

AI technology in global cross-border e-commerce: applications and impacts

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Abstract: The global cross-border e-commerce landscape is undergoing a profound transformation, driven by the rapid integration of artificial intelligence (AI) technologies. This paper provides a comprehensive analysis of AI's multifaceted role in this dynamic sector. It systematically examines its principal applications across supply chain optimization, personalized marketing, customer service automation, and risk management. The study further evaluates the subsequent impacts on operational efficiency, consumer experience, and competitive dynamics, highlighting how AI serves as a critical enabler of scalability and internationalization for businesses of all sizes. Concurrently, the paper addresses the significant challenges and ethical considerations inherent in AI adoption, including data privacy, algorithmic bias, and regulatory compliance. Finally, the study explores emerging trends and offers strategic recommendations, positing that the strategic and ethical deployment of AI will be a paramount determinant of success in the future of global digital trade.

Keywords: artificial intelligence (AI); cross-border e-commerce; machine learning; supply chain optimization; personalized recommendation; natural language processing (NLP); predictive analytics; ethical AI

1 Introduction

The expansion of global cross-border e-commerce is a defining feature of contemporary international trade, facilitated by digitalization and evolving consumer demand for foreign goods. However, this domain is inherently complex, characterized by logistical challenges, cultural and linguistic barriers, regulatory heterogeneity, and intense competition. In this context, artificial intelligence (AI) has emerged not merely as an innovative tool but as a disruptive force fundamentally reshaping operational paradigms and strategic imperatives.

AI technologies, encompassing machine learning, natural language processing, and computer vision, offer unprecedented capabilities for processing vast datasets, predicting trends, and automating complex decision-making processes. Their application promises to mitigate the inherent frictions of cross-border trade, creating more efficient, responsive, and intelligent global supply chains. The research problem, therefore, centers on understanding the scope, mechanisms, and consequences of AI integration within this specific sector. This paper aims to synthesize a holistic view of AI's applications, quantify its multifaceted impacts, and critically examine the accompanying challenges. The methodology employed is a systematic literature review and theoretical analysis, drawing upon academic research, industry whitepapers, and case studies to construct a comprehensive framework.

2 Literature review

The theoretical foundation of this research is situated at the intersection of digital transformation in international

business and AI theory. Previous scholarship has extensively documented the impact of digital technologies on lowering market entry barriers and creating global value chains [1]. Simultaneously, the literature on AI in business elucidates its capacity for optimizing operations and personalizing customer interactions [2].

However, a distinct gap exists in the integrated analysis of AI's role specifically within the cross-border e-commerce context. While studies often focus on isolated applications—such as recommender systems or chatbots—few provide a systemic examination of how AI interconnects across the entire value chain [3], from procurement to post-purchase support, while also addressing the unique challenges of international trade. This paper seeks to fill this gap by presenting a unified and detailed analysis.

3 Key application areas of AI

3.1 Intelligent operations and supply chain optimization

AI algorithms are revolutionizing backend operations. Machine learning models analyze historical sales data, search trends, and macroeconomic indicators to generate highly accurate demand forecasts, enabling proactive inventory management across international warehouses and significantly reducing stockouts or overstock situations. In logistics, route optimization algorithms calculate the most efficient and cost-effective shipping paths, while AI-powered warehouse automation—through autonomous robots and computer vision—accelerates order processing and minimizes errors. Furthermore, dynamic pricing engines continuously adjust product prices in real-time based on competitor pricing, demand fluctuations, currency exchange rates, and local purchasing power, maximizing revenue and competitiveness in diverse markets.

3.2 Hyper-personalized marketing and customer engagement

The ability to deliver personalized experiences at scale is a cornerstone of AI's value proposition. AI-driven recommendation systems analyze individual user behavior, purchase history, and broader cohort data to suggest relevant products, dramatically increasing conversion rates and average order value. Beyond product recommendations, AI enables micro-segmentation of customer bases and the creation of highly targeted advertising campaigns. The emergence of AI-generated content (AIGC) tools further automates the creation of product descriptions, marketing copy, and visual assets tailored to different languages and cultural contexts, enhancing local relevance and engagement [4].

3.3 Enhanced customer service and experience

AI directly tackles the linguistic and scalability challenges of global customer support. NLP-powered chatbots and virtual assistants provide instant, 24/7 responses to customer inquiries in multiple languages, handling routine questions and order tracking, thus freeing human agents for complex issues. Real-time machine translation breaks down language barriers, making product listings and reviews accessible to a global audience. Additionally, sentiment analysis tools monitor customer feedback and social media conversations, providing valuable insights into brand perception and emerging issues across different regions.

3.4 Risk management and fraud prevention

The anonymous nature of online transactions heightens fraud risks. AI enhances security by deploying anomaly detection systems that analyze patterns in payment transactions to identify and flag fraudulent activities with high precision, reducing chargebacks and financial losses. These systems continuously learn from new data, adapting to evolving fraudulent tactics. AI also strengthens cybersecurity defenses by monitoring for data breaches and unauthorized access attempts, ensuring the protection of sensitive customer information in compliance with regulations like GDPR.

4 Multifaceted impacts of AI integration

4.1 Economic and operational impacts

The primary impact is a significant enhancement in operational efficiency. AI-driven automation reduces manual labor in customer service, data entry, and inventory management, leading to lower operational costs. Improved forecasting and logistics optimize capital allocation, reduce holding costs, and accelerate inventory turnover rates. The cumulative effect is a stronger return on investment (ROI) and improved profitability, even in the face of rising global competition.

4.2 Consumer and market impacts

For the consumer, AI creates a seamless and intuitive shopping experience. Personalized interactions foster a sense of being understood, leading to higher customer satisfaction, loyalty, and lifetime value. For the market, AI democratizes access to global trade; small and medium-sized businesses (SMBs) can leverage cloud-based AI tools to compete with larger corporations in areas like marketing, translation, and customer service, thereby fostering a more diverse and innovative ecosystem.

4.3 Organizational and strategic impacts

Organizations transition towards data-driven decision-making, where strategic choices are informed by AI-derived insights rather than intuition. This necessitates a workforce transformation, creating demand for new skills in data science, AI management, and digital marketing, while simultaneously shifting the role of human workers towards more strategic and creative tasks.

5 Challenges and ethical considerations

Despite its benefits, AI adoption presents considerable challenges. The vast data collection required raises serious data privacy and security concerns, requiring strict adherence to international regulations like GDPR and CCPA. Algorithmic bias is a critical risk; if trained on biased data, AI systems can perpetuate or even amplify discrimination in pricing, credit scoring, or ad targeting. The high initial investment and the scarcity of technical expertise can be prohibitive for some companies. Finally, navigating the patchwork of cross-border regulations concerning AI ethics, data sovereignty, and digital trade remains a complex and evolving hurdle.

6 Future trends and directions

The future will see the increased adoption of generative AI for creating hyper-realistic product visuals and personalized marketing content. The integration of AI with IoT and blockchain will create even more transparent and efficient supply chains, with sensors providing real-time data for AI to analyze. Predictive analytics will evolve into prescriptive analytics, not just forecasting outcomes but also recommending optimal actions. The ultimate horizon is the development of largely autonomous supply chains that self-optimize from manufacturer to end-consumer with minimal human intervention.

7 Conclusion and recommendations

This analysis confirms that AI is a transformative technology reshaping global cross-border e-commerce. Its applications enhance efficiency, personalize experiences, and manage risk, ultimately creating a more competitive and dynamic global marketplace. However, its benefits are not automatic and are contingent upon strategic and ethical implementation.

Recommendations for businesses: Companies should develop a clear AI strategy aligned with business goals, starting with pilot projects in high-impact areas like customer service or demand forecasting. Investing in data governance and ethical AI frameworks is essential to build trust and ensure compliance.

Recommendations for policymakers: There is a need to develop harmonized international regulations for data flows and AI ethics to reduce compliance complexity for businesses. Supporting initiatives for digital skills training and making AI tools accessible to SMBs will ensure inclusive growth [5].

This study is theoretical and would benefit from future empirical research quantifying AI's ROI in cross-border settings and deeper analysis of sector-specific applications.

Conflicts of interest

The author declares no conflicts of interest regarding the publication of this paper.

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