

Understanding BDA-AI Adoption in E-Commerce: An Integrated Framework of TOE and Technology Acceptance

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ABSTRACT

This study develops an integrated theoretical framework examining the adoption and acceptance of Big Data Analytics and Artificial Intelligence (BDA-AI) in e-commerce environments. By synthesizing the Technology-Organization-Environment (TOE) framework with the Technology Acceptance Model (TAM), this research examines how technological and environmental contexts influence the adoption of BDA-AI and subsequent user behavior. The framework proposes that contextual factors affect BDA-AI implementation, which in turn influences users' perceived ease of use and perceived usefulness. These perceptions, along with user satisfaction, ultimately determine the intention to continue using BDA-AI-enabled e-commerce platforms. Through a comprehensive literature review spanning 2014-2025, this study establishes theoretical foundations for understanding AI adoption patterns in digital commerce. The research contributes to existing literature by: (1) conceptualizing BDA-AI as a unified technological construct, examining the interplay between external contexts and user acceptance factors, (2) providing a validated research instrument for future empirical investigations. For practitioners, this study offers strategic insights into implementing AI solutions that enhance user experience while maintaining competitive advantage in digital marketplaces.

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1. INTRODUCTION

The integration of Big Data Analytics and Artificial Intelligence (BDA-AI) is revolutionizing electronic commerce ecosystems through enhanced customer experience optimization, operational efficiency improvements, and data-centric decision-making capabilities [1]. While Big Data encompasses the management and analysis of complex, high-volume datasets to extract valuable insights, Artificial Intelligence facilitates human-like cognitive processing for automated operations and predictive analytics [2, 3]. The synergistic combination of these technologies enables e-commerce entities to deliver sophisticated functionalities, including customized product recommendations, advanced fraud prevention mechanisms, dynamic pricing strategies, and elevated customer interaction frameworks [4]. In Taiwan's digital commerce landscape, the widespread adoption of AI technologies has positioned BDA-AI as a crucial determinant of market competitiveness [5]. The synthesis of AI-driven personalization with interactive user interfaces has demonstrated significant improvements in system usability and perceived benefits, fostering sustained platform engagement [6]. The ongoing evolution in BDA-AI convergence is catalyzing fundamental transformations in electronic commerce paradigms. Taiwan's digital marketplace exemplifies a distinctive implementation of BDA-AI, characterized by the sophisticated integration of Small and Medium Enterprise (SME) digital capabilities with culturally-informed technology adoption patterns. This market environment is distinguished by its innovative fusion of social and commercial platforms, establishing itself as a hub for AI development. This has led to the emergence of novel retail and educational implementation strategies that effectively harmonize BDA-AI technologies with local consumer preferences while maintaining global market competitiveness.

The research framework employs the Technology-Organization-Environment (TOE) paradigm to investigate the interplay between technological and environmental determinants in the context of AI implementation within electronic commerce platforms [7]. The Technological Context (TC) encompasses a comprehensive spectrum of advanced capabilities, including AI-enabled recommendation systems, cybersecurity infrastructure, and machine learning applications. Concurrently, the Environmental Context (EC) incorporates external market dynamics, competitive pressures, and regulatory frameworks [2]. These contextual dimensions function as integral determinants that collectively influence BDA-AI adoption patterns and catalyze the digital transformation trajectory within Taiwan's electronic commerce ecosystem. Hence, this study aims to establish and describe relationships between TOE and BDA-AI.

The research incorporates the Technology Acceptance Model (TAM) to examine the interconnected relationships between Perceived Ease of Use (PEOU) and Perceived Usefulness (PU) as antecedents to user Satisfaction (SAT) and Continuous Intention (CI) within AI-enabled platforms. The framework posits that platforms characterized by enhanced usability and demonstrable utilitarian value facilitate sustained user engagement,

which subsequently contributes to elevated levels of user retention and brand loyalty [8, 9]. This theoretical integration provides a structured approach to understanding the psychological mechanisms underlying user adoption and continued participation in AI-driven environments. Hence, this research explores the associations of PEOU and PU with SAT and CI.

The proposed integrated framework is anchored within the Stimulus-Organism-Response (S-O-R) paradigm [10], which provides theoretical coherence to the model structure. In this conceptualization, TOE factors (TC and EC) serve as environmental stimuli that trigger organizational adoption of BDA-AI. BDA-AI adoption and TAM constructs (PEOU, PU) function as organismic states representing cognitive and affective processing. Finally, user satisfaction and continuous intention represent behavioral responses to these internal states. This S-O-R alignment enhances the model's structural robustness and aligns with established scholarly conventions in technology acceptance and e-commerce research [2]. This investigation provides a research instrument and framework for future researchers by thoroughly examining the existing literature. It addresses several critical research gaps in the literature. First, it conceptualizes TC and EC as fundamental determinants of BDA-AI adoption. Second, it examines the causal linkages between BDA-AI implementation and the core TAM constructs of PE and PU. Third, it investigates the subsequent relationships between these TAM constructs and user SAT and CI. Through the systematic examination of these interconnected relationships, this research endeavors to contribute both theoretical advancement and practical implications for understanding AI-driven consumer behavior patterns. The comprehensive analysis of the interactions between BDA-AI implementation and user experience factors, coupled with technology acceptance determinants, provides essential insights for organizations seeking to enhance AI-enabled platforms and optimize customer retention strategies.

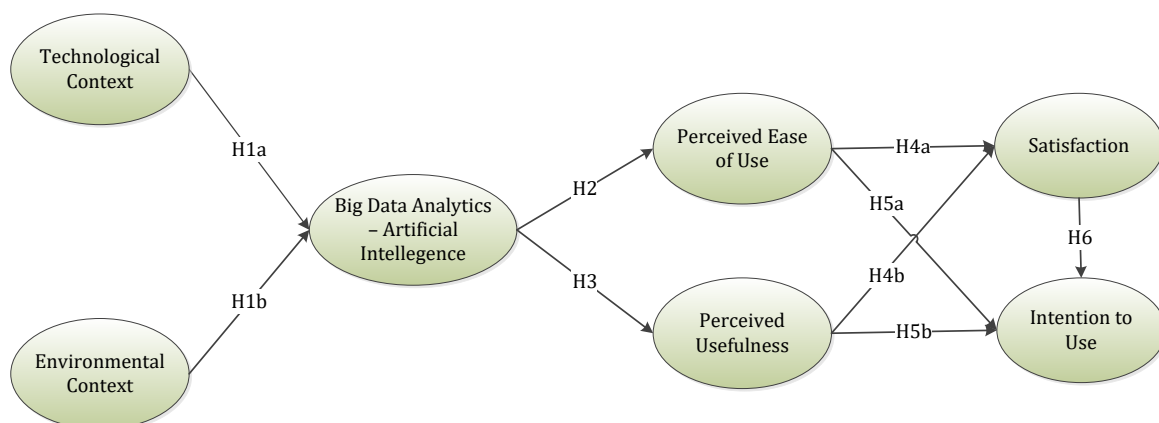


Figure 1. Theoretical Framework of the Research

2. THEORETICAL BACKGROUND AND HYPOTHESES DEVELOPMENT

2.1. TOE and BDA-AI

TC represents the technologies, including existing systems, infrastructure, and available innovations. Prior studies indicate that technological readiness has a significant influence on an organization's capacity to adopt advanced technologies. Drawing from IT adoption literature, technological infrastructure has been consistently identified as a critical enabler for advanced system implementations [11]. Furthermore, studies in digital transformation indicate that organizations with strong technological foundations demonstrate better capabilities in leveraging data-driven solutions [12]. The TC provides the necessary foundation for the adoption of new technologies, such as BDA-AI, including data processing capabilities, system compatibility, and technical expertise [13].

EC encompasses external pressures and industry conditions that influence technology adoption decisions, including competitive pressure, regulatory support, and market dynamics. Studies in digital transformation suggest that competitive intensity often drives organizations to adopt advanced technologies in order to maintain their market position [2]. Drawing from institutional theory, mimetic pressures in highly competitive environments lead firms to adopt similar technological innovations [5]. Research has shown that regulatory support and industry standards have a significant influence on the adoption of data-driven technologies [14]. Moreover, market demands for personalized services and improved customer experience create environmental pressures that drive organizations toward BDA-AI adoption [2]. As firms operate in increasingly dynamic environments, external pressures become crucial determinants of technological innovation adoption.

Hence, the following are hypothesized.

H1a: TC significantly impacts BDA-AI adoption.

H1b: EC significantly impacts BDA-AI adoption.

2.2. BDA-AI and TAM

The TAM posits that PU and PE are fundamental determinants of user acceptance of technology [15]. In the context of BDA-AI, these relationships merit particular attention. Studies have shown that AI-driven systems can enhance user experience through intelligent interfaces and automated processes [16]. When BDA-AI is effectively implemented, it can simplify complex tasks through automated data analysis and intelligent recommendations, potentially increasing users' PE. This is supported by research in AI-enabled services, which demonstrates that AI capabilities can reduce cognitive load and simplify user interactions [17]. Similarly, BDA-AI's ability to provide personalized recommendations, predictive insights, and data-driven decision support has been found to enhance users' PU [18]. The integration of BDA-AI can improve task performance and decision quality, directly influencing PU. Research in digital platforms has shown that AI-enhanced features

contribute to both operational efficiency and user-perceived benefits [19]. Hence, the following are proposed.

H2: BDA-AI adoption significantly impacts PE.

H3: BDA-AI adoption significantly impacts PU.

2.3. TAM and Satisfaction

PU and PE are considered crucial antecedents of user SAT in technological contexts [19]. Research in digital services has demonstrated that PU significantly influences user SAT by fulfilling utilitarian needs and performance expectations [20]. Similarly, PE of use contributes to SAT by reducing cognitive burden and user frustration. Studies have shown that when users find a system easy to navigate and operate, their satisfaction levels increase due to reduced learning curves and operational barriers [21]. In the context of BDA-AI in e-commerce technologies, the PE becomes particularly critical, as it determines the user's ability to leverage the system's benefits [19] effectively. The positive relationship between these perceptions and SAT is further supported by expectation-confirmation theory, suggesting that when user expectations of utility and usability are met, SAT naturally follows [22]. Hence, the following is proposed.

H4a: PU significantly impacts SAT.

H4b: PE significantly impacts SAT.

2.4. TAM and Intention to Use

PU directly affects continuous intention as users are more likely to persist with systems they find valuable for their tasks and objectives [19]. Research in digital technologies has demonstrated that when users recognize tangible benefits from system use, their CI in using the BDA-AI system [23]. Similarly, PE influences CI, reducing barriers to sustained usage. Studies in information systems have demonstrated that user-friendly interfaces and straightforward operational procedures foster long-term engagement with technology [17]. This relationship is particularly relevant in the context of BDA-AI, where system complexity could potentially deter the adoption of CI. Recent studies in AI-enabled services suggest that both PU (utilitarian benefits) and PE (reduced cognitive effort) significantly impact users' decisions to continue using advanced technological systems [24]. Hence, the following is proposed.

H5a: PE significantly impacts CI to use BDA-AI.

H5b: PU significantly impacts CI to use BDA-AI.

2.5. Satisfaction and Intention to Use

Prior research has consistently shown that the SAT serves as a crucial determinant of college readiness in technology-enabled platforms. Drawing on the expectation-

confirmation theory, the SAT represents users’ post-adoption evaluative judgments formed through actual system interaction experiences [25]. In the context of AI-driven platforms, SAT emerges as users’ cumulative assessment of system performance, features, and delivered value [19]. Studies in e-commerce contexts have established that satisfied users demonstrate a higher propensity for CI usage behavior [26]. Furthermore, empirical evidence suggests that SAT acts as a psychological mechanism that transforms positive user experiences into behavioral loyalty, particularly in digital service environments [27]. When users experience SAT with AI-enabled features and personalized services, they are more likely to develop sustained usage patterns and platform commitment [25]. Therefore, the following is hypothesized.

H6: SAT significantly impacts CI.

Table 1. presents the literature synthesis of this manuscript

Author & Year	Research Focus	Key Variables	Main Findings	Relevance to Current Study
TOE Framework & BDA-AI Adoption				
Chen et al. [2]	BDA-AI adoption antecedents	TC, EC, Operational Performance	TC and EC significantly influence BDA-AI adoption; competitive pressure drives implementation	Foundation for H1a, H1b; Source of TC, EC, BDA-AI measurement items
Nevi et al. [11]	AI adoption in SMEs	Technological readiness, AI adoption	Technological infrastructure critical enabler for AI adoption	Supports TC as antecedent to BDA-AI
Stjepić et al. [7]	Business intelligence adoption risks	Technology, Organization, Environment	TOE effectively explains BI adoption patterns in small businesses	Validates TOE application in technology adoption
BDA-AI Integration & Impact				
Lutfi et al. [1]	Big data analytics in retail	BDA drivers, retail performance	BDA enhances customer experience and operational efficiency	Establishes BDA importance in commerce
Chen et al. [4]	BDA-AI and corporate image	BDA-AI, corporate image, green communication	BDA-AI enables sophisticated functionalities and competitive advantage	Demonstrates BDA-AI strategic value
Chen et al. [5]	BDA-AI impact on innovation	BDA-AI, environmental performance	BDA-AI critical for market competitiveness in Taiwan	Context-specific validation; Supports institutional theory application
BDA-AI Influence on TAM Constructs				
Park & Kim [16]	AI chatbot acceptance	Motivation, PU, PEOU	AI systems enhance user experience through intelligent interfaces	Supports H2 (BDA-AI→PE)

Author & Year	Research Focus	Key Variables	Main Findings	Relevance to Current Study
Yao & Wang [17]	AI in education	Digital literacy, self-efficacy, PEOU, PU	AI capabilities reduce cognitive load and simplify interactions	Supports H2 (BDA-AI→PE)
Talha et al. [18]	AI tools in teaching	PEOU, PU, Adoption	AI integration improves task performance and decision quality	Supports H3 (BDA-AI→PU)
TAM Constructs and Satisfaction				
Lu et al. [20]	Mobile learning apps	PEOU, PU, Flow, Satisfaction	PU fulfills utilitarian needs; PE reduces cognitive burden	Supports H4a, H4b
Amin et al. [22]	Mobile website satisfaction	PU, PEOU, Trust, Satisfaction	When expectations of utility and usability are met, satisfaction follows	Supports expectation-confirmation theory application
TAM and Continuance Intention				
Yan et al. [23]	E-learning continuance	PEOU, PU, Continuous intention	Users recognize tangible benefits leading to continuous intention	Supports H5a, H5b
Basuki et al. [24]	Online platform usage	PEOU, PU, Enjoyment, Behavioral intention	Both PU and PE significantly impact sustained usage decisions	Supports H5a, H5b
Satisfaction and Continuance Intention				
Zhao & Khan [9]	Online platform continuance	Flow, Satisfaction, Continuous intention	Satisfaction determines intention to continue platform usage	Source of SAT and CI measurement items; Supports H6
Goel et al. [27]	E-shopping continuance	Impulse buying, SAT, Continuance intention	Satisfaction transforms positive experiences into behavioral loyalty	Supports H6 psychological mechanism

3. RESEARCH METHOD

The research methodology employed a systematic literature review adhering to the PRISMA guidelines to construct a holistic conceptual framework that synthesizes BDA-AI with the TAM in electronic commerce environments. The scholarly investigation encompassed academic literature published between 2014 and 2025, utilizing comprehensive database searches across Web of Science, Scopus, and IEEE Xplore repositories. Through the application of rigorous inclusion criteria—encompassing peer-reviewed status, English language medium, empirical research design, and full-text accessibility—the initial collection of 351 publications was methodically refined to 178

foundational works. These selected publications underwent a systematic thematic analysis and coding procedure to extract and consolidate theoretical contributions, thereby establishing the empirical foundation for the proposed theoretical relationships.

This methodological approach culminated in the development of a testable framework amenable to future empirical validation through both quantitative and qualitative research paradigms

This study proposes a research instrument for future researchers to use in conducting empirical studies. The research instrument follows a seven-point Likert scale. The TC, EC, and BDA-AI's research items were adapted from Chen et al.'s [2] study. Furthermore, PE and PU were proposed to be measured by the items suggested by [28]. Lastly, SAT and CI items were proposed and modified from Zhao and Khan's [9] study. The proposed research instrument is provided in the appendix of this research. Figure 2 indicates the PRISMA flowchart for this study.

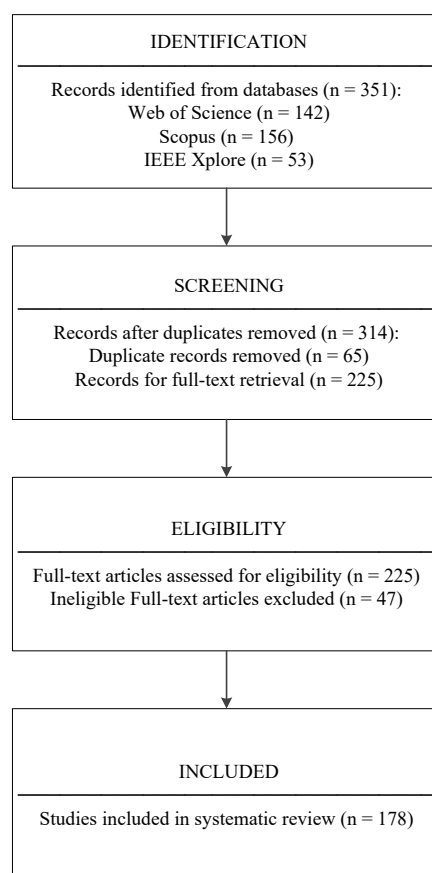


Figure 2. PRISMA flowchart

4. RESULT AND DISCUSSIONS

4.1. Theoretical Implications

This study offers several significant theoretical contributions to the literature. First, regarding BDA-AI, this research extends the theoretical understanding of this integrated technological paradigm in e-commerce contexts. While previous research has treated BDA and AI as separate technological entities, the present study theoretically conceptualizes BDA-AI as a unified technological construct [5]. Second, this research enriches the TOE framework by specifically examining the TC and EC in the adoption of BDA-AI on e-commerce platforms. This theoretical extension is particularly significant, as it refines the applicability of the TOE framework in the context of advanced AI technologies [11]. Third, this study makes a substantial contribution to the TAM by examining how BDA-AI adoption influences core TAM constructs. While Davis's [15] original TAM focused on general technology acceptance, the present research extends its theoretical boundaries by demonstrating how advanced AI capabilities influence PE and PU [29]. The findings suggest that the theoretical relationships in TAM need to be reconceptualized when applied to AI-driven technologies, as the complexity and sophistication of these systems create unique patterns of user perception and acceptance. Fourth, this research contributes to the theoretical understanding of user behavior by incorporating SAT and CI constructs from the Theory of Planned Behavior (TPB) [30]. While previous studies have examined these constructs in traditional e-commerce settings, this study demonstrates their unique role in BDA-AI contexts.

These theoretical contributions collectively advance the understanding of technology adoption and user behavior in the context of advanced AI systems. By integrating multiple theoretical frameworks (TOE, TAM, and TPB constructs) and demonstrating their interrelationships in the BDA-AI context, this study provides a more comprehensive theoretical foundation for understanding the adoption and acceptance of advanced AI technologies in e-commerce environments.

4.2. Practical Implications

This research offers several valuable practical implications for managers, practitioners, and policymakers in the e-commerce sector. First, for business managers and e-commerce platform operators, the findings highlight the critical role of integrating BDA-AI capabilities in ways that enhance both PE and PU. Managers should focus on implementing AI-driven features that simplify user interactions while delivering tangible benefits. For instance, AI-powered recommendation engines should be designed to provide not only accurate suggestions but also intuitive user interfaces that minimize cognitive load.

Second, practitioners in the e-commerce industry can benefit from understanding how TC and EC influence the adoption of BDA-AI. The findings suggest that organizations

should conduct thorough assessments of their technological infrastructure before implementing AI solutions. This includes evaluating existing data analytics capabilities, cybersecurity measures, and technical expertise. Furthermore, practitioners should actively monitor the competitive landscape and regulatory environment to ensure their BDA-AI implementations remain both compliant and competitive.

Third, for policymakers and regulatory bodies, this research underscores the importance of creating a supportive EC for BDA-AI adoption. This suggests the need for balanced regulatory frameworks that promote innovation while ensuring data privacy and security. Policymakers should consider developing guidelines that facilitate the responsible adoption of AI in e-commerce, potentially including incentives for businesses that implement AI solutions that enhance the customer experience while upholding ethical standards. Additionally, policies supporting digital literacy and AI education could help bridge the technological adoption gap among different user segments.

4.3. Research Limitations and Future Research Directions

This study, while offering valuable insights into BDA-AI adoption in e-commerce, has several limitations that suggest directions for future research. First, the conceptual framework primarily focuses on TC and EC while excluding organizational context from the TOE framework. Future studies should incorporate organizational factors such as firm size, organizational structure, and corporate culture to provide a more comprehensive understanding of BDA-AI adoption dynamics

Second, this study provides a research framework and a research instrument but lacks empirical data and analysis. Future researchers are encouraged to collect data and conduct an empirical analysis to gain further valuable insights.

Third, the current framework does not account for potential adverse effects of BDA-AI implementation, such as privacy concerns, algorithmic bias, or user resistance. Future studies should investigate these potential drawbacks and their impact on user acceptance and continuous intention, possibly incorporating privacy calculus theory or resistance models into the theoretical framework.

5. CONCLUSION

This study advances the understanding of BDA-AI adoption in e-commerce by developing a comprehensive theoretical framework that uniquely integrates TC and EC with user acceptance factors. By establishing clear relationships between contextual factors, BDA-AI adoption, and user behavioral intentions, the framework provides a structured approach to understanding how external factors influence TAM, affecting SAT and CI. The research makes a distinct contribution by demonstrating the mediating role of BDA-AI between contextual factors and user perceptions, addressing a significant gap in existing

literature. Furthermore, this study provides a validated research instrument, developed through carefully constructed constructs and measurement items, enabling future researchers to conduct empirical investigations in various e-commerce contexts. The proposed questionnaire items, grounded in established theoretical foundations and adapted for the BDA-AI context, offer a reliable tool for quantitative research. This methodological contribution, combined with the theoretical framework, equips researchers and practitioners with both the conceptual understanding and practical tools necessary for investigating AI adoption patterns in digital commerce environments.

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