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AI Capabilities and Digital Transformation: The Moderating Role of Sustainable Innovation in Shaping Perceived Competitive Advantage

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Abstract

The growth of e-commerce has intensified competition, necessitating the need for companies to build competitive advantage through the integration of digital capabilities and sustainable business practices. This study analyzes the influence of AI Capability and Digital Transformation on Perceived Competitive Advantage and examines the moderating role of Sustainable Innovation. The study employed a quantitative approach with a survey of 160 Generation Z Shopee and TikTok Shop users in Maluku Province, Indonesia. Data were analyzed using Partial Least Squares Structural Equation Modeling (PLS-SEM). The results show that AI Capability and Digital Transformation have a positive and significant effect on Perceived Competitive Advantage, with Digital Transformation having a stronger effect. Furthermore, Sustainable Innovation significantly strengthens the influence of both AI Capability and Digital Transformation on Perceived Competitive Advantage, indicating that a Sustainable Innovation orientation enhances the effectiveness of digital capabilities in creating value for customers. These findings indicate that competitive advantage in e-commerce depends not only on technology adoption but also on an organization's ability to integrate sustainability principles into its innovation strategy. This research enriches the marketing and digital transformation literature through the integration of Resource-Based View, Dynamic Capability Theory, and Stakeholder Theory, while providing practical implications for e-commerce platforms in designing customer-oriented digital strategies that are in line with the expectations of Generation Z consumers.

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INTRODUCTION

The advancement of Artificial Intelligence (AI) and digital transformation have fundamentally changed the business competitive landscape. Organizations across various sectors continue to increase investments in AI, data analytics, and cloud computing. Computing the Internet of Things (IoT) and various other digital technologies are being used to improve operational efficiency, accelerate innovation, and enhance the customer experience. However, this increased investment has not consistently resulted in sustainable competitive advantage. Many organizations have successfully adopted digital technologies but have not been able to translate these investments into tangible customer value or differentiation that is difficult for competitors to replicate. This phenomenon suggests that technology ownership is no longer the primary differentiator in competition, but rather the organization's ability to transform digital capabilities into a source of sustainable value creation (Andreassen, 2024; Pulido, 2023; Tabelessy, 2024).

This paradox becomes even more relevant in the industry 5.0 era, when an organization's success is no longer measured solely by its level of digitalization, but by its ability to integrate technology with human creativity to create customer-oriented and sustainable solutions. This paradigm shift raises questions that increasingly important question in the literature is why organizations with relatively similar levels of digital technology adoption demonstrate different capabilities in building competitive advantage. This difference suggests that technology investments do not automatically generate strategically valuable competitive advantages (Limba, 2026). Therefore, the primary research question is no longer whether organizations have undergone digital transformation, but rather how digital capabilities can translate into customer-perceived competitive advantage.

While previous research has widely demonstrated that digital transformation and AI contribute to organizational efficiency, innovation, and performance, empirical evidence regarding their impact on competitive advantage remains mixed. While some studies report that digital investments enhance differentiation and customer value, these benefits are strongly influenced by organizational characteristics, digital maturity, and the effectiveness of technology implementation. This inconsistency suggests that the current literature focuses more on explaining the impact of technology on organizational performance than on the causal mechanisms that explain how organizations with relatively similar levels of digital capabilities can generate different levels of competitive advantage (Kang, 2025; Li et al., 2025; Ojong, 2025).

The results indicate the need for a deeper understanding of the mechanisms between digital capabilities, technology implementation, organizational context, and competitive differentiation, including factors such as customer value, transactional costs, and benefit/cost distribution across different industry and regional contexts (Li et al., 2025; Ojong, 2025).

According to data from the Central Statistics Agency (BPS), e-commerce penetration in Eastern Indonesia has increased significantly in recent years. Along with this growth, Shopee has become one of the most dominant and widely used e-commerce platforms in Eastern Indonesia. Besides Shopee, GoodStats data shows that there are five e-commerce platforms with the highest usage rates in Indonesia, with Shopee and TikTok Shop being the two most frequently used by consumers.

The majority of users of both platforms are Generation Z (Gen Z), known as a generation with a high digital technology adoption rate and greater use of digital media and online shopping platforms than other generational groups. This situation is also relevant to the context of Ambon City as one of the main cities in Eastern Indonesia, where Generation Z is an increasingly active consumer group. Utilize e-commerce platforms to meet their daily needs. Generation Z's familiarity with digital technology, social media, and online shopping makes this group an ideal research target for understanding purchasing behavior on e-commerce platforms, particularly Shopee and TikTok Shop.

This study synthesizes a conceptual framework on how Perceived Competitive Advantage is formed in the TikTok Shop environment, emphasizing the role of AI capabilities as a strategic capacity, digital transformation, and Sustainable Innovation. The customer perspective is used as the focus to measure perceived value as a representation of the evaluation of the value created by the organization, while considering that the relationship between AI capabilities and competitive advantage is not automatic and is mediated by the orientation of Sustainable Innovation and the regional context of e-commerce platforms in developing countries. Related literature is stated to be relevant to understanding the mechanisms and empirical limitations in the context of digital platforms, especially in regions with limited access to information such as eastern Indonesia. This study emphasizes the need for a model that explains the mechanisms (how) and conditions (when) the formation of Perceived Competitive Advantage through the organization and its customers, and examines the moderation of Sustainable Innovation on the impact of AI and digital transformation on customer value (Kang, 2025; Ojong, 2025).

Based on these conditions, this study argues that the formation of competitive advantage is not only determined by the level of technology adoption, but also by the organization's ability to develop Artificial

Intelligence capabilities as a strategic capability to transform digital investments into business value. The success of this process further needs to be understood from the customer's perspective. From this perspective, competitive advantage in the digital environment is ultimately reflected in how customers perceive the company's superiority over its competitors. Therefore, this study uses Perceived Competitive Advantage as an outcome that represents customer evaluation of the value created by the organization. Furthermore, this study also argues that this relationship does not occur automatically, but is influenced by the organization's ability to integrate sustainability orientation Innovation (Kang, 2025; Ojong, 2025).

In this study, Sustainable Innovation is positioned as a boundary condition explaining when AI Capability and Digital Transformation are capable of generating a stronger Perceived Competitive Advantage. Although research on these two capabilities continues to grow, several gaps remain. First, the relationship between AI Capability and competitive advantage shows inconsistent empirical results. Second, most studies still measure success from an organizational perspective, thus not fully explaining customer perceptions of competitive advantage. Third, previous research has focused more on the direct relationship between variables, while the role of conditions that strengthen the effectiveness of digital capabilities has received relatively little attention. Furthermore, empirical evidence from e-commerce platforms in developing countries, particularly eastern Indonesia, is still limited. These gaps highlight the need for a model that can explain both the mechanisms and conditions that influence the formation of Perceived Competitive Advantage (Kang, 2025; Mikalef et al., 2023; Ojong, 2025).

Based on this gap, this study develops a conceptual model that integrates Artificial Intelligence Capabilities, Digital Transformation, Sustainable Innovation, and Perceived Competitive Advantage into a single analytical framework. This model provides a more comprehensive perspective on how digital capabilities translate into perceived competitive advantage and explains the role of Sustainable Innovation as a strengthening condition for this relationship. In addition to expanding the development of the Resource-Based View, Dynamic Capabilities Theory, and Stakeholder Theory, this study also enriches the empirical evidence regarding the implementation of AI and digital transformation in the context of e-commerce platforms in Maluku Province, which until now has been relatively underrepresented in the literature.

This study contributes to the marketing and digital transformation literature by extending the integration of the Resource-Based View, Dynamic Capabilities Theory, and Stakeholder Theory, highlighting Sustainable Innovation as a critical boundary condition that strengthens the impact of digital capabilities on perceived competitive advantage (Kang, 2025; Ojong, 2025).

First, this study provides empirical evidence that Digital Transformation has a stronger influence than Artificial Intelligence Capability in shaping Perceived Competitive Advantage on e-commerce platforms.

These findings suggest that for Generation Z users, easy, fast, integrated, and responsive digital experiences play a more dominant role in building perceived competitive advantage than the isolated use of AI technology. These findings extend previous research, which generally positions AI as the primary driver of competitive advantage, by demonstrating that comprehensive digital transformation is a stronger determinant in the e-commerce context (Andreassen, 2024; Huseynli, 2022a; Verhoef et al., 2021).

Second, this study contributes by positioning Sustainable Innovation as a boundary condition that strengthens the relationship between Artificial Intelligence Capabilities, Digital Transformation, and Perceived Competitive Advantage. Unlike most previous studies that position Sustainable Innovation as an independent variable or as a consequence of digital transformation, this study proposes and empirically proves the moderating role of Sustainable Innovation. These findings indicate that sustainability-oriented innovation can increase the effectiveness of digital capabilities in creating superior customer value and sustainable competitive differentiation (El-Haddadeh, 2020; George & Schillebeeckx, 2022; Ojong, 2025; Pulido, 2023).

Third, this study provides empirical contributions by presenting evidence from the context of Generation Z e-commerce users in Maluku Province, Eastern Indonesia. Most research on Artificial Intelligence Capabilities and Digital Transformation is still dominated by the context of developed countries or metropolitan areas, while empirical evidence from developing regions, particularly Eastern Indonesia, is still very limited. By using a customer perspective through the construct of Perceived Competitive Advantage, this study extends the generalizability of the digital marketing and strategic management literature while providing practical implications on how e-commerce platforms can integrate Artificial Intelligence Capabilities, Digital Transformation, and Sustainable Innovation to strengthen their competitive position among Generation Z consumers (Andreassen, 2024; Kang, 2025; Ojong, 2025; Payne et al., 2020).

Based on these arguments, this study aims to analyze the influence of AI Capability and Digital Transformation on Perceived Competitive Advantage, and examine the role of Sustainable Innovation in strengthening this relationship. The research findings are expected to enrich theories on digital capabilities and competitive advantage, while also providing a basis for organizations in designing digital transformation strategies that focus not only on technology adoption but also on customer value creation and sustainability.

The development of Artificial Intelligence (AI) and Digital Transformation has transformed the way organizations build and maintain competitive advantage. However, digital technology investments do not always result in sustainable competitive advantage, and technology ownership alone cannot explain differences in the level of competitive advantage between organizations with similar levels of digitalization. Therefore, this research requires a theoretical foundation that explains how digital resources are developed into organizational capabilities, translated into customer value, and ultimately shape Perceived Competitive Advantage.

This perspective is explained through the Resource-Based View (RBV), which states that competitive advantage stems from the possession of valuable, rare, inimitable, and non-substitutable resources (Barney, 1991). In the context of the digital economy, AI, data, digital infrastructure, and information technology are strategic resources that have the potential to create competitive differentiation if managed effectively. However, the RBV also emphasizes that resources do not automatically generate competitive advantage. The strategic value of resources depends heavily on an organization's ability to combine, integrate, and leverage them to create greater value than competitors. Thus, the RBV explains why organizations need AI and digital transformation capabilities as strategic resources, but have not yet fully utilized them. The RBV also explains how these resources generate competitive advantage in a dynamic business environment.

This limitation is complemented by Dynamic Capability Theory (DCT), which emphasizes that sustainable competitive advantage is determined not only by resource ownership but also by the organization's ability to integrate, build, and reconfigure resources in response to changes in the business environment (D. J. Teece et al., 1997; J. D. Teece & Augier, 2007). In this study, AI Capability and Digital Transformation are viewed as dynamic capabilities that enable organizations to identify opportunities, utilize digital technologies, and transform business processes. These capabilities improve the quality of decision-making, accelerate innovation, and strengthen organizational flexibility in responding to changing customer needs. However, Dynamic Capability Theory emphasizes the creation of competitive advantage from an internal perspective, so it does not fully explain how the value generated by the organization is perceived by customers. This perspective is then complemented by Stakeholder Theory, which emphasizes that organizational success is determined not only by the management of internal resources, but also by its ability to create value for stakeholders, especially customers (Freeman & McVea, 1984).

In a digital business environment, customers assess an organization's success through service experience, the quality of digital interactions, responsiveness, and perceived value. Therefore, Perceived Competitive Advantage is used as the research outcome because it better reflects an organization's success in transforming digital capabilities into customer-recognized value. Based on the integration of Resource-Based View (RBV), Dynamic Capability Theory (DCT), and Stakeholder Theory, this study argues that Perceived Competitive Advantage is formed through the ownership of digital resources, the organization's ability to develop and utilize them, and customer validation of their value. Therefore, AI Capability and Digital Transformation do not directly generate competitive advantage but must be translated into relevant value for customers. The effectiveness of this process is expected to be stronger when organizations are able to integrate Sustainable Innovation into their business strategies. Based on these arguments, this study develops a conceptual model that examines the influence of AI Capability and Digital Transformation on Perceived Competitive Advantage, with Sustainable Innovation as a moderating variable.

Although organizations are increasingly investing in Artificial Intelligence (AI), empirical evidence suggests that the success of AI implementation in creating competitive advantage remains variable. Some organizations are able to leverage AI to improve decision-making, accelerate innovation, and create superior customer experiences, while others have not achieved comparable strategic benefits despite relatively similar levels of technology investment. This difference suggests that the possession of AI technology is not a direct determinant of competitive advantage. Rather, an organization's ability to develop and manage AI as a strategic capability is a more decisive factor in the value creation process (Andreassen, 2024; El-Haddadeh, 2020).

From a Resource-Based View (RBV) perspective, AI capabilities are viewed as strategic capabilities that enable organizations to integrate technology, data, talent, and analytical resources into a difficult-to-imitate source of competitive advantage. However, the strategic value of AI does not derive from the technology itself, but from the organization's ability to combine these resources to support business processes and decision-making. Thus, organizations with higher AI capabilities are expected to be better able to create innovation, improve operational efficiency, and provide more responsive services than their competitors.

This perspective is reinforced by the Dynamic Capabilities Theory, which explains that AI Capabilities are a form of dynamic capabilities that enable organizations to continuously detect environmental changes sensing, take advantage of business opportunities (struggle), and transform organizational processes (change) through the use of artificial intelligence (J. D. Teece & Augier, 2007). This capability enables organizations not only to increase internal productivity but also to generate more adaptive solutions to changing customer needs. Therefore, organizations that are able to develop AI capabilities effectively are expected to maintain better competitive

differentiation in a rapidly changing digital business environment.

However, in the context of digital competition, the success of AI capabilities cannot be measured solely by increased efficiency or organizational performance. The strategic value of AI will only provide a competitive advantage if the resulting benefits are truly felt by customers. AI enables organizations to provide more personalized services, improve accuracy, and enhance customer satisfaction. Product recommendations, accelerating response to customer needs, and creating better digital experiences. When customers perceive a company as providing superior value than competitors through the use of AI, the company's perceived competitive advantage also increases. Thus, Perceived Competitive Advantage is a logical consequence of an organization's ability to translate AI capabilities into relevant value for customers.

Several studies provide empirical support for this argument. (Andreassen, 2024) demonstrated that the use of AI enhances an organization's ability to create customer value through personalized services and data-driven decision-making. (El-Haddadeh, 2020) found that AI capabilities contribute to increased organizational innovation when supported by effective digital governance. Meanwhile, (El-Hishi, 2026) emphasized that the benefits of AI for competitive advantage depend largely on an organization's ability to integrate the technology into its business strategy. Although research findings vary, most studies indicate that AI capabilities have the potential to be a source of competitive advantage when developed as an organizational capability, rather than simply as a technology investment. Based on these theoretical arguments and empirical evidence, this study argues that the higher an organization's Artificial Intelligence (AI) capabilities, the greater its ability to create value that customers perceive as superior to competitors. Therefore, the first hypothesis in this study is formulated as follows.

H1:Artificial Intelligence capabilities have a positive influence on Perceived Competitive Advantage.

Digital transformation has become a key strategy adopted by organizations to enhance competitiveness in an increasingly dynamic business environment. However, various studies show that the success of digital transformation in creating competitive advantage still produces mixed results. Some organizations have successfully leveraged digital transformation to enhance innovation, strengthen customer relationships, and create competitive differentiation, while others have not achieved significant strategic benefits despite allocating significant digital investments. This variation in results suggests that digital transformation does not automatically generate competitive advantage but rather depends on an organization's ability to integrate digital technologies into its value creation processes (Andreassen, 2024; El-Haddadeh, 2020; Huseynli, 2022a).

From a Resource-Based View (RBV) perspective, Digital Transformation is not only about adopting technology, but also about an organization's ability to integrate digital resources, business processes, human resources, and knowledge to create strategic value. This capability enables organizations to increase efficiency, accelerate innovation, and strengthen competitiveness. This perspective is supported by Dynamic Capability Theory, which views digital transformation as an organization's capability to respond to environmental changes by identifying customer needs, exploiting digital opportunities, and continuously adapting business models. Thus, digital transformation improves an organization's flexibility, service quality, and responsiveness to market dynamics. Its success is reflected not only in internal efficiency but also in the ability to create faster, more personalized, and easier customer experiences through digital platforms. When customers perceive improved service quality, ease of transactions, and responsiveness compared to competitors, the company's Perceived Competitive Advantage will be strengthened. Therefore, Perceived Competitive Advantage is a more appropriate indicator for assessing the success of digital transformation than performance measures that are solely oriented towards an internal perspective. Empirical findings support this argument. (Andreassen, 2024) suggests that digital transformation enhances customer value creation through the integration of digital technology into business processes. (Huseynli, 2022) reports that digital capabilities contribute to increased competitive advantage through improved service quality and customer experience. Meanwhile, (El-Haddadeh, 2020) emphasizes that the benefits of digital transformation on organizational competitiveness are strongly influenced by the organization's ability to integrate technology with business strategy. Although research findings vary across contexts, most studies indicate that organizations that effectively implement digital transformation have a greater opportunity to build a competitive advantage perceived by customers.

Based on theoretical arguments and empirical evidence, this study argues that digital transformation is a strategic capability that enables organizations to create customer value through improved service quality, innovation, and responsiveness. The higher the level of digital transformation, the greater the organization's ability to build a perceived competitive advantage over its competitors. Therefore, the second hypothesis is formulated as follows.

H2: Digital transformation has a positive impact on Perceived Competitive Advantage.

Although AI capabilities and digital transformation are expected to enhance perceived competitive advantage, various studies show that this relationship does not always produce consistent findings. Organizations with relatively similar levels of AI and digital transformation capabilities often exhibit varying degrees of competitive advantage. Some organizations have successfully translated digital capabilities into customer-recognized value,

while others have not achieved comparable strategic benefits. This situation suggests that the relationship between digital capabilities and competitive advantage is likely not linear, but is influenced by organizational conditions that determine the extent to which technology is able to create competitive value. Therefore, a conceptual mechanism is needed that can explain when and under what conditions AI capabilities and digital transformation have a greater impact on perceived competitive advantage.

This study argues that one such condition is Sustainable Innovation. In contrast to the view that places Sustainable Innovation as an outcome of digital transformation, this study positions Sustainable Innovation as an organization's ability to integrate economic, social, and environmental objectives into the innovation process so that the use of technology generates sustainable value for customers and stakeholders. This perspective aligns with Dynamic Capabilities Theory, which emphasizes that competitive advantage depends not only on the ability to acquire and utilize resources, but also on the organization's ability to reconfigure those resources to remain relevant to changes in the business environment (J. D. Teece & Augier, 2007). In this context, Sustainable Innovation is a capability that enables organizations to direct the use of AI and digital transformation toward creating value that is more adaptive, responsible, and difficult for competitors to imitate.

From a Stakeholder Theory perspective, organizations that integrate sustainability principles into innovation tend to gain greater legitimacy and trust from customers. The implementation of AI and digital transformation combined with Sustainable Innovation practices enables organizations not only to improve operational efficiency but also to strengthen transparency, service quality, social responsibility, and environmental stewardship. This combination creates a stronger value proposition than organizations that focus solely on technology adoption. In other words, customers evaluate not only the sophistication of a company's technology but also how it is leveraged to create broader, sustainable benefits.

This argument suggests that organizations with high levels of Sustainable Innovation are expected to be able to leverage Artificial Intelligence (AI) Capabilities more effectively to create competitive advantage. AI capabilities enable organizations to acquire, analyze, and utilize information more accurately, while Sustainable Innovation ensures that these capabilities are translated into innovations that deliver tangible benefits to customers. Therefore, when Sustainable Innovation is at a high level, the influence of AI Capabilities on Perceived Competitive Advantage is expected to be stronger than for organizations with low levels of Sustainable Innovation.

Empirical findings support this argument. (Pulido, 2023) shows that integrating digital technology with sustainability strategies enhances an organization's ability to create long-term value. (El-Haddadeh, 2020) also emphasizes that the success of AI implementation is strongly influenced by an organization's ability to integrate technology with sustainability governance and innovation strategies. Similarly, recent evidence suggests that sustainability-related attributes embedded in digital platforms positively influence customer evaluations and strengthen a company's competitive position in the online environment (Tabelessy & Nanere, 2026). Furthermore, (El-Hishi, 2026) shows that organizations that align digital transformation with a sustainability orientation achieve greater competitive advantage than those that only integrate sustainability. Focus on the digitalization of business processes. Based on this argument, this study proposes the following hypothesis.

H3: Sustainable Innovation strengthens the positive influence of artificial intelligence capabilities on perceived competitive advantage.

In addition to strengthening the relationship between AI Capability and Perceived Competitive Advantage, Sustainable Innovation also increases the effectiveness of Digital Transformation in creating competitive advantage. Digital transformation that focuses solely on digitizing business processes tends to increase internal efficiency without providing optimal value for customers. Conversely, when integrated with Sustainable Innovation, organizations are able to develop products, services, and business models that are more responsive to customer needs while meeting sustainability demands. Thus, Sustainable Innovation optimizes the benefits of digital transformation, strengthens differentiation, and enhances customer perceptions of a company's competitive advantage.

In line with this argument, organizations with high levels of Sustainable Innovation are expected to be able to convert digital transformation outcomes into customer value more effectively than those with low levels of Sustainable Innovation. Therefore, this study proposes the following hypothesis.

H4:Sustainable Innovation strengthens the positive influence of Digital Transformation on Perceived Competitive Advantage

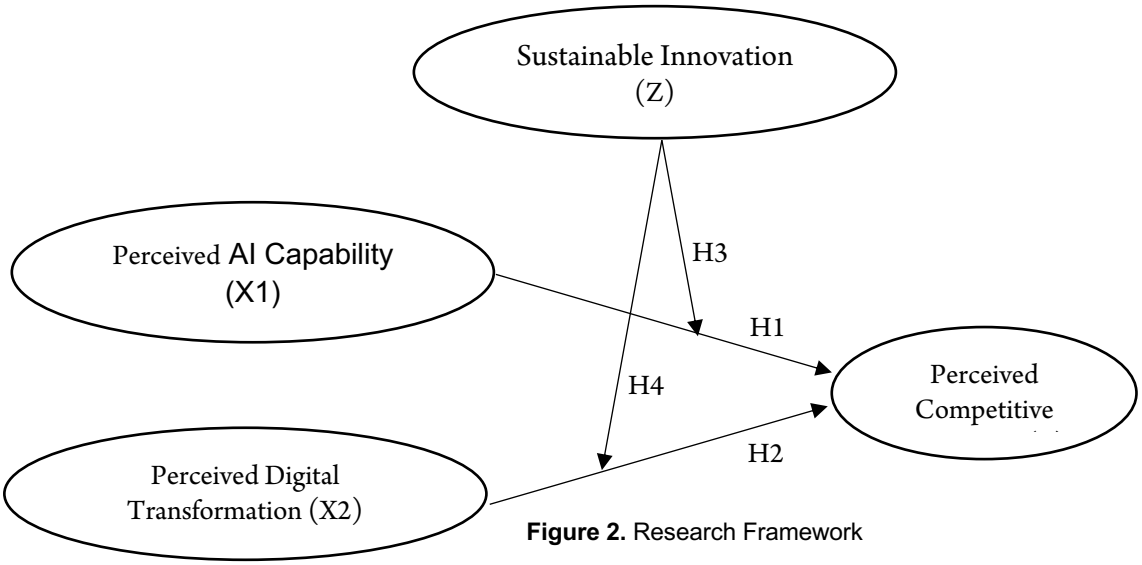


Figure 2. Research Framework

METHOD

This research uses a quantitative approach with an exploratory research design (explanatory research) to examine the relationship between Perceived AI Capability, Perceived Digital Transformation, and Perceived Competitive Advantage, as well as the moderating role of Perceived Sustainable Innovation. An explanatory design was chosen because this study aims to examine the relationship between latent constructs based on a previously developed conceptual model (Hair Jr et al, 2022).

The population of this study consists of Shopee and TikTok Shop users in Maluku Province who are included in the Generation Z category. This group was chosen because they have a high level of digital technology adoption and actively utilize e-commerce platforms in their daily transaction activities, so it is considered relevant to evaluate perceptions regarding Ability Artificial intelligence, Digital Transformation, Sustainable Innovation, And Perceived Competitive Advantage this research uses the technique sampling aims to obtaining respondents with characteristics that meet the research objectives (Hair Jr et al, 2022). The respondent criteria include: (1) aged 17–28 years, (2) domiciled in Maluku Province, (3) having made a transaction through Shopee or TikTok Shop in the last six months, (4) having used one of these platforms at least twice in the last three months, and (5) willing to participate voluntarily in the research. To ensure that all respondents meet these criteria, a series of screening questions (screening questions) is placed at the beginning of the questionnaire. Only respondents who meet all requirements can continue filling out the main questionnaire.

The minimum sample size was determined using G*Power 3.1 software with a significance level of 5%, statistical power of 0.95, and effect size of 0.15. The analysis results indicate that this study requires at least 160 respondents to have adequate statistical power in the SEM-PLS analysis (Cohen, 1988). To anticipate unusable data, 195 questionnaires were distributed online through various digital communication channels aimed at Shopee and TikTok Shop users from Generation Z in Maluku Province. After the data collection period ended, all received questionnaires were checked to ensure the completeness of the answers and their compliance with the established inclusion criteria. Based on the screening process and data quality evaluation, 35 questionnaires were eliminated because they were incomplete or did not meet one or more research criteria, resulting in 160 questionnaires deemed suitable for analysis. To improve data quality, all question items on Google Forms are set as mandatory questions so as to minimize data lost, while duplicate responses and inconsistent answers were checked and eliminated before the analysis process was carried out. In addition, because the research instrument was adapted from various previous validated studies, the questionnaire was first reviewed to ensure that the wording, content, and meaning of each question item were appropriate to the e-commerce context in Indonesia and easily understood by Generation Z respondents. Thus, this study obtained response rate of 82.05%, which is included in the very good category for survey-based research (Dillman et al., 2014), while ensuring that the data used truly represents the target population and meets all the established sample criteria.

All constructs in this study are conceptualized as reflective constructs reflective construction Every The constructs were operationalized based on the conceptual definitions discussed in the literature review and measured using indicators adapted from various previous studies. The research instrument was translated into

Indonesian using a back-translation procedure to ensure equivalence of conceptual meaning between languages (Brislin, 1984). Instrument adaptation was carried out without changing the conceptual meaning of each construct to maintain content validity. Content validity while increasing its suitability to the context of e-commerce users in Indonesia. All indicators were measured using a five-point Likert scale, ranging from 1 = strongly disagree to 5 = strongly agree, as commonly used in PLS-SEM-based marketing and consumer behavior research (Sarstedt et al., 2022). The operational definitions, measurement indicators, and adaptation sources for each construct are presented in Table 1.

Tabel 1. Operational Definitions and Variable Measurement Indicators

Variables	Code	Indicators	Adaptation Source
Perceived Artificial Intelligence Ability (X1)	AI1	AI provides product recommendations that suit my needs.	(Dwivedi et al., 2021; Huang & Rust, 2021)
	AI2	AI helps me get information or solutions quickly.	
	AI3	AI personalizes my shopping experience.	
	AI4	AI makes it easier for me to find the products I'm looking for.	
Digital Perception Transformation (X2)	DT1	This platform uses modern digital technology.	(Verhoef et al., 2021; Vial, 2019)
	DT2	The digital transaction process takes place easily.	
	DT3	Digital features make my shopping activities easier.	
	DT4	This platform continues to develop digital technology to improve the quality of service.	
Perceived Sustainable Innovation (Z)	SI1	This platform provides innovations that support environmental sustainability.	(Chen et al., 2006; Dangelico & Pujari, 2010)
	SI2	This platform leverages technology to reduce environmental impact.	
	SI3	This platform demonstrates a commitment to sustainable business practices.	
	SI4	This platform continues to develop innovations that support sustainability.	
Perceived Competitive Advantage (Y)	PCA1	This platform is superior to other e-commerce platforms.	(Barney, 1991; Vorhies & Morgan, 2005)
	PCA2	This platform provides better quality of service than its competitors.	
	PCA3	This platform offers higher value than other platforms.	
	PCA4	This platform is my first choice compared to other competing platforms.	

Primary data was collected using a structured questionnaire distributed online via Google Forms. The research instrument consisted of respondent characteristics and statements measuring all research constructs. To reduce potential bias, Common method bias ParaRespondents were assured that their answers would be anonymous and used only for academic purposes (podsakoff, M et al., 2003). Data collection was conducted during May–June 2026 using a descriptive approach. Data were analyzed using Structural Equation Modeling–Partial Least Squares (SEM PLS) with the help of SmartPLS 4. This approach was chosen because it is suitable for testing

the relationship between latent constructs and moderating effects in prediction-oriented research models (Sarstedt et al., 2022). The analysis was conducted using a bootstrapping procedure with 10,000 subsamples, while testing for moderating effects. Sustainable Innovation Perceived to be Done through the Approach Two Stages On SmartPLS 4.

RESULT AND DISCUSSION

Result

This study involved 160 respondents who met the criteria as e-commerce users. Based on gender, 103 respondents (64.4%) were female and 57 respondents (35.6%) were male, thus women dominated the study sample. This condition indicates that women have a higher level of participation in utilizing e-commerce platforms to search for product information, compare alternatives, and conduct online transactions. Nevertheless, the proportion of male respondents still provides adequate representation, so that perceptions regarding AI Capability, Digital Transformation, Sustainable Innovation, and Perceived Competitive Advantage can describe both user groups. Thus, the distribution of respondents by gender is considered sufficiently representative to support the analysis of the relationships between variables in this study.

The measurement model was evaluated to ensure that each construct met the reliability and validity requirements before conducting the structural model analysis (Hair Jr et al, 2022).

Table 2. Measurement Model Assessment

Construction	Indicators	Currently loading G	α Cronbach	rho_A	CR	AVE
The capabilities of AI that Felt	AI1	0,911	0,903	0,925	0,932	0,774
	AI2	0,912				
	AI3	0,795				
	AI4	0,895				
Perception of Digital Transformation	DT1	0,888	0,901	0,903	0,931	0,771
	DT2	0,892				
	DT3	0,894				
	DT4	0,838				
Perceived Sustainable Innovation	SI1	0,828	0,835	0,846	0,890	0,669
	SI2	0,782				
	SI3	0,867				
	SI4	0,793				
Perceived Competitive Advantage	PCA1	0,850	0,869	0,891	0,909	0,713
	PCA2	0,889				
	PCA3	0,843				
	PCA4	0,794				

Table 2 shows that all indicators have outer loading values ranging from 0.782–0.912, exceeding the minimum value of 0.708 recommended to indicate indicator reliability (Hair Jr et al., 2022). All constructs also have Cronbach's alpha (0.835–0.903), rho_A (0.846–0.925), and Composite Reliability (0.890–0.932), all of which are above the minimum value of 0.70, thus meeting the requirements for internal consistency reliability (Hair Jr et al, 2022). Furthermore, the Average Variance Extracted (AVE) values range from 0.669–0.774, greater than the minimum limit of 0.50, so all constructs meet the requirements for convergent validity (Fornell & Larcker, 1981; Sarstedt et al., 2022).

Table 3. Discriminant Validity (HTMT)

Construction	AI	DT	YA	PCA
AI	–			
DT	0,324	–		
YA	0,086	0,312	–	
PCA	0,518	0,578	0,443	–

Table 3 shows that all Heterotrait–Monotrait Ratio (HTMT) values ranged from 0.086 to 0.578, lower than the recommended threshold of 0.85 for adequate discriminant validity (Henseler et al., 2015; Sarstedt et al., 2022). Thus, each construct in this study represents a distinct concept and does not show any overlap in measurement between constructs.

Table 4. Structural Model Assessment

Connection	VIF dalam	f^2
AI → PCA	1.181	0,188
DT → PCA	1.372	0,221
AI × SI → PCA	1.086	0,031
DT × SI → PCA	1.402	0,033

Table 4 shows that all Inner VIF values are in the range of 1.086–1.402, lower than the threshold of 3.0 (or a conservative limit of 5.0), so there is no indication of multicollinearity between the predictor constructs in the structural model (Sarstedt et al., 2022). Based on the effect size (f^2) values, Perceived AI Capability (0.188) and Perceived Digital Transformation (0.221) show a medium effect. Meanwhile, the interaction effects of AI × SI (0.031) and DT × SI (0.033) show small effect sizes according to the classification (Cohen, 1988), namely 0.02 (small), 0.15 (medium), and 0.35 (large).

Table 5. Model Summary

Endogenous Construction	R^2	The R^2 customized	SRMR
Competitive Advantage that Felt	0,515	0,500	0,089

Furthermore, the R^2 value of 0.515 indicates that the model is able to explain 51.5% of the variation in Perceived Competitive Advantage, which falls into the category of moderate explanatory power. According to (Hair Jr et al, 2022), the Adjusted R^2 value of 0.500 indicates that the model's explanatory power remains stable after accounting for the number of predictor constructs. The SRMR value of 0.089 is below the threshold of 0.10, indicating that the model has an adequate level of fit with the empirical data. Thus, the structural model is considered suitable for use in hypothesis testing (Hair Jr et al, 2022).

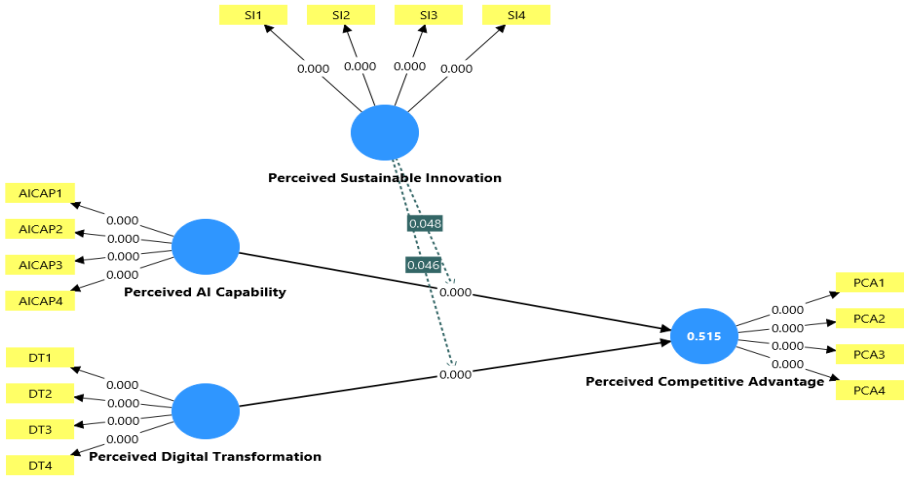


Figure 3. Research Model
Source: SmartPLS 4

Tabel 6. Hipotesis Testing

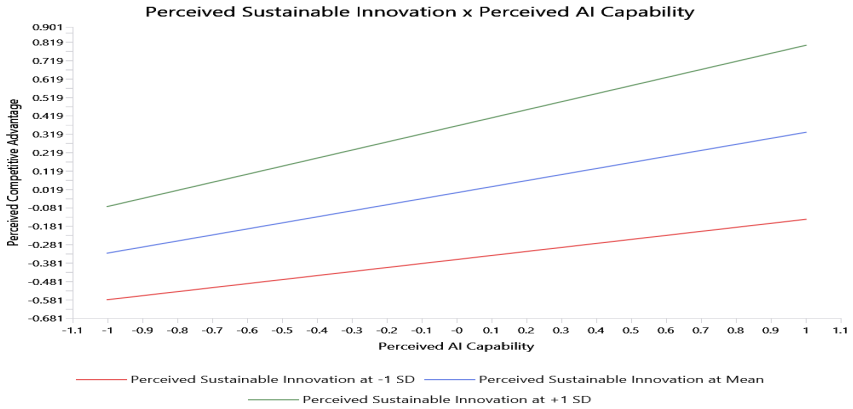
Hypothesis	Connection	B	T mark	P mark	Results
H1	Perception of AI Capabilities → Perception of Competitive Advantage	0,328	4.666	<0,001	Supported
H2	Perception of Digital Transformation → Perception of Competitive Advantage	0,383	5.144	<0,001	Supported
H3	Perception of AI Capabilities × Perception of Sustainable Innovation → Perception of Competitive Advantage	0,110	1.981	0,048	Supported
H4	Perception of Digital Transformation × Perception of Sustainable Innovation → Perception of Competitive Advantage	0,095	1.998	0,046	Supported

Table 6 shows that all direct relationships have t-statistic values above 1.96 and p-values below 0.05, thus supporting H1 and H2 (Hair Jr et al, 2022). Between the two this direct relationship, Perception of Digital Transformation shows a stronger influence on Perception of Competitive Advantage (β = 0.383) than Perception of AI Capability (β = 0.328), which indicates that increasing digital transformation contributes more to the formation of competitive advantage for e-commerce platforms.

In addition, both moderating effects were also found to be significant. Perceived Sustainable Innovation positively moderated the relationship between Perceived AI Capability and Perceived Competitive Advantage (β = 0.110; T = 1,981; P = 0.048), as well as the relationship between Perception of Digital Transformation and Perceived Competitive Advantage (β = 0.095; T = 1,998; P = 0.046). The positive and significant interaction coefficient indicates that the higher the level of Perceived Sustainable Innovation, the stronger the influence of Perceived AI Capability and Perceived Digital Transformation on Perceived Competitive Advantage. Thus, all research hypotheses (H1–H4) are supported.

To provide a more comprehensive interpretation of the moderating effects, a simple slope analysis was performed as presented in Figure 3. The graph shows that all lines have a positive slope, indicating that an increase in Perceived AI Capability is consistently followed by an increase in Perceived Competitive Advantage at all levels of Perceived Sustainable Innovation. However, the slope of the lines increases with increasing levels of Perceived Sustainable Innovation. The line representing Perceived Sustainable Innovation at a high level (+1 SD) has the steepest slope and is at the highest level of Perceived Competitive Advantage, followed by the line at the average level (Mean), while the line at a low level (-1 SD) has the gentlest slope and is at the lowest level of Perceived Competitive Advantage. This pattern indicates that organizations with higher levels of Perceived Sustainable Innovation derive greater benefits from increased Perceived AI Capabilities in building Perceived Competitive Advantage. A similar interaction pattern is also found in the relationship between Perceived Digital Transformation

and Perceived Competitive Advantage, thus confirming that Perceived Sustainable Innovation acts as a variable that strengthens the influence of both capabilities on Perceived Competitive Advantage.



Fugure 4. Moderation Effect Graph
Source: SmartPLS4

Discussion

The results of the study confirm that Artificial Intelligence (AI) Capabilities have a positive influence on Perceived Competitive Advantage, thus H1 is accepted. This finding indicates that a company's ability to integrate AI into data management, decision-making, and various business activities can improve customer perceptions of the company's competitive advantage. From a Resource-Based View (RBV) perspective, this condition indicates that competitive advantage is not solely determined by technology ownership, but rather by the organization's ability to manage the technology into strategic capabilities that can create value for customers (Barney, 1991). This explanation is also in line with Dynamic Capabilities Theory, which emphasizes the importance of an organization's ability to respond to environmental changes through a continuous process of adaptation and capability renewal (J. D. Teece & Augier, 2007).

These results reinforce the findings of (Andreassen, 2024; El-Haddadeh, 2020; El-Hishi, 2026). These findings align with the view that AI provides a competitive advantage when integrated with an organization's business strategy. In this study, Shopee and TikTok Shop users in Maluku Province, predominantly Generation Z, valued fast, personalized, and data-driven digital services. Therefore, the platform's ability to utilize AI to provide relevant product recommendations, improve search accuracy, and deliver responsive service strengthened their perception of the platform's superiority over competitors. These results also indicate that the success of AI implementation is more accurately measured by its ability to create perceived customer value rather than simply improving internal company efficiency.

This study also shows that Digital Transformation has a positive influence on Perceived Competitive Advantage, even with a greater influence strength compared to AI Capabilities. These results indicate that comprehensively implemented digital transformation can have a more tangible impact in building competitive advantage. This supports the RBV perspective and Dynamic Capabilities Theory, which defines digital transformation as an organization's ability to integrate technology with business processes and continuously adapt its operational model to remain relevant to a dynamic business environment (Barney, 1991; J. D. Teece & Augier, 2007).

These findings are consistent with research (Andreassen, 2024; El-Haddadeh, 2020; Huseynli, 2022) These findings indicate that digital transformation increases customer value through better service experiences. In this study, Shopee and TikTok Shop users in Maluku Province experienced the benefits of digital transformation through easy app navigation, various payment methods, integrated logistics services, and interactive features such as live shopping and product recommendations. As a generation that grew up in the digital era, Generation Z has high expectations for ease, speed, and convenience of services, making digital transformation a more dominant factor in shaping Perceived Competitive Advantage than AI Capability alone.

The results of the study indicate that Sustainable Innovation strengthens the influence of AI Capability and Digital Transformation on Perceived Competitive Advantage. Although the moderating effect is smaller than the direct influence of both variables, the results are still statistically significant. This finding suggests that the success of digital technology implementation depends not only on the level of technology adoption, but also on the organization's ability to integrate sustainability principles into the innovation process. Thus, Sustainable Innovation acts as a condition that increases the effectiveness of digital capabilities in creating greater value for

customers, as explained in Dynamic Capability Theory (J. D. Teece & Augier, 2007).

This interpretation is supported by the results of a simple slope analysis, which shows that the relationship between AI Capability and Perceived Competitive Advantage remains positive at all levels of Sustainable Innovation, but becomes stronger when the level of Sustainable Innovation is in the high category. A similar pattern is also seen in the relationship between Digital Transformation and Perceived Competitive Advantage, thus understanding that Sustainable Innovation magnifies the benefits resulting from the application of digital capabilities. In the context of Shopee and TikTok Shop users in Maluku Province, these findings indicate that Generation Z consumers not only value technological sophistication but also increasingly consider how this technology is used responsibly through business practices that consider economic, social, and environmental aspects.

The results of this study are in line with the results of research (El-Haddadeh, 2020; El-Hishi, 2026; Pulido, 2023). This study shows that the integration of digital transformation and sustainability strategies can produce a stronger competitive advantage. Conceptually, this study contributes by positioning Sustainable Innovation as a moderating variable that strengthens the relationship between AI Capability and Digital Transformation on Perceived Competitive Advantage, not as a consequence of digital transformation. This finding confirms that competitive advantage in e-commerce companies depends not only on the adoption of AI and digital transformation, but also on the organization's ability to integrate sustainability principles into the innovation process. Digital Transformation is the most dominant factor in shaping Perceived Competitive Advantage, while AI Capability enhances the company's ability to create more personalized and responsive value for customers. The effectiveness of both capabilities is strengthened when supported by Sustainable Innovation.

Innovation, so that all three work synergistically to create value that customers recognize as a competitive advantage. In the context of Shopee and TikTok Shop users in Maluku Province, which is dominated by Generation Z, research shows that competitive advantage will be more optimal when digital technology advancements are balanced with sustainability-oriented innovations that meet digital consumer expectations.

CONCLUSSION AND RECOMMENDATION

The results of the study indicate that Artificial Intelligence (AI) Capabilities and Digital Transformation have a positive influence on Perceived Competitive Advantage, with Digital Transformation being the most dominant factor. Furthermore, Sustainable Innovation is proven to strengthen the influence of both capabilities, so that competitive advantage on e-commerce platforms is not only determined by the ability to adopt digital technology, but also by the ability to integrate sustainability principles into the innovation process. These findings indicate that the synergy between AI Capabilities, Digital Transformation, and Sustainable Innovation can increase customer perceived value, especially Shopee and TikTok Shop users in Maluku Province, which is dominated by Generation Z.

Based on these findings, e-commerce companies are advised to focus not only on AI development and digital transformation, but also on integrating Sustainable Innovation practices into their business strategies. This approach will strengthen the customer experience, enhance the perception of competitive advantage, and support business sustainability in the face of evolving digital market dynamics. However, the results of this study need to be interpreted with several limitations in mind, namely the use of a research design. Cross-sectional, the limited scope of respondents to Generation Z Shopee and TikTok Shop users in Maluku Province, and the use of data based on respondents' perceptions. Therefore, further research is recommended to use a longitudinal design, expand the coverage area and characteristics of respondents, involve various e-commerce platforms, and combine perception data with more objective performance indicators to obtain a more comprehensive understanding of the role of AI Capabilities, Digital Transformation, and Sustainable Innovation in shaping Perceived Competitive Advantage.

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