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ORIGINAL

Optimization of Branding and Value Chain Mapping Using Artificial Intelligence for the Batik Village Clusters in Indonesia to Achieve Competitive Advantage

Optimización de la marca y mapeo de la cadena de valor mediante inteligencia artificial para los clústeres de Batik Village en Indonesia para lograr una ventaja competitive

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ABSTRACT

This research investigates the role of artificial intelligence (AI) in optimizing branding and mapping value chains to strengthen the competitive advantage of Batik Village Clusters in Indonesia. Employing a quantitative approach, the study analyzes survey data from stakeholders in the batik industry, focusing on their perceptions of AI's impact on branding and value chain processes. The study reveals that AI has a significant positive impact on branding optimization (t-statistic = 29,249, p = 0,000) and value chain mapping (t-statistic = 15,066, p = 0,000). Additionally, both branding optimization (t-statistic = 8,621) and value chain mapping (t-statistic = 16,853) were found to positively affect the competitive advantage of batik clusters. These findings suggest that AI can enhance branding efforts, improve value chain efficiency, and elevate the competitive positioning of Batik Village Clusters. The study provides actionable recommendations for batik entrepreneurs and policymakers, emphasizing the need to incorporate AI technologies to improve global competitiveness and ensure long-term sustainability in the batik industry.

Keywords: Branding Optimization; Value Chain Mapping; Artificial Intelligence; Competitive Advantage; Batik Village Clusters.

RESUMEN

Esta investigación investiga el papel de la inteligencia artificial (IA) en la optimización de la marca y el mapeo de las cadenas de valor para fortalecer la ventaja competitiva de Batik Village Clusters en Indonesia. Empleando un enfoque cuantitativo, el estudio analiza datos de encuestas de las partes interesadas en la industria del batik, centrándose en sus percepciones sobre el impacto de la IA en los procesos de marca y cadena de valor. El estudio revela que la IA tiene un impacto positivo significativo en la optimización de la marca (estadística t = 29,249, p = 0,000) y el mapeo de la cadena de valor (estadística t = 15,066, p = 0,000). Además, se descubrió que tanto la optimización de la marca (estadística t = 8,621) como el mapeo de la cadena de valor (estadística t = 16,853) afectan positivamente la ventaja competitiva de los grupos de batik. Estos hallazgos sugieren que la IA puede mejorar los esfuerzos de marca, mejorar la eficiencia de la cadena de valor y elevar el posicionamiento competitivo de Batik Village Clusters. El estudio proporciona

recomendaciones prácticas para empresarios y formuladores de políticas de batik, enfatizando la necesidad de incorporar tecnologías de inteligencia artificial para mejorar la competitividad global y garantizar la sostenibilidad a largo plazo en la industria del batik.

Palabras clave: Optimización del Branding; Mapeo de la Cadena de Valor; Inteligencia Artificial; Ventaja Competitiva; Clústeres de Aldeas Batik.

INTRODUCTION

Kampung Batik is one of Indonesia's cultural icons that has great potential to be developed as a tourist destination and creative industry center. However, in facing global competition and changing consumer preferences, Kampung Batik needs to adopt innovative strategies to maintain and improve its competitive advantage. To improve its competitive advantage as a cultural tourism destination, Kampung Batik must utilize innovative strategies, especially through the integration of AI and value chain analysis. By implementing AI technology, Kampung Batik can optimize its branding and value chain, gaining valuable insights that inform data-driven decisions.[1]

Artificial Intelligence has great potential to analyze market data, consumer trends, and product performance in real-time.[2] By utilizing AI, Batik Village can make faster and more accurate decisions in formulating branding and marketing strategies [3]. AI also allows Batik Village to optimize brand imaging, strengthen identity, and create a more consistent image in the eyes of consumers. More personalized and relevant marketing campaigns can be designed with the help of this technology, which will ultimately increase customer loyalty.

In addition, value chain mapping also plays an important role in increasing efficiency and competitiveness. This process involves identifying and analyzing each stage in the production chain, from raw materials to finished products. With AI, Batik Village can identify weak points that need to be fixed and optimize the production process to improve quality and efficiency.[4] AI technology also opens up opportunities for innovation in design, production, and marketing, which will produce superior and more attractive products for consumers.[5,6]

Optimizing brand image and mapping the value chain based on AI not only provides direct benefits to Batik Village, but also has a positive impact on the local economy. With increased efficiency in production and product quality, this can contribute to increasing income and welfare of the local community.[7] Thus, the adoption of AI technology has the potential to strengthen Batik Village's position in the global market while increasing broader socio-economic impacts.

However, batik artisans in various clusters, such as Batik Madura, Lasem, Keisya, Sasirangan Banjarmasin (Interview, September 18, 2023), and Suhana from Banten (Interview, December 25, 2023), face significant challenges in legal documentation, raw material supply, design innovation, and the development of human resources competencies in marketing. For instance, Parlan from Lasem (Interview, October 16, 2023) highlighted difficulties in human resource regeneration and limited marketing efforts, while Kholili from Klampar, Madura (Interview, November 20, 2023) expressed concerns about the challenges of creating more innovative designs.

Although batik has been recognized by UNESCO as an Indonesian cultural heritage, various preservation and promotional efforts have still not succeeded in bringing local batik artisans to the global stage. The intervention of technology in the commercialization of batik remains limited, which is evident in partnerships in the Batik Village of Pamekasan (Madura), Lasem (Central Java), Sasirangan (Banjarmasin), and Banten, where the number of batik artisans in each village exceeds 100 MSMEs (Micro, Small, and Medium Enterprises). Despite efforts from stakeholders to provide facilitation, including promotion, the impact on enhancing competitive advantage has yet to be significant.

This research is highly relevant due to the urgent need to empower batik clusters, address production barriers, and improve conventional marketing approaches that still dominate. In this regard, AI modeling can play a crucial role in optimizing the commercialization process of batik, from upstream to downstream. Furthermore, product diversification, branding through e-commerce for international promotion, and AI-based value chain mapping become critical. With the advancement of AI technology, marketing performance can be optimized to create more efficient and effective solutions.

The key issue that needs to be addressed is how AI can optimize commercialization performance, enhance branding, and provide valuable data for strategic decision-making by stakeholders. This is particularly important considering that most batik partners continue to operate with limited human resources (typically 1-5 workers per SME) and face several key challenges: limitations in design innovation, ineffective marketing, and the protection of their products from intellectual property (IP) infringements. Currently, many partners have yet to adopt AI technology and still produce batik with traditional patterns that have been passed down through generations, without adequate protection of their IP.

Batik partners also desire technology that is easily accessible and interconnected. Rahmawati et al.[8]

emphasize the importance of a materialist and existential critical perspective in this context, focusing on value chain mapping that must be accompanied by digital branding to expand the market. AI assistance is considered crucial to driving innovation, while legal protection provides the foundation for stronger branding and global market expansion.[9] Marketing management supported by information technology alone is insufficient without continuous innovation, and the results of such innovation must be legally protected through IP to support export readiness and address market saturation.

Previous research, such as that conducted by Kustiyahningsih et al.[10], highlights the importance of four indicators in the development of batik SMEs: marketplaces, online marketing, and employees certified in information technology. Similarly, Sugiono[11] also supports the active role of the government in supporting SMEs. However, the proposed research differs in that its primary focus is on optimizing brand image and AI-based value chain mapping to create a competitive advantage for Batik Villages. This approach aims to foster innovation, enhance stakeholder roles, and empower SMEs and their organizations.

Purwaningsih et al.[12] note the complex interaction between technology adoption, operational efficiency, and financial outcomes in SMEs. Based on this understanding, this research aims to analyze the key issues faced by Batik Villages, develop a model, and implement it as a prototype to improve competitiveness, innovation, and batik product commercialization, while also considering the applicable legal framework.

The novelty of this research lies in its objectives and substance, which encompass three main steps: (1) building a model for Branding Optimization and AI-based Value Chain Mapping for Batik Villages in Indonesia to create a competitive advantage, (2) implementing this model by developing AI-based digital branding through the creation of company profile web programs, and developing generative AI programs specifically for the batik cluster, and (3) providing guidance and facilitating AI modeling and digital marketing to support new innovations and legal protection, ultimately assisting the batik cluster in gaining a competitive advantage, reaching export markets, and developing prototypes protected by IP (industrial design, trademarks, and copyrights).

In the long term, competitive advantages will be nurtured and created at the cluster level by the partners. Substantively, the optimization of branding and AI-based value chain mapping will be applied in Batik Villages to achieve competitive advantages, foster innovation, and strengthen the role of stakeholders in empowering partners. The ultimate outcome of this research will be the prototype of innovative batik designs for each cluster, with a humanistic artistic touch that preserves the uniqueness of each cluster while ensuring protection of IP. These innovations will be registered for industrial designs, trademarks, and copyrights, ensuring that each innovation is independently created and produced by the partners.

METHOD

This study employs a mixed-methods design, integrating both qualitative and quantitative descriptive approaches to provide an in-depth understanding of the implementation of Artificial Intelligence (AI) technology within the batik industry. The methodological framework encompasses participatory research, sociological, and statutory approaches, aiming to analyze phenomena from participatory, social, and legal policy perspectives. The research was conducted in four batik villages representing the cultural diversity of batik in Indonesia: Kampung Batik Tulis Pamekasan (Madura), Kampung Batik Tulis Lasem (Central Java), Kampung Sasirangan (Banjarmasin), and Kampung Batik in Serang, Banten Province. The study spanned six months, from January 2024 to June 2024. The population comprised micro, small, and medium enterprises (MSMEs) involved in batik production across the four villages, totaling 400 batik producers. Sampling was carried out using purposive sampling, with informants selected through snowball sampling techniques.

Instruments

The research instruments included questionnaires designed based on predetermined indicators, utilizing a five-point Likert scale with response options: very well understood, well understood, somewhat understood, not understood, and not at all understood. The research instruments were divided into several dimensions: AI, Branding Optimization, Mapping Value Chain (MVC), and Competitive Advantage (CA). Table 1 outlines the research instruments used:

Table 1. Research Instruments

Dimension	Indicator	Item Number
Artificial Intelligence (AI)	Utilization of AI	AI-1
	Application of AI in product design	AI-2
	Role of AI in assisting batik artisans in creating designs	AI-3
	Role of AI in facilitating batik designers	AI-4
Branding Optimization (BO)	Role of trademarks	BO-1
	Efforts to protect products through trademarks	BO-2

	Benefits of trademarks in protecting and promoting products	BO-3
	Benefits of trademarks in promotion	BO-4
Mapping Value Chain (MVC)	Strategies to enhance value chain efficiency	MVC-1
	Strategies to overcome value chain barriers	MVC-2
	Efforts to improve marketing performance through MVC	MVC-3
	Systematic development of the value chain	MVC-4
Competitive Advantage (CA)	Sustainable innovation	CA-1
	Sophistication of production tools	CA-2
	Ability to capture market share	CA-3
	Becoming a leader in the field	CA-4

Primary data were collected through questionnaires, in-depth interviews, participatory observations, and documentation. Secondary data were obtained from relevant legislation concerning batik governance policies, as well as literature and documents held by MSMEs and related governmental departments. To ensure the validity of qualitative data, techniques such as checking, rechecking, and cross-checking were employed, alongside triangulation of sources, methods, and theories.

Data Analysis

Quantitative data were analyzed using descriptive analysis and Partial Least Squares (PLS), which facilitates the testing of relationships between variables despite relatively small sample sizes. Qualitative data were analyzed through an interpretative analysis approach, involving three coding processes: open coding, axial coding, and selective coding. This analysis was conducted through data reduction, data display, and conclusion/verification phases to derive the main findings from the collected data. A problem-solving approach was adopted by applying digital marketing based on generative AI for the creation of innovative batik motifs while maintaining local values.

RESULTS

Based on the research findings, the quantitative data analysis is presented in table 2 below. This table outlines the descriptive analysis of respondents' answers to ten survey items.

Table 2. Descriptive Analysis of Respondents' Answers

Aspect		Item Number									
		1	2	3	4	5	6	7	8	9	10
N	Valid	102	102	102	102	102	102	102	102	102	102
	Missing	0	0	0	0	0	0	0	0	0	0
Mean		2,89	3,22	3,19	3,21	3,40	3,33	3,36	3,28	3,40	3,26
Median		3,00	3,00	3,00	3,00	3,00	3,00	3,00	3,00	4,00	3,00
Mode		3,00	4,00	4,00	3,00	4,00	3,00	3,00	4,00	4,00	4,00
Std. Deviation		,932	,953	,856	,765	,748	,848	,741	,800	,858	1,052
Variance		,869	,909	,733	,587	,560	,719	,550	,641	,738	1,107
Skewness		-,155	-,190	-,391	-,255	-,236	,092	-,108	-,562	-,597	-,240
Std. Error of Skewness		,239	,239	,239	,239	,239	,239	,239	,239	,239	,239
Kurtosis		-,513	-,810	-1,063	-,984	-,431	-,597	-,396	,013	,004	-,788
Std. Error of Kurtosis		,474	,474	,474	,474	,474	,474	,474	,474	,474	,474
Range		4,00	4,00	4,00	3,00	3,00	3,00	3,00	4,00	4,00	4,00
Minimum		1,00	1,00	1,00	2,00	2,00	2,00	2,00	1,00	1,00	1,00
Maximum		5,00	5,00	5,00	5,00	5,00	5,00	5,00	5,00	5,00	5,00
Sum		295,00	329,00	326,00	328,00	347,00	340,00	343,00	335,00	347,00	333,00

From table 2, it can be observed that the highest mean values are found in items 5 and 9, both of which have a mean of 3,40. Item 5 addresses the "Difference between branded and non-branded products and their

impact on competitive advantage," which indicates that respondents generally have a good understanding of this aspect. Similarly, item 9, which focuses on "How to sell products through e-commerce or marketplaces with the help of AI," shows a high level of understanding among respondents regarding the use of AI in product sales via digital platforms. In contrast, the lowest mean value is found in item 1, with a mean of 2,89, which concerns "How to obtain legal protection for products." This suggests that respondents have relatively low understanding in this area and require further attention.

The standard deviation (SD) shows how much the data disperses from the mean value. Item 10 has the highest standard deviation of 1,052, indicating a high variability in responses concerning "The role of an innovative Web Company Profile in product commercialization." This variability may be due to the recent development and socialization phase of company web profiles, leading to a broad range of responses. On the other hand, items 5 and 6 show lower standard deviations (0,748 and 0,848, respectively), suggesting that responses on these aspects are more consistent.

Skewness and kurtosis analyses provide insights into data distribution. Skewness measures the symmetry of data distribution. Items 8 and 9 have significant negative skewness (-0,562 and -0,597), indicating that the data distribution is skewed to the left, deviating from normal distribution. This suggests that most respondents rated these items above the average. Conversely, item 6 shows the lowest skewness value (-0,108), indicating a more symmetric distribution, closer to normal. Kurtosis measures the peakedness of the distribution, and most items have negative kurtosis, indicating a flatter distribution compared to a normal distribution. Items 8 and 9 have kurtosis values closer to zero, suggesting that their distributions are neither too peaked nor too flat.

The range, which reflects the difference between the maximum and minimum values, was also analyzed. The smallest range of 3 is observed in items 4, 5, 6, and 7, indicating smaller variation in responses and greater consistency among respondents on these aspects. In contrast, items 1, 2, 3, 8, 9, and 10 show the highest range of 4, indicating greater variation in responses. A larger range suggests more diverse opinions or understandings among respondents on these aspects.

Overall, this research identifies both strengths and areas for improvement in respondents' understanding of the various aspects studied. Respondents showed good understanding in areas related to item 5 (branding and competitive advantage) and item 9 (AI in e-commerce). However, aspects concerning legal protection for products (item 1) require attention, as the mean score indicates a lower level of understanding. Additionally, the high variability in item 10 indicates uncertainty or differing opinions regarding the innovative role of Web Company Profiles in product commercialization. The distribution of responses, which mostly deviates from normal distribution, except for item 6, also suggests variations in how respondents rated each aspect.

Table 3. How to Obtain Legal Protection for Products

Response	Frequency	Percent	Valid Percent	Cumulative Percent
1	7	6,9 %	6,9 %	6,9 %
2	27	26,5 %	26,5 %	33,3 %
3	40	39,2 %	39,2 %	72,5 %
4	26	25,5 %	25,5 %	98,0 %
5	2	2,0 %	2,0 %	100,0 %
Total	102	100,0 %	100,0 %	

Table 3 shows that among 102 respondents, 7 (6,9 %) were very unaware of how to obtain legal protection for products. 27 (26,5 %) were somewhat unaware, 40 (39,2 %) were somewhat aware, 26 (25,5 %) were aware, and only 2 (2,0 %) were very aware. This suggests that most respondents need further education or clarification on the legal mechanisms for protecting their products.

Table 4. The Process and Techniques of Manufacturing and Marketing Products Generationally

Response	Frequency	Percent	Valid Percent	Cumulative Percent
1	2	2,0 %	2,0 %	2,0 %
2	25	24,5 %	24,5 %	26,5 %
3	29	28,4 %	28,4 %	54,9 %
4	40	39,2 %	39,2 %	94,1 %
5	6	5,9 %	5,9 %	100,0 %
Total	102	100,0 %	100,0 %	

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Table 4 illustrates that 2 (2,0 %) respondents had no knowledge of the techniques of manufacturing and marketing products generationally. A total of 25 (24,5 %) were not very familiar, 29 (28,4 %) were somewhat familiar, 40 (39,2 %) were familiar, and 6 (5,9 %) were very familiar. This suggests that a significant portion of respondents have a solid understanding of generational manufacturing and marketing techniques, although some still lack a deeper knowledge of this area.

Table 5. Intellectual Property Rights in Products and Innovations/New Designs

Response	Frequency	Percent	Valid Percent	Cumulative Percent
1	1	1,0 %	1,0 %	1,0 %
2	25	24,5 %	24,5 %	25,5 %
3	30	29,4 %	29,4 %	54,9 %
4	45	44,1 %	44,1 %	99,0 %
5	1	1,0 %	1,0 %	100,0 %
Total	102	100,0 %	100,0 %	

Table 5 reveals that 1 (1,0 %) respondent had no knowledge of intellectual property rights in products and new designs. 25 (24,5 %) had limited knowledge, 30 (29,4 %) were somewhat knowledgeable, and 45 (44,1 %) were well-versed in the topic. This indicates that the majority of respondents have a good understanding of intellectual property rights, although some still need further clarification in this area.

Table 6. How to Obtain Protection for Products such as Trademarks, Copyrights, and Industrial Designs

Response	Frequency	Percent	Valid Percent	Cumulative Percent
2	20	19,6 %	19,6 %	19,6 %
3	41	40,2 %	40,2 %	59,8 %
4	40	39,2 %	39,2 %	98,0 %
5	1	1,0 %	1,0 %	100,0 %
Total	102	100,0 %	100,0 %	

Table 6 reveals that 20 respondents (19,6 %) were unaware of how to obtain protection for products such as trademarks, copyrights, and industrial designs. Meanwhile, 41 respondents (40,2 %) were somewhat aware, and 40 respondents (39,2 %) were fully aware. Only 1 respondent (1,0 %) was very familiar with the process. This suggests that while most respondents have a sufficient understanding of how to protect their products, there is still room for improvement, particularly in increasing awareness regarding intellectual property protection.

Table 7. The Difference Between Branded and Non-Branded Products and Their Impact on Competitive Advantage

Response	Frequency	Percent	Valid Percent	Cumulative Percent
2	12	11,8 %	11,8 %	11,8 %
3	41	40,2 %	40,2 %	52,0 %
4	45	44,1 %	44,1 %	96,1 %
5	4	3,9 %	3,9 %	100,0 %
Total	102	100,0 %	100,0 %	

Table 7 shows that the majority of respondents, 45 individuals (44,1 %), expressed a strong understanding of the differences between branded and non-branded products, as well as their impact on competitive advantage. Furthermore, 41 respondents (40,2 %) indicated a moderate understanding, while only 12 respondents (11,8 %) reported a lack of understanding. Only 4 respondents (3,9 %) were very knowledgeable in this area. This suggests that while most respondents have a good grasp of how branding influences competitive advantage, there is still a small group that requires further clarification.

Table 8. How to Present Products with Attractive Packaging (Design) on the Web

Response	Frequency	Percent	Valid Percent	Cumulative Percent
2	17	16,7 %	16,7 %	16,7 %
3	42	41,2 %	41,2 %	57,8 %
4	35	34,3 %	34,3 %	92,2 %
5	8	7,8 %	7,8 %	100,0 %
Total	102	100,0 %	100,0 %	

Table 8 indicates that 42 respondents (41,2 %) have a moderate understanding of how to present products with attractive packaging (design) on the web. Another 35 respondents (34,3 %) expressed a good understanding, while 17 respondents (16,7 %) were not familiar with the concept. Only 8 respondents (7,8 %) were very knowledgeable in this area. This suggests that while most respondents possess a reasonable understanding of the importance of product packaging design on digital platforms, some still require further education on this matter.

Table 9. The Importance of Promotion and E-commerce Through Digital Online Channels for Increasing Revenue

Response	Frequency	Percent	Valid Percent	Cumulative Percent
2	12	11,8 %	11,8 %	11,8 %
3	45	44,1 %	44,1 %	55,9 %
4	41	40,2 %	40,2 %	96,1 %
5	4	3,9 %	3,9 %	100,0 %
Total	102	100,0 %	100,0 %	

Table 9 shows that 12 respondents (11,8 %) were unaware of the importance of promotion and e-commerce through online digital channels for increasing revenue. Forty-five respondents (44,1 %) were somewhat aware, and 41 respondents (40,2 %) were fully aware. Only 4 respondents (3,9 %) had a very deep understanding. These results suggest that the majority of respondents recognize the value of digital promotion and e-commerce for increasing business revenue, but there is still a small group that may benefit from further awareness.

Table 10. The Importance of Product Innovation

Response	Frequency	Percent	Valid Percent	Cumulative Percent
1	2	2,0 %	2,0 %	2,0 %
2	14	13,7 %	13,7 %	15,7 %
3	41	40,2 %	40,2 %	55,9 %
4	43	42,2 %	42,2 %	98,0 %
5	2	2,0 %	2,0 %	100,0 %
Total	102	100,0 %	100,0 %	

Table 10 shows that 2 respondents (2,0 %) were very knowledgeable, and 14 respondents (13,7 %) had little understanding of the importance of product innovation. Meanwhile, 41 respondents (40,2 %) were somewhat familiar with the concept, and 43 respondents (42,2 %) had a solid understanding. Only 2 respondents (2,0 %) were very unfamiliar with this topic. This indicates that most respondents acknowledge the significance of product innovation in boosting competitiveness, although some may need further exposure or understanding.

The sale of products through e-commerce platforms or marketplaces, facilitated by AI, has increasingly become a focal point in the digital business world. To understand how this technology is perceived, a survey conducted in a 2024 study gathered responses from 102 participants. The survey results revealed that 2 respondents (2,0 %) rated the use of AI with a score of 1, while 14 respondents (13,7 %) gave a rating of 2. A total of 32 respondents (31,4 %) assigned a score of 3, and 49 respondents (48,0 %) rated it with a 4. Finally, 5 respondents (4,9 %) gave a rating of 5. Consequently, the cumulative percentage of the responses totaled 100 %, reflecting the diverse perspectives of the respondents on the application of AI in online product sales.

The role of innovative company profiles on the web in product commercialization has become an important topic in the digital business world. A study conducted in 2024 surveyed respondents to assess how they perceive

the role of company web profiles in the product commercialization process. Of the 102 participants involved, 4 respondents (3,9 %) rated it with a score of 1, while 24 respondents (23,5 %) gave a rating of 2. A total of 25 respondents (24,5 %) assigned a score of 3, and 39 respondents (38,2 %) rated it with a 4. Finally, 10 respondents (9,8 %) provided a rating of 5. Overall, this distribution of responses reflects a variety of perspectives on the impact of innovative company web profiles in supporting product commercialization, with the cumulative percentage reaching 100 %.

Testing the Outer Model

The Partial Least Squares (PLS) analysis begins with testing the Outer Model, which evaluates the validity through loading factors (Hair & Brunsveld, 2019). For the indicators of each variable, those with a loading factor less than 0,6 are excluded from the model (Hair et al., 2014). The results of the convergent validity test, after the invalid indicators were removed from the model, are presented in the table below:

Table 11. Outer Model

Indicator	Artificial Intelligence	Branding Optimization	Competitive Advantage	Value Chain Mapping
AI-1	0,848			
AI-2	0,854			
AI-3	0,873			
AI-4	0,771			
BO-1		0,847		
BO-2		0,779		
BO-3		0,839		
BO-4		0,806		
CA-1			0,894	
CA-2			0,872	
CA-3			0,888	
CA-4			0,781	
MVC-1				0,784
MVC-2				0,906
MVC-3				0,932
MVC-4				0,886

Subsequently, a discriminant validity test was conducted, yielding the following values: Artificial Intelligence = 0,858; Branding Optimization = 0,835; Competitive Advantage = 0,882; Value Chain Mapping = 0,874. These results indicate that the model meets the criteria for discriminant validity.

Table 12. Construct Validity and Reliability

Construct	Cronbach's Alpha	rho_A	Composite Reliability	Average Variance Extracted (AVE)
Artificial Intelligence	0,858	0,866	0,903	0,701
Branding Optimization	0,835	0,837	0,890	0,669
Competitive Advantage	0,882	0,888	0,919	0,740
Value Chain Mapping	0,874	0,885	0,916	0,735

Based on the table, the Cronbach's Alpha values for all constructs exceed 0,6, which is the acceptable threshold (Hair et al., 2011). Therefore, all constructs meet the criteria for construct reliability.

Testing the Inner Model

The Inner Model represents the relationships between latent variables based on substantive theory. To assess the model in PLS, we begin by examining the R-squares for each dependent latent variable. The results of the inner model test show the relationships between constructs, which can be assessed by comparing the significance values and R-square values from the research model.[13]

Table 13. R-Square Values

Construct	R Square	Adjusted R Square
Branding Optimization	0,661	0,659
Competitive Advantage	0,811	0,808
Value Chain Mapping	0,389	0,386

The R-square value for Branding Optimization (0,661) indicates that 66,1 % of its variability is explained by Artificial Intelligence, while the remaining 33,9 % is explained by other variables not included in the model. Similarly, the R-square value for Value Chain Mapping (0,389) suggests that 38,9 % of its variability is explained by Artificial Intelligence, with the remaining 61,1 % attributed to other external factors. The R-square value for Competitive Advantage (0,811) means that 81,1 % of its variability is explained by Artificial Intelligence, Branding Optimization, and Value Chain Mapping, while 18,9 % is attributed to external variables.

Testing Direct Effects

Hypothesis testing regarding the effects of the variables Competitive Advantage, Artificial Intelligence, Branding Optimization, and Value Chain Mapping is presented in figure 1.

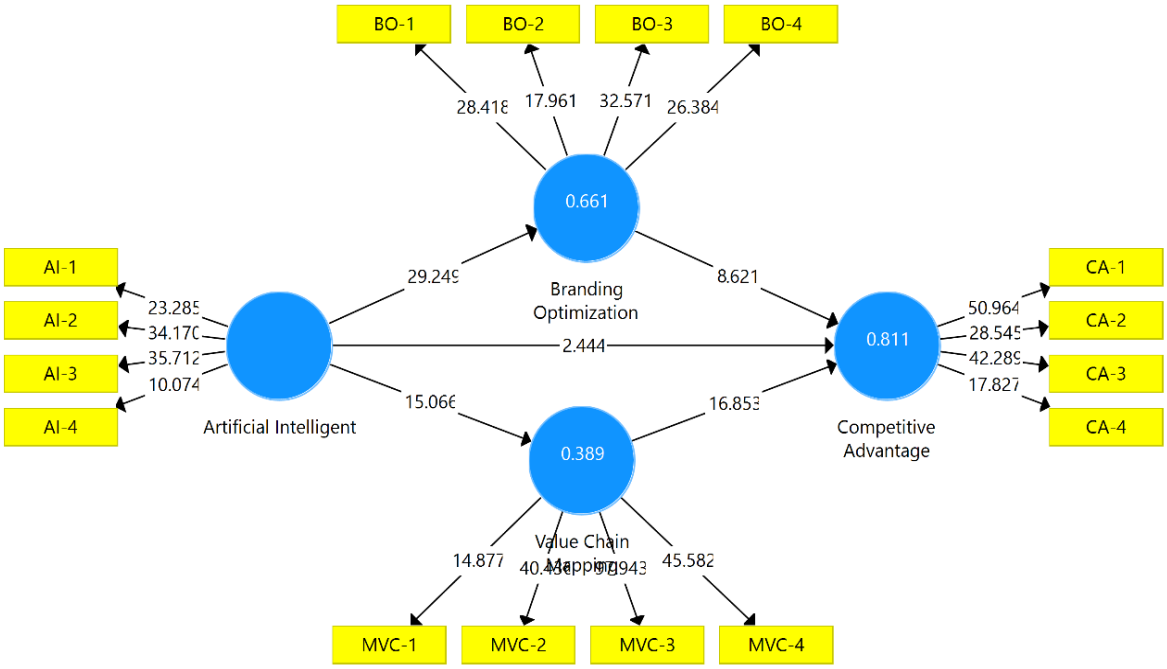

Figure 1. Path Analysis Model t-Statistics Values

Hypothesis testing in the PLS method is conducted using simulations for each hypothesized relationship, with bootstrapping applied to the sample. Bootstrapping is also used to minimize issues arising from non-normality in the research data. The T-table value for a significance level of 5 % is determined to be 1,652. All path coefficients have t-statistics values exceeding 1,652.

Table 14. Direct Effects

	Original Sample (O)	Sample Mean (M)	Standard Deviation	T Statistic	P Values
Artificial Intelligent -> Branding Optimization	0,813	0,818	0,028	29,249	0
Artificial Intelligent -> Competitive Advantage	0,144	0,143	0,059	2,444	0,015
Artificial Intelligent -> Value Chain Mapping	0,623	0,628	0,041	15,066	0
Branding Optimization -> Competitive Advantage	0,044	0,045	0,071	8,621	0,035
Value Chain Mapping -> Competitive Advantage	0,836	0,838	0,05	16,853	0

The path coefficient results for the first hypothesis between Artificial Intelligence and Branding Optimization

yield a t-statistic of 29,249 ≥ 1,652 with a P-value of 0,000 ≤ 0,05, indicating a significant positive effect. This suggests that as Artificial Intelligence increases, so does Branding Optimization.

Similarly, for the second hypothesis between Artificial Intelligence and Value Chain Mapping, a t-statistic of 15,066 ≥ 1,652 with a P-value of 0,000 ≤ 0,05 confirms a significant positive effect.

For the third hypothesis, the relationship between Branding Optimization and Competitive Advantage shows a t-statistic of 8,621 ≥ 1,652 and a P-value of 0,035 ≤ 0,05, indicating a significant positive relationship.

The fourth hypothesis testing between Value Chain Mapping and Competitive Advantage yields a t-statistic of 16,853 ≥ 1,652 with a P-value of 0,000 ≤ 0,05, signifying a strong positive impact.

Finally, the fifth hypothesis, testing the effect of Artificial Intelligence on Competitive Advantage, shows a t-statistic of 2,444 ≥ 1,652 and a P-value of 0,015 ≤ 0,05, confirming a significant effect.

In the analysis of indirect effects using SmartPLS V3.2.9, two significant relationships were identified between Artificial Intelligence (AI), Branding Optimization, Value Chain Mapping, and Competitive Advantage. First, the relationship between AI and Competitive Advantage through the mediation of Branding Optimization yielded a t-statistic value of 7,614, which is greater than the threshold of 1,652, along with a p-value of 0,004, which is smaller than 0,05. This indicates a significant positive indirect effect, meaning that an increase in AI can enhance Competitive Advantage through Branding Optimization.

Additionally, the analysis for the seventh hypothesis revealed that the relationship between AI and Competitive Advantage through the mediation of Value Chain Mapping resulted in a t-statistic value of 11,833, which is well above 1,652, and a p-value of 0,000, which is also smaller than 0,05. This confirms a significant positive indirect effect, suggesting that an increase in AI can enhance Competitive Advantage through Value Chain Mapping.

DISCUSSION

Based on the results of quantitative data analysis and model testing, this study successfully reveals a significant relationship between AI, Brand Optimization, Value Chain Mapping, and Competitive Advantage in the context of e-commerce and product protection. The results show how these elements interact and influence each other, providing important insights for the development of digital business strategies, particularly for companies involved in e-commerce and intellectual property protection.

The results of the model validity test in this study show satisfactory findings, with the Outer Model tested using factor loading, indicating that all variable indicators have significant loading values (greater than 0,6). These findings are consistent with guidelines from previous studies, which emphasize that factor loadings above 0,6 are indicators of good validity in measuring relevant constructs.[14,15] Furthermore, the discriminant validity test conducted on the variables in this study, such as AI, Brand Optimization, Competitive Advantage, and Value Chain Mapping, shows strong values, with the values for each variable being 0,858, 0,835, 0,882, and 0,874, respectively. These values, which demonstrate strong discriminant validity, confirm that the model effectively differentiates between distinct constructs, which is crucial for establishing its predictive ability.[16] This high predictive ability indicates that the model can reliably predict outcomes, strengthening its practical application in the context of the research.[17] Moreover, the evidence of discriminant validity supports the notion that each construct tested is not only theoretically relevant but also demonstrates reliability in practical application. The alignment of these constructs with established theoretical frameworks enhances the validity of the constructs, ensuring that the model accurately measures the intended concepts.[18]

In the context of model evaluation, it is important to recognize that while high factor loadings and strong discriminant validity are crucial, they do not guarantee the effectiveness of the model in real-world applications, particularly in e-commerce and branding. Asher[19] emphasizes the need to assess practical relevance alongside statistical validity to ensure that the model provides actionable insights and solves real-world problems.[20] Furthermore, the predictive quality of these models must be rigorously tested to confirm their ability to forecast outcomes accurately in industry settings.[21] This involves conducting follow-up tests that not only evaluate statistical performance but also ensure theoretical relevance, aligning the model with established principles and theories. Ultimately, a comprehensive approach that integrates these aspects will enhance the application of the model and support critical decision-making in various contexts.

Overall, the results of this study provide strong evidence that the model tested is valid in measuring relevant constructs, consistent with the latest international literature, and offers practical potential in the evolving context of branding and e-commerce. Therefore, this model is expected to contribute to understanding the application of AI in brand optimization, creating competitive advantage, and mapping value chains in today's digital industry.

The construct reliability test in this study, conducted using Cronbach's Alpha, rho_A, and Composite Reliability, shows very good results, with all Cronbach's Alpha values greater than 0,6, as recommended by Sarstedt[22]. This result confirms that the constructs tested have a high level of reliability, meaning that the instruments used in this study are dependable and consistent in measuring the intended aspects. High reliability is crucial in

ensuring that the model developed is not only valid but also capable of providing stable and trustworthy results when used to analyze more complex relationships between variables in a broader context.

These findings are consistent with the literature, which shows that Cronbach's Alpha values above 0,6 qualify as indicators of reliability. According to Henseler[23], reliability tests such as rho_A and Composite Reliability also guarantee that the constructs tested have good internal consistency, which is important for supporting model quality. Specifically, Composite Reliability is a more accurate measure in the context of PLS-SEM-based models because it considers the variation among indicators.

Furthermore, research by Ringle[24] emphasizes that construct reliability significantly impacts the model's ability to predict more complex variables, as reflected in the relationships between variables in this study. With tested reliability, this model is not only trustworthy for statistical analysis but can also provide deeper insights into the relationships between more complex constructs in the field. Therefore, the results of this reliability test provide strong support for the validity and reliability of the model developed, ensuring that the instruments used can be relied upon to analyze the relationships between variables in the context of this research.

The results of the direct and indirect effect tests conducted in this study show significant relationships between the variables examined, providing important insights into the role of AI in brand optimization, value chain mapping, and achieving competitive advantage in the digital market. First, a strong positive relationship was found between AI and Brand Optimization, with a t-statistic of 29,249, far exceeding the threshold value of 1,652 used to test significance. This finding suggests that the implementation of AI in branding strategies can significantly improve branding efficiency and effectiveness, which in turn contributes to enhancing a company's competitiveness. Other studies also indicate that the use of AI in branding helps companies better understand consumer behavior and strengthen their brand positioning in an increasingly competitive market.[25,26]

Next, the direct effect of AI on Value Chain Mapping was also highly significant, with a t-statistic of 15,066. This indicates that the application of AI enables more effective analysis and mapping of the value chain, which in turn helps companies optimize distribution and production flows. AI allows companies to analyze larger and more complex data quickly, leading to better decision-making in supply chain management and operational strategies. In line with this finding, a study shows that AI can enhance visibility and efficiency in supply chain management, which is crucial in an increasingly complex business world.[18,27,28,29]

The relationship between Brand Optimization and Competitive Advantage also shows a significant positive influence with a t-statistic of 8,621, though smaller compared to the direct relationship between AI and Competitive Advantage. This reflects that while brand optimization has an important impact, a company's competitive advantage does not rely solely on brand strength but is also influenced by other factors, such as product innovation, service quality, and marketing effectiveness. Research suggests that brand optimization can increase brand awareness, but long-term competitive advantage also requires the integration of innovation and effective marketing strategies.[30,31]

Meanwhile, the greatest influence on Competitive Advantage was found in the relationship between Value Chain Mapping and Competitive Advantage, with a t-statistic of 16,853. This suggests that value chain optimization is key to creating sustainable competitive advantage. An effective value chain map allows companies to enhance efficiency, reduce costs, and improve product or service quality, which in turn strengthens their competitive position in the market. This finding is consistent with the work of Al-Shammari[32], who states that effective value chain management provides companies with significant competitive advantages by creating operational efficiencies.

In addition to direct effects, this study also found significant indirect effects of AI on Competitive Advantage through the mediating roles of Brand Optimization and Value Chain Mapping. The analysis results show that AI significantly influences Competitive Advantage through Brand Optimization (t-statistic 7,614) and Value Chain Mapping (t-statistic 11,833). This suggests that AI not only directly impacts competitive advantage but also influences other variables that contribute to achieving competitive advantage, such as brand optimization and value chain efficiency. This finding aligns with studies that state AI serves as a key driver in various operational and strategic aspects of a company, contributing to increased competitive advantage.[33]

Overall, the results of these direct and indirect effect tests provide strong evidence that AI implementation plays a crucial role in creating competitive advantage through brand optimization and value chain mapping. These findings highlight the importance of applying AI in company strategies, especially in the digital era, to achieve sustainable competitive advantage.

The results of this study provide several practical implications for companies aiming to enhance their competitiveness in the e-commerce and digital industries. First, companies need to integrate AI technology into their branding strategies and value chain management to improve operational efficiency and create a competitive advantage. Proper implementation of AI can not only enhance the understanding of consumer behavior but also optimize operational processes such as logistics and inventory management.

Second, companies should focus on developing and maintaining a strong brand identity, as although brand

optimization has a positive influence on competitive advantage, its impact is relatively smaller compared to other factors, such as the value chain. Therefore, companies must strike a balance between strengthening the brand and optimizing internal processes to ensure they can survive and thrive in an increasingly competitive market.

Finally, this study also highlights the importance of effective value chain mapping as a key to achieving sustainable competitive advantage. By leveraging AI technology to improve value chain mapping, companies can create higher efficiency, reduce costs, and improve the quality of services provided to consumers, which in turn will strengthen their position in the market.

The current study has several limitations that should be taken into consideration. First, the sample size used may not fully represent the population of companies in the e-commerce sector or those involved in intellectual property protection, meaning the findings of this study may not be generalizable to the entire industry or across different geographical regions. Second, the data collected relies on respondent reports, which may be influenced by biases, such as the tendency to provide socially desirable responses or recall biases, potentially affecting the accuracy of the study's results. Additionally, while this research covers key constructs such as Artificial Intelligence, Branding Optimization, and Value Chain Mapping, other external variables that may influence the relationships between these constructs, such as market trends or regulatory changes, were not accounted for. Finally, although the quantitative approach provides a clear overview of the relationships between variables, it does not fully capture the complexity and dynamics involved. Therefore, future research utilizing qualitative methods could offer deeper insights into the practical implications of these findings.

CONCLUSIONS

Based on the results of this study, it can be concluded that the implementation of AI has a significant impact on improving brand optimization, value chain mapping, and competitive advantage for companies. The findings show that AI can strengthen a company's branding strategy by more effectively analyzing consumer behavior and market trends, thereby enhancing the brand's position in the market. Furthermore, AI has been shown to increase efficiency in value chain mapping, helping companies optimize operational processes and improve internal performance. Additionally, both directly and indirectly, AI plays a significant role in enhancing a company's competitive advantage by improving branding and operational efficiency. The indirect impact of AI on competitive advantage through the mediation of brand optimization and value chain mapping underscores the importance of integrating AI into broader business strategies. Overall, this study provides evidence that companies integrating AI into their branding and value chain management strategies can achieve a stronger competitive advantage in a highly competitive market. These findings are expected to serve as a reference for companies and other researchers to develop more effective AI-based strategies to address the challenges of the digital market.

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