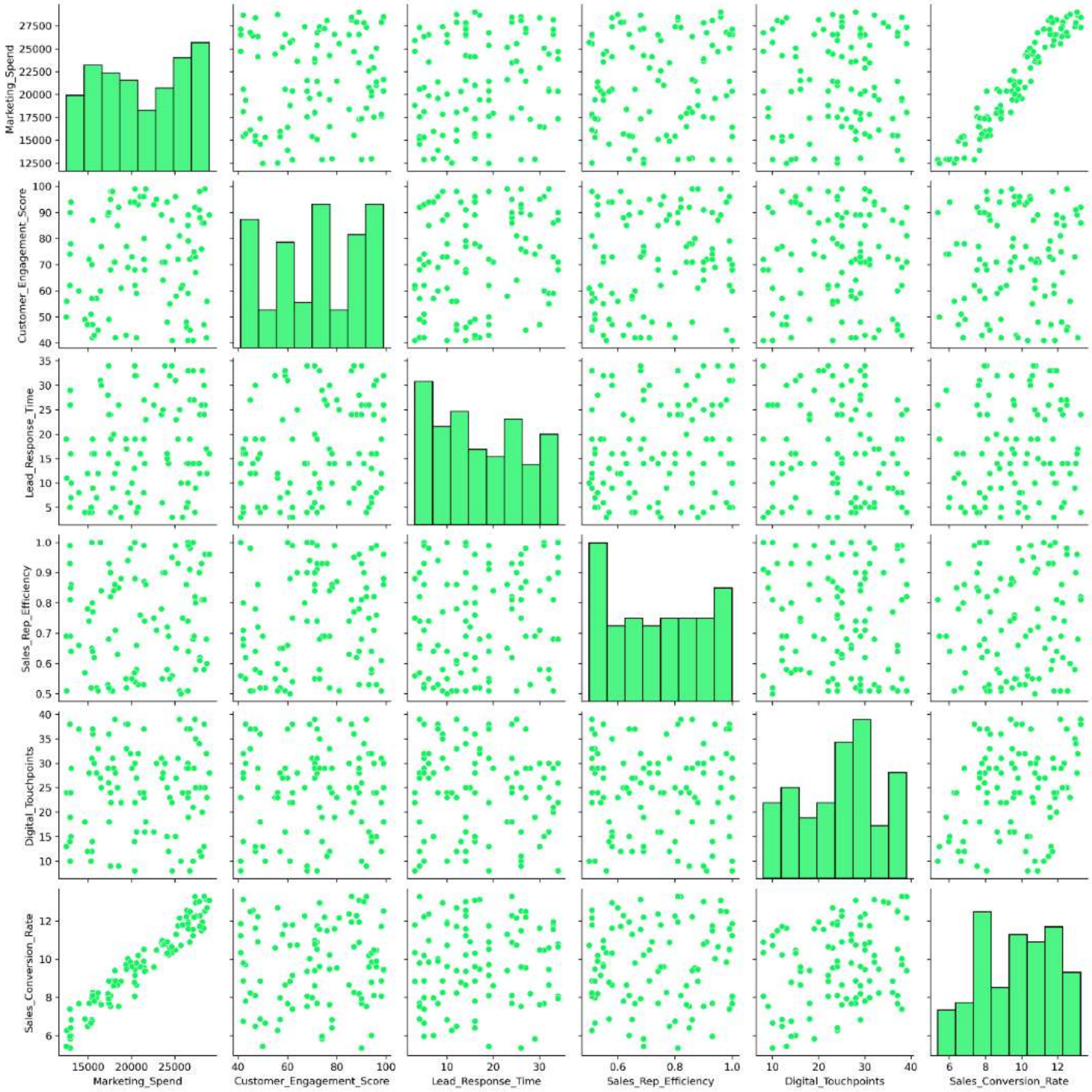

FIGURE 1. Scatter plot of the variousAI inNext Generation Sales Engine and Digital Transformation Initiatives

This pair of graphs illustrates the relationships between various sales and marketing variables. A strong positive linear relationship is evident between marketing spend and sales conversion rate, indicating that increased marketing investment directly increases conversions. However, other variables such as customer engagement score, lead response time, and sales rep skill do not show a clear linear pattern with conversion rate or with each other, indicating weak or no correlation. Most scatter plots are widely scattered, highlighting the complexity and nonlinearity of the relationships. This suggests that more advanced models, such as support vector regression, may be better suited to capturing hidden patterns beyond simple linear trends.

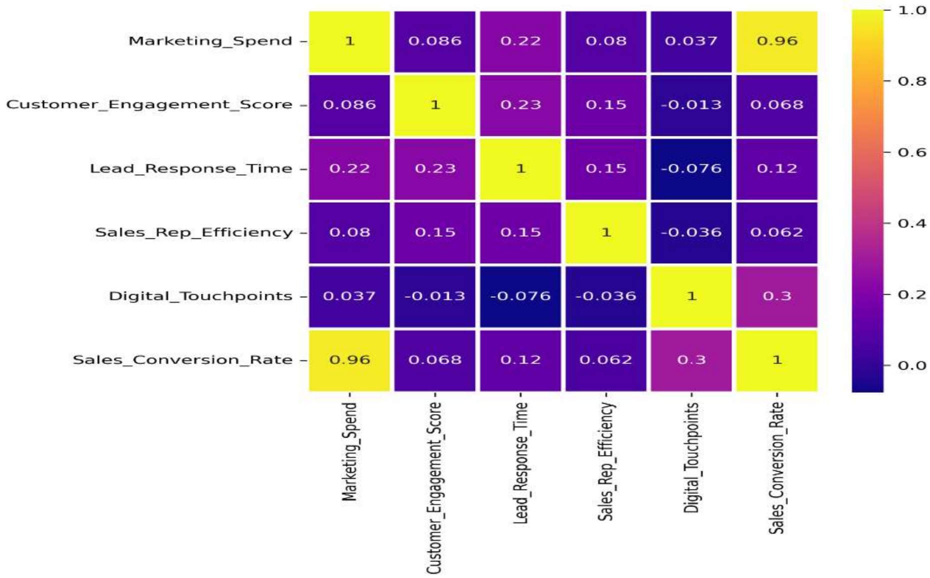

FIGURE 2. Heat map of the connection between process variables and outcome.

Figure 2 provides a correlation heat map that shows the strength of the linear relationships between the variables. The strong positive correlation between marketing spends and sales conversion rate (0.96) reinforces the conclusion that increased spending significantly improves conversions. Digital touchpoints also show a moderate correlation with sales conversion rate (0.30), indicating some influence. However, other variables such as customer engagement score, lead response time, and sales rep skill exhibit weak correlations with the target variable (all below 0.23), indicating minimal linear impact. These insights suggest that while some predictors are influential, others may require nonlinear modeling techniques such as SVR for deep pattern extraction.

Decision Tree Regression

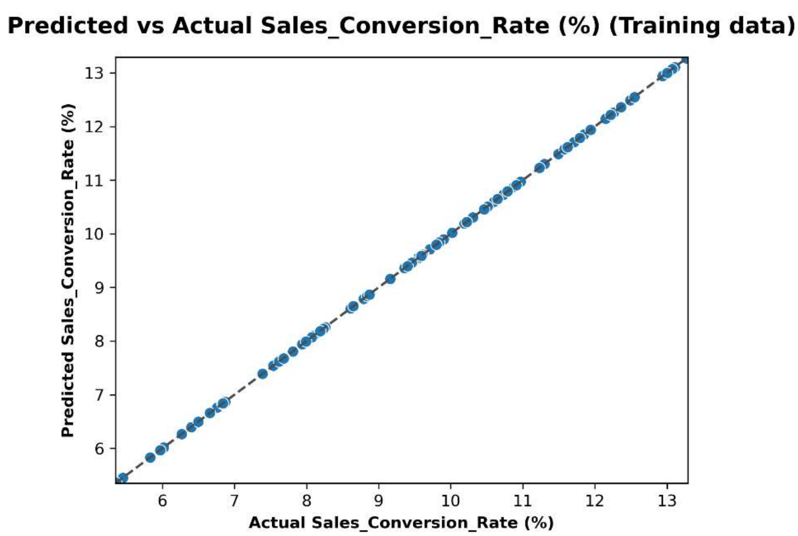

FIGURE 3. Decision Tree Regression on Sales_Conversion_Rate(Training data)

Figure 3 the scatter plot shows the predicted vs. actual Sales_Conversion_Rate (%) using Decision Tree Regression on training data. The points closely follow the diagonal line, indicating a near-perfect fit. This suggests that the model has accurately learned the training data, with minimal prediction error and high model performance.

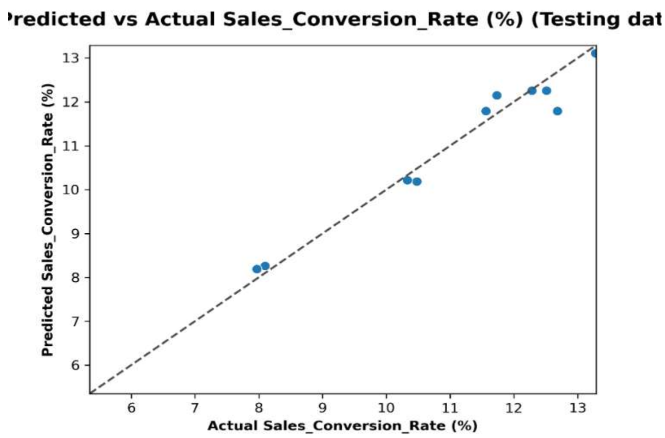

FIGURE 4. Decision Tree Regression on Sales_Conversion_Rate (Testing data)

Figure 4 presents a scatterplot of predicted vs. actual sales_conversion_rate (%) for the test data using decision tree regression. The points deviate more from the diagonal line compared to the training data, indicating reduced prediction accuracy. This indicates possible overfitting, where the model performs better on the training data but performs less effectively on the unseen data.

TABLE 2. Decision Tree Regression on Sales_Conversion_Rate (Training Data, Testing Data)

Data	R2	EVS	MSE	RMSE	MAE	MaxError	MSLE	MedAE
Train	1.00000	1.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
Test	0.95862	0.96020	0.12834	0.35825	0.27600	0.89000	0.00080	0.22500

Table 2 Performance metrics for decision tree regression on sales_change_rate show perfect prediction (R^2 = 1.0, all errors = 0) on the training data, indicating that the model has fully memorized the training set. On the test data, the R^2 score is 0.95862, indicating strong generalization, although the presence of non-zero error values such as RMSE (0.35825) and maximum error (0.89) indicates small prediction deviations. This gap between the training and test results reflects a slight overfitting, but the model maintains high accuracy on data that has not yet been observed.

XG Boost Regression

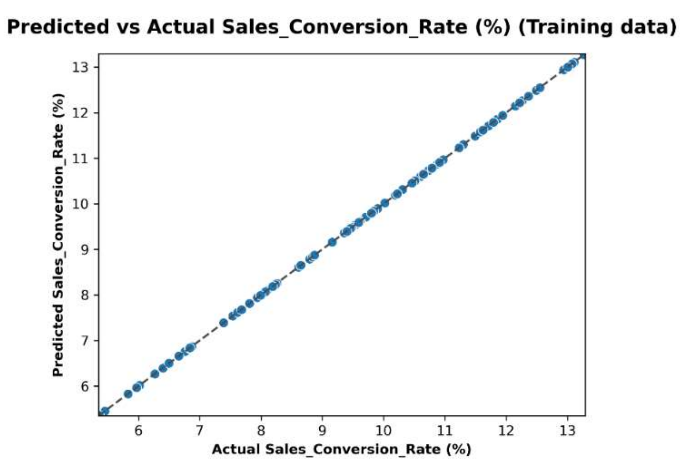

FIGURE 5. XG Boost Regression on Sales_Conversion_Rate (Training data)

Figure 5 shows a scatterplot of predicted vs. actual sales_conversion_rate (%) for the training data using XGBoost regression. The points lie exactly on the diagonal line, indicating a good model fit with a prediction error close to zero. This indicates that the XGBoost model has effectively captured the underlying patterns in the training data.

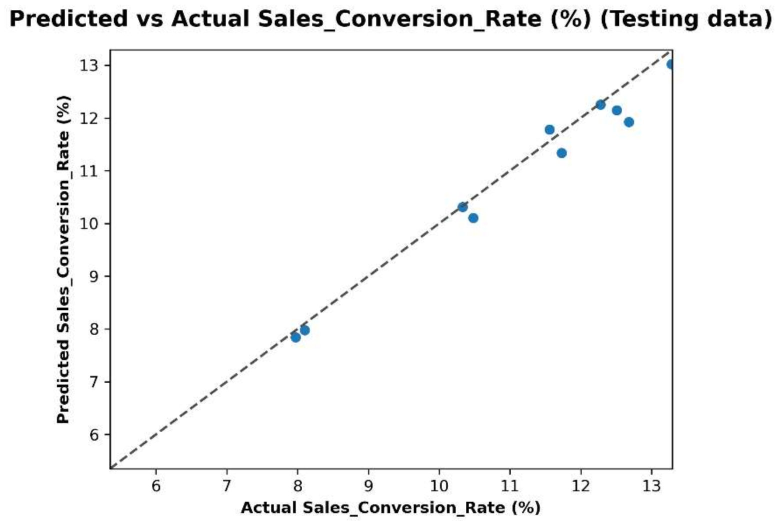

FIGURE 6. XG Boost Regression on Sales_Conversion_Rate (Testing data)

Figure 6 Scatter plot illustrating predicted vs. actual sales_conversion_rate (%) using XGBoost regression on the test data. Most of the points align closely to the diagonal, indicating high prediction accuracy. Despite small deviations, the model demonstrates strong generalization performance, effectively capturing the relationship between features and target values in the unobserved data.

TABLE 3.XG Boost Regression on Sales_Conversion_Rate (Training Data, Testing Data)

Data	R2	EVS	MSE	RMSE	MAE	MaxError	MSLE	MedAE
Train	1.00000	1.00000	0.00000	0.00091	0.00065	0.00331	0.00000	0.00042
Test	0.96313	0.97893	0.11434	0.33814	0.26539	0.75648	0.00071	0.23967

Table 3 Performance metrics for XGBoost regression on sales_conversion_rate reveal a nearly perfect fit on the training data (R^2 = 1.0, with almost zero errors), indicating excellent learning of the training set. On the test data, the model maintains strong performance (R^2 = 0.96313, RMSE = 0.33814), showing accurate generalization. The relatively low errors, including MAE (0.26539) and maximum error (0.75648), confirm the robustness of the model. Compared to the decision tree model, XGBoost shows slightly better generalization, balancing accuracy, and overfitting resistance more effectively.

CONCLUSION

This comprehensive study provides important new information about how digital technologies are changing B2B sales processes, demonstrating the critical role of machine learning in understanding and improving sales performance. The research reveals that digital transformation in sales it's more than just implementing new technology; it demands an all-encompassing strategy that integrates operational capabilities, data analytics, and customer-centric strategies to drive sustainable business growth.

A comparative analysis between decision tree regression and XGBoost regression algorithms demonstrates the superiority of ensemble methods in capturing complex, nonlinear relationships within sales data. XGBoost's improved generalization performance (R^2 = 0.96313) underscores its effectiveness in critical real-world applications. The strong correlation between marketing spends and sales conversion rates (0.96) confirms the importance of strategic investment in digital marketing efforts, while the modest influence of digital touchpoints (0.30) highlights the need for quality over quantity in customer interactions.The study identifies several critical success factors for digital transformation in sales: fast lead response times, effective sales rep performance, and meaningful digital engagement strategies. However, the presence of external factors in the data set, such as high marketing spends and engagement not translating into proportional returns, underscores the complexity of digital transformation and the potential for declining returns or operational inefficiencies.

Organizations embarking on digital transformation must address fundamental challenges, including cultural resistance, leadership alignment, and skill development needs. The research underscores that successful digital transformation involves organizational change management, data security considerations, and performance strategies beyond technology implementation. Future research should explore the integration of AI-powered predictive analytics with real-time customer behavior data to further improve sales forecast accuracy. Additionally, examining Long-term sustainability of digital transformation initiatives and their impacts customer lifetime value will provide valuable insights for strategic decision-making in an increasingly competitive digital marketplace.

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