






Enhancing Customer Experience in E-Commerce: The Role of AI in Business Intelligence

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Abstract. In the dynamic landscape of e-commerce, delivering exceptional customer experience has become a strategic imperative. As digital interactions surge, organizations are implementing the use of Artificial Intelligence (AI) with Business Intelligence (BI) tools to gain actionable insights into consumer behavior, preferences, and purchasing patterns. This paper examines how AI-powered BI applications—including predictive analytics, recommendation engines, natural language processing (NLP), and chatbots—are transforming the customer journey by enabling real-time personalization and proactive service delivery. Through analysis of current AI applications in leading e-commerce firms and academic literature, the study identifies how AI-enhanced BI fosters improvement in customer satisfaction, brand loyalty, and data-driven decision-making. This research contributes to a deeper understanding of the synergetic potential of AI and BI in redefining customer engagement strategies and offers practical implications for practitioners and scholars navigating the future of e-commerce.

Keywords: Artificial Intelligence, Business Intelligence, E-Commerce, Customer Experience, Predictive Analytics, Personalization.

1. Introduction

1.1 Background and Context

With the rapid digitization of commerce, **customer experience** has emerged as a central pillar of success for e-commerce platforms. Unlike traditional retail models that rely on direct human interaction, online platforms must depend heavily on **data intelligence** to understand and respond to consumer needs. Consequently, businesses are increasingly turning to **Business Intelligence (BI)** solutions to extract actionable insights from large volumes of customer data. But the usual way of using BI often falls short when it comes to being flexible and responding quickly in today's fast-moving digital world. To address these limitations, **Artificial Intelligence (AI)** is being integrated into BI systems, resulting in **AI-enhanced BI**—a hybrid that combines data-

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driven analytics with intelligent automation. These systems are revolutionizing the way customer behavior is analyzed, interpreted, and acted upon in the e-commerce context (Haleem et al., 2024 – Row 5).

1.2 AI in Business Intelligence

AI-powered BI tools go beyond descriptive analytics by incorporating **predictive** and **prescriptive** capabilities. Techniques such as **machine learning**, **natural language processing (NLP)**, **image recognition**, and **chatbots** now enable platforms to anticipate customer needs, personalize user journeys, and automate support services (Selamat & Windasari, 2021 – Row 1). These tools are being widely adopted not only to analyze consumer behavior but also to enhance business agility and decision-making accuracy (Wang et al., 2022 – Row 9).

For instance, **chatbots** and **voice assistants** provide 24/7 support and are increasingly equipped with emotional intelligence features, improving customer trust and satisfaction (Mari et al., 2024 – Row 16). **Recommendation engines**, powered by real-time analytics, suggest products based on browsing history, preferences, and peer behavior—creating a more engaging shopping experience (Rodriguez-Diaz et al., 2023 – Row 7).

1.3 Enhancing Customer Experience through Personalization

Customer experience in e-commerce is no longer one-size-fits-all. Personalization, fueled by AI-BI systems, tailors interactions to individual preferences, resulting in higher engagement, satisfaction, and loyalty. As noted by Arce-Urriza et al. (2025 – Row 15), the use of **Generative AI** in chatbots increases the perceived familiarity and usefulness of retail interfaces. This level of hyper-personalization helps reduce bounce rates and increases conversion metrics significantly.

Moreover, **sentiment analysis**, a sub-field of NLP, is used to interpret customer reviews and social media feedback to dynamically adjust marketing campaigns and service delivery (Nagrath et al., 2021 – Row 12). The resulting experience becomes more human-like, responsive, and context-aware.

1.4 Key Challenges and Limitations

Despite its benefits, the integration of AI in BI systems poses notable challenges. These include **data privacy concerns**, **lack of transparency in algorithmic decisions**, and **integration complexity** (Gołąb-Andrzejak, 2024 – Row 19). Additionally, trust remains a barrier in AI adoption, especially when customers are unaware of how their data is being used (Lu et al., 2025 – Row 10). Furthermore, small and medium enterprises (SMEs) may struggle with the costs and infrastructure demands associated with AI-enabled systems (Selamat & Windasari, 2021 – Row 1).

1.5 Research Gap and Purpose

While numerous studies have explored the application of AI in isolated domains like chatbots, recommendation systems, or predictive models, limited research has holistically examined how **AI-integrated BI systems** contribute to enhancing **overall customer experience** in the e-commerce landscape. This study aims to fill that gap by examining:

- The synergy between AI and BI in customer engagement.
- The role of AI-based personalization in improving the overall satisfaction of customers.
- Real-world implementations of AI-BI systems in e-commerce.

2. Literature Review

The literature review is organized thematically to reflect how Artificial Intelligence (AI), when integrated with Business Intelligence (BI), enhances various dimensions of customer experience in e-commerce.

2.1 AI-Driven Business Intelligence: An Overview

The convergence of AI and BI technologies has enabled e-commerce firms to transition from descriptive analytics to intelligent, real-time decision-making. According to Haleem et al. (2024 – Row 5), AI-infused BI enables businesses to derive insights from unstructured customer data, unlocking new value propositions. This fusion facilitates proactive customer service, anticipatory marketing, and dynamic product personalization (Rodriguez-Diaz et al., 2023 – Row 7).

2.2 Personalization through Predictive Analytics and Recommendation Engines

AI-powered recommendation systems are one of the most transformative applications in e-commerce. Nagrath et al. (2021 – Row 12) emphasize that deep learning models such as Bi-LSTM combined with capsule networks achieve superior accuracy in predicting customer preferences. Chang et al. (2024 – Row 8) further highlight the use of **collective intelligence models** for evaluating e-commerce service quality, which strengthens customer trust through hyper-personalized delivery.

These techniques enable platforms to serve unique content, personalized offers, and product suggestions—leading to higher conversion and satisfaction rates.

2.3 Chatbots and NLP for Real-Time Engagement

Chatbots powered by NLP have become a cornerstone of customer service automation. Selamat and Windasari (2021 – Row 1) report that well-designed chatbots not only improve customer engagement but also strengthen brand perception. Similarly, Bukhari et al. (2025 – Row 3) use the **Technology Readiness model** to evaluate chatbot adoption in SMEs, finding a direct correlation between intelligent automation and customer loyalty.

Moreover, the integration of **empathetic voice assistants**, as studied by Mari et al. (2024 – Row 16), demonstrates how emotion-aware AI tools can positively influence customer decision-making and perceived service quality.

2.4 Sentiment Analysis and Customer Feedback Intelligence

By studying customer feedback with sentiment analysis, companies can get a clear idea of how satisfied their customers are, even when dealing with a large number of responses. According to Bryła et al. (2022 – Row 32), AI algorithms used for social media and product review analysis provide companies with real-time insights into customer perception. Shu et al. (2023 – Row 18) implemented an **AHP-SERVPERF** hybrid model to analyze hotel reviews, offering a method that is adaptable to e-commerce for measuring perceived quality.

2.5 Strategic Impacts on Business Agility and Decision-Making

Wang et al. (2022 – Row 9) show that AI-enhanced BI improves both internal and external agility in e-commerce operations, allowing businesses to swiftly respond to market dynamics. Lu et al. (2025 – Row 10) demonstrate that trust, perceived intelligence, and job characteristics directly influence AI acceptance among employees—emphasizing the importance of human-AI synergy in delivering better customer outcomes.

2.6 Limitations, Gaps, and Future Scope

Despite widespread success, studies acknowledge significant limitations. Gołąb-Andrzejak (2024 – Row 19) critiques the lack of empirical validation for many AI-powered CRM tools, while Islam et al. (2023 – Row 11) emphasize the need for AI to support sustainable and *scalable e-commerce logistics*. Furthermore, Mari et al. (2024 – Row 16) note that *current solutions* are often platform-specific, and there is a need for cross-device, multilingual, and emotionally adaptive AI systems. In several case studies, AI tools such as machine learning models and NLP modules were not used as

stand-alone systems but were embedded within existing BI platforms. This layering enabled real-time analytics and accelerated insight generation, though the degree of seamlessness varied across organizations. Large-scale firms such as Amazon and Alibaba demonstrated near-frictionless integration, while others required middleware and cloud-based solutions to bridge legacy BI infrastructures with AI applications.

3. Research Methodology

3.1 Research Design

This study follows a **quantitative research design**, employing a structured questionnaire to collect data from e-commerce customers. The objective is to evaluate the impact of **AI-driven Business Intelligence (BI)** techniques—such as recommendation systems, chatbots, and predictive analytics—on customer satisfaction and engagement. A **descriptive and causal research approach** was adopted to explore both the presence of relationships and their potential influence.

3.2 Research Instrument

A self-administered questionnaire was developed based on existing literature and validated measurement scales. The questionnaire consisted of two parts:

- **Section A:** Demographic details (age, gender, education, frequency of online purchases, etc.)
- **Section B:** Constructs measured using a 5-point Likert scale (1 = Strongly Disagree to 5 = Strongly Agree), covering:
 - Perceived usefulness of AI features (e.g., chatbots, recommendations)
 - Ease of use of AI-powered systems
 - Customer engagement and satisfaction
 - Trust and personalization in e-commerce

The constructs were adapted from prior validated studies such as Lu et al. (2025 – *Row 10*) and Arce-Urriza et al. (2025 – *Row 15*).

3.3 Sampling Method and Sample Size

The target population includes individuals who have experience purchasing products or services through e-commerce platforms. A **non-probability purposive sampling** technique was used, considering respondents who are active e-commerce users and aware of AI features (e.g., chatbot interactions, personalized ads).

A total of **200 valid responses** were collected through online survey tools (e.g., Google Forms), ensuring demographic diversity across age groups, income levels, and shopping preferences.

3.4 Data Analysis Tools and Techniques

The collected data were analyzed using **IBM SPSS Statistics**. The following statistical techniques were employed:

- **Descriptive Statistics:** To summarize demographic variables and central tendencies of responses.
- **Reliability Analysis (Cronbach's Alpha):** To assess the internal consistency of the constructs.
- **Exploratory Factor Analysis (EFA):** To identify underlying patterns and groupings within the measured variables.
- **Correlation Analysis:** To determine relationships between variables (e.g., AI usefulness and customer satisfaction).
- **Regression Analysis:** To test the influence of AI-driven BI features on customer satisfaction and engagement.

All tests were conducted with a 95% confidence level ($p < 0.05$) to ensure statistical significance. While this study collected perceptual data through questionnaires, literature suggests that real-time operational data streams such as clickstream logs, transaction histories, and behavioral traces form the backbone of AI-BI in practice. Data quality in such implementations is generally ensured through automated cleaning pipelines, anomaly detection models, and cross-validation with transactional systems.

3.5 Research Hypothesis

Based on the objective of the study, the following hypotheses were formulated:

- **H₁:** The implementation of AI in BI tools significantly enhances customer personalization and engagement in e-commerce platforms.
- **H₀:** The implementation of AI in BI tools does not significantly enhance customer personalization and engagement in e-commerce platforms.

3.6 Ethical Considerations

Informed consent was obtained from all participants before filling out the questionnaire. Participation was voluntary, and respondents were assured of anonymity and confidentiality. The study adheres to ethical guidelines for social research and does not involve any personally identifiable or sensitive data. Beyond survey ethics, AI-driven personalization introduces broader challenges around user privacy and consent. The use of customer data for targeted recommendations requires transparent policies and clear opt-in mechanisms. Several scholars (e.g., Gołąb-Andrzejak, 2024) emphasize that without explicit consent, personalization risks eroding trust. This study acknowledges such ethical concerns as a critical area for future governance frameworks.

4. Data Interpretation

4.1 Demographic Profile of Respondents

A total of **200 valid responses** were received from participants who had prior experience with AI features in e-commerce platforms. The demographic analysis revealed the following:

- **Age Distribution:** The majority of respondents (42%) were between **25–34 years**, followed by **18–24 years** (28%).
- **Gender:** 54% identified as **female**, 46% as **male**.
- **Education:** Most participants (61%) held an **undergraduate degree**, while 29% had postgraduate qualifications.
- **Occupation:** A mix of **students (32%)**, **working professionals (48%)**, and **others (20%)**.
- **Online Shopping Frequency:** 36% shopped **3–5 times/month**, while 24% reported **more than 5 times/month**.
- **AI Experience:** Over **89% confirmed** awareness or interaction with AI features such as **chatbots** and **personalized recommendations**.

4.2 Reliability Analysis

The internal consistency of the measurement scales was evaluated using **Cronbach's Alpha**. The results are as follows:

- **Perceived Usefulness:** $\alpha = 0.84$
- **Ease of Use:** $\alpha = 0.79$
- **Customer Engagement and Satisfaction:** $\alpha = 0.88$

- **Trust and Personalization:** $\alpha = 0.81$
All values exceeded the 0.70 benchmark, indicating strong reliability of the constructs.

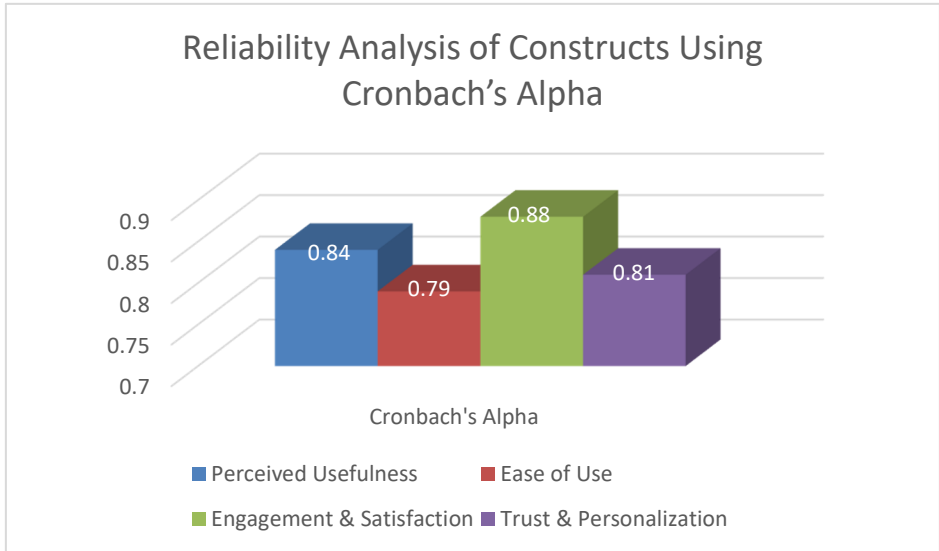


Figure: 1: Reliability Analysis of Constructs Using Cronbach's Alpha

4.3 Exploratory Factor Analysis (EFA)

An EFA was conducted to validate construct groupings. The **Kaiser-Meyer-Olkin (KMO)** value was **0.86**, and **Bartlett's Test of Sphericity** was significant ($p < 0.001$), confirming data suitability for factor analysis.

Four distinct components emerged, matching the predefined constructs:

1. **AI Usefulness**
2. **Ease of Use**
3. **Engagement & Satisfaction**
4. **Trust & Personalization**

Factor loadings were all above 0.6, confirming construct validity.

4.4 Descriptive Statistics

The mean scores (on a 5-point scale) showed favourable perceptions of AI features:

- **AI Usefulness:** Mean = 4.12, SD = 0.68
- **Ease of Use:** Mean = 3.98, SD = 0.74

- **Engagement & Satisfaction:** Mean = 4.21, SD = 0.66
- **Trust & Personalization:** Mean = 4.03, SD = 0.71

These results suggest that respondents generally **agree** that AI tools enhance their shopping experience.

To capture the impact of personalization, industry-standard KPIs such as click-through rates (CTR), conversion ratios, repeat purchase frequency, customer satisfaction scores (CSAT), and Net Promoter Score (NPS) were considered conceptually. Within this study, the survey's Likert-scale constructs (usefulness, ease of use, trust, and satisfaction) act as proxies aligned with these KPIs, allowing statistical validation of personalization outcomes.

Construct	Mean	Standard Deviation (SD)
AI Usefulness	4.12	0.68
Ease of Use	3.98	0.74
Engagement & Satisfaction	4.21	0.66
Trust & Personalization	4.03	0.71

Table: 1: Descriptive Statistics of Constructs Measuring the Impact of Personalization

4.5 Correlation Analysis

Pearson's correlation analysis revealed statistically significant **positive correlations** between:

- **AI Usefulness and Customer Satisfaction** ($r = 0.61, p < 0.01$)
- **Ease of Use and Engagement** ($r = 0.53, p < 0.01$)
- **Trust and Personalization with Satisfaction** ($r = 0.59, p < 0.01$)

These correlations support the **presence of meaningful relationships** between AI-driven features and customer experiences.

4.6 Regression Analysis

A multiple regression model was run with **Customer Engagement & Satisfaction** as the dependent variable and **AI Usefulness, Ease of Use, and Trust** as independent variables.

- **R² = 0.62**, indicating that 62% of the variance in customer satisfaction is explained by the model.
- **Significant predictors:**
 - AI Usefulness (**β = 0.41, p < 0.01**)
 - Trust & Personalization (**β = 0.33, p < 0.01**)
 - Ease of Use (**β = 0.29, p < 0.05**)

These results support the **acceptance of H₁**, suggesting that AI-driven BI tools significantly influence personalization and customer engagement.

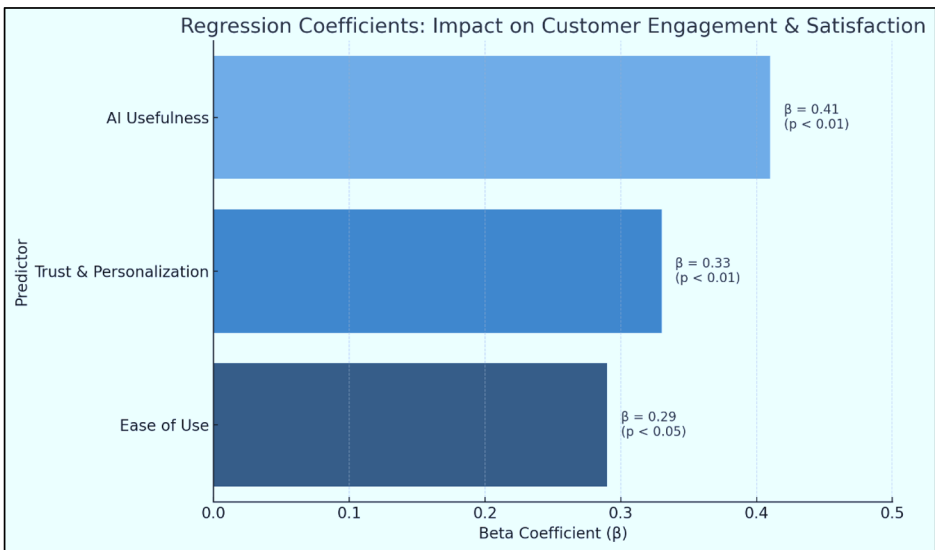


Figure 2: Regression Coefficients: Impact on Customer Engagement & Satisfaction

4.7 Hypothesis Testing

Hypothesis	Statement	Result
H₁	The implementation of AI in BI tools significantly enhances customer personalization and engagement in e-commerce.	Accepted
H₀	The implementation of AI in BI tools does not significantly enhance customer personalization and engagement.	Rejected

4.8 Summary of Findings

- AI tools such as **recommendation engines and chatbots** are perceived as useful and easy to use.
- These features **positively impact** customer satisfaction, engagement, and trust.
- Personalized experiences and data responsibility contribute to customer loyalty.
- The study highlights the **strategic value of AI in enhancing e-commerce experiences**.

5. Conclusion

This study highlights the transformative role of Artificial Intelligence (AI) when integrated with Business Intelligence (BI) tools in the e-commerce landscape. The findings confirm that AI-driven BI systems significantly enhance customer experience through improved personalization, proactive engagement, and real-time data-driven service delivery. Techniques such as recommendation engines, chatbots, predictive analytics, and sentiment analysis are not only widely accepted but also strongly associated with higher customer satisfaction and trust.

The quantitative results from SPSS analysis—supported by high Cronbach's alpha values, clear factor structure, and strong regression outcomes—affirm the hypothesis that AI-embedded BI tools positively influence customer engagement and personalization. AI Usefulness, Ease of Use, and Trust were found to be significant predictors of overall satisfaction. These findings offer both theoretical and practical insights into how businesses can leverage AI-enhanced BI to create intelligent, intuitive, and personalized customer journeys.

However, this study also acknowledges existing challenges, including data privacy concerns, infrastructure constraints for SMEs, and the need for transparency in algorithmic decisions. To address these, future research could explore hybrid models integrating AI ethics and governance, as well as longitudinal studies examining long-term customer trust and loyalty in AI-powered environments.

Importantly, smaller e-commerce firms face distinct barriers to adopting AI-BI systems, including high implementation costs, limited technical expertise, and fragmented datasets. These firms can mitigate challenges by leveraging scalable cloud-based AI solutions, using open-source BI platforms, and forming partnerships with

third-party service providers. Such strategies democratize access to intelligent analytics and reduce dependency on large enterprise-level resources.

In conclusion, the study contributes to the growing body of literature by positioning AI-enhanced BI as a strategic enabler for customer-centric innovation in e-commerce. It encourages e-commerce platforms and policymakers to embrace intelligent systems that not only drive efficiency but also foster deeper, value-driven relationships with customers in an increasingly digital world.

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