

Design and Evaluation of Geo-Marketing Enabled CMS E-Catalog Platform for Improving Digital Competitiveness of SMEs

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Abstract

Digital transformation has become a global phenomenon, reshaping how organizations operate and create value. In Indonesia, the digitalization of Micro, Small, and Medium Enterprises (MSMEs) is a national priority, yet many MSMEs still rely on social media and have not adopted integrated systems combining Content Management Systems (CMS) and geo-marketing. This study distinguishes two connected phases: development of the WarungUKM CMS-based e-catalog platform using the ADDIE framework and a subsequent cross-sectional empirical evaluation of relationships among CMS adoption, geo-marketing and location-based services, platform satisfaction, and digital competitiveness. The evaluation involved 200 MSME users in Central Java selected through purposive sampling and analyzed using Partial Least Squares Structural Equation Modeling (PLS-SEM). The reported structural relationships were statistically significant: CMS adoption was positively associated with digital competitiveness ($\beta = 0.205$, $p = 0.002$) and platform satisfaction ($\beta = 0.316$, $p < 0.001$); geo-marketing was positively associated with digital competitiveness ($\beta = 0.286$, $p < 0.001$) and platform satisfaction ($\beta = 0.305$, $p < 0.001$); and platform satisfaction was positively associated with digital competitiveness ($\beta = 0.306$, $p < 0.001$). Indirect-effect estimates further indicate that platform satisfaction partially mediates the relationships of CMS adoption and geo-marketing with digital competitiveness. These findings describe predictive associations within the sampled platform users and should not be interpreted as definitive causal effects. The study highlights the value of integrating manageable CMS functions, location-based marketing, and user-centered platform quality when supporting MSME digital competitiveness.

Keywords: Msmes, Digital Transformation, CMS, Geo-Marketing, Digital Competitiveness, Platform Satisfaction

1. Introduction

Digital transformation has become a global phenomenon that drives fundamental changes in the way organizations operate and create value. The integration of digital technologies is essential to achieve sustainable development, which encompasses social, environmental and economic dimensions. Digitalization not only changes the landscape of large industries, but also opens up new opportunities for the Micro, Small, and Medium Enterprises (MSMEs) sector. There are about 70 million MSMEs in ASEAN, accounting for 97.2%–99.9% of total businesses, with micro-enterprises forming the majority. They contribute significantly by providing 85% of employment, 44.8% of GDP, and 18% of national exports [1].

SMEs still face a digital divide compared to large enterprises, but adopting technologies such as generative AI, data analytics, and digital work can help address challenges while strengthening long-term resilience [2], [3], [4]. In Indonesia, the digital transformation of MSMEs is a national priority in efforts to recover the post-pandemic economy and improve global competitiveness. Digital adoption among Indonesian micro and small enterprises remains uneven. Evidence from a survey across 17 provinces shows that differences in owner characteristics, firm conditions, business environments, connectivity infrastructure, and local culture are associated with disparities in digital adoption. The study also finds a positive association between digital adoption and sales growth, underscoring the need for support tailored

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to firms' differing circumstances [5]. A study by [6] indicates that most MSMEs primarily rely on social media for marketing activities, with limited adoption of more advanced digital management systems such as CMS. This finding aligns with insights from [7] and the literature review by [8], which highlight media social as the dominant digital tool for promotion, while resource constraints and digital literacy gaps pose barriers to more professional digital integration. Empirical research on location-based mobile advertising indicates that the effectiveness of geographically targeted promotions is strongly influenced by location-context quality and users' perceptions of the relevance and benefits of location-based services [9].

In this context, a CMS-based E-Catalog platform offers a strategic solution. CMS such as WordPress, Joomla, or Shopify make it easy for MSMEs to manage product content, stock, and pricing information independently without requiring high programming skills [10].

The adoption of a Content Management System (CMS) can enhance efficiency, strengthen online visibility, and improve the professional image of digital businesses. At the same time, the geo-marketing approach offers more accurate market segmentation by leveraging customers' geographic data. As defined by [11], geo-marketing refers to the application of geographic information in planning and executing marketing strategies, allowing businesses to identify and evaluate opportunities based on spatial factors. By employing digital mapping technologies, data can be visualized spatially, which supports more targeted analysis across specific regions. This method is widely applied in various contexts, such as determining new business locations, optimizing the placement of advertisements, tailoring website content to user locations, and conducting location-based digital advertising. Moreover, geo-marketing enables a detailed mapping of customer distribution. As a form of knowledge-driven marketing, it is supported by Geographic Information Systems (GIS) and advanced mapping tools that facilitate decision-making through structured analysis, including data modeling, data mining, and the identification of patterns and deviations in consumer behavior [12].

In this context, location intelligence becomes a technical method for integrating spatial data with geographically accurate business and social information, to uncover hidden patterns that can improve business effectiveness while minimizing the risk of misplaced investments. The rapid development of digital cities and e- environments has also opened up new opportunities in the living, working and entertainment aspects of modern society. Geo-marketing strategies use technologies such as GPS, digital maps, and real-time location data to customize promotional campaigns contextually and locally [13]. In digital marketing, geo-marketing is proven to increase engagement, conversion, and customer loyalty. Unfortunately, there are still few studies in Indonesia that simultaneously examine the integration between the utilization of CMS platforms and geo-marketing approaches in improving the digital competitiveness of local MSME products.

Digital competitiveness in this study is reflected through several indicators, including online visibility, promotional efficiency, market penetration, and revenue growth [14], [15]. The E-Catalog platform represents a digital innovation designed to support MSMEs in independently promoting local products through a user-friendly system. Built on Content Management Systems (CMS) such as WordPress or OpenCart, this platform enables MSME actors to organize and update product catalog content without requiring advanced technical knowledge. A distinctive strength of the platform lies in the integration of geo-marketing features, namely promotion strategies based on geographic locations. With this feature, catalog content can be customized according to the consumer's location or targeted market area, thereby enhancing the relevance and effectiveness of promotional efforts.

The WarungUKM platform was initially developed through a Research and Development (R&D) process structured by the ADDIE model: needs analysis, system and interface design, CMS and geo-marketing feature development, implementation for MSME use, and formative evaluation. This development phase produced the technological artifact evaluated in the present study. The article does not treat ADDIE as the design of the hypothesis test; instead, the empirical phase uses a cross-sectional explanatory quantitative design and PLS-SEM to evaluate predictive relationships among users' perceptions of CMS adoption, geo-marketing and location-based services, platform satisfaction, and digital competitiveness.

Research on MSME digitalization generally focuses on the adoption of technology, social media, or e-commerce separately. Although digital technology has been proven to improve MSME performance and competitiveness, most studies still view Content Management Systems (CMS) and digital marketing as stand-alone elements. Furthermore,

research integrating CMS architecture with geo-marketing features in a single platform is still very limited. Therefore, this study fills this gap by developing and evaluating a CMS-based e-catalog platform integrated with geo-marketing to improve MSME digital competitiveness. This research contributes to strengthening the digital transformation literature and providing a more comprehensive systems approach to MSME development.

2. Literature Review

2.1. CMS-based E-Catalog Platform

Small and medium-sized enterprises (SMEs) need practical, cost-effective, and efficient marketing strategies to expand their market reach. One promising approach is the implementation of web-based information technology, such as a Content Management System (CMS), which simplifies website management and enables seamless content distribution. A Content Management System (CMS) is software that can be used to organize, control, or manage website content, where data can include text, links, images, videos, HTML documents, and other media formats [16]. CMS is basically a web-based system that allows users to add, edit, and display content without having to have technical programming skills [10]. CM) consists of software, applications, databases, and other elements that serve as an information framework for both corporate and global needs.

In the MSME context, a Content Management System (CMS) functions as the core framework for building e-catalog platforms that act as tools for product promotion and communication with prospective buyers. The CMS-based e-catalog is regarded as a digital innovation that enables MSMEs to manage their product listings independently, with greater flexibility and efficiency. According to [17] CMS enhances the online visibility of small enterprises by offering a system that is user-friendly, adaptable in terms of design, and efficient in updating product details. This technology not only fosters digital autonomy for MSMEs but also broadens their online marketing reach. Hence, employing CMS as the foundation of an e-catalog is a strategic move to accelerate MSME digitalization and strengthen the competitiveness of local products.

2.2. MSMEs and Digital Transformation

Digital transformation can help SMEs strengthen their competitiveness by developing digital capabilities and adapting their business models. Their importance extends beyond individual firms: SMEs are estimated to account for approximately 90% of businesses and more than half of employment worldwide [18], [19].

In Indonesia, Law No. 20 of 2008 defines MSMEs as productive enterprises managed by individuals or business entities that fall within the criteria of micro, small, and medium-scale businesses, determined by net assets or annual sales. The advancement of digital transformation creates opportunities for MSMEs to expand their market presence both domestically and globally through digital platforms. Improved online accessibility allows wider distribution of goods and services, thereby opening greater prospects for business growth [20]. MSMEs with higher levels of digital capability are progressing toward becoming fully digital enterprises, whereas those with lower levels of maturity tend to focus only on digitizing specific functions such as sales [21].

Within the MSME context, digital transformation can be understood as a fundamental shift in business operations and strategic approaches, driven by the adoption of digital technologies. These include the use of information systems, e-commerce, online marketing platforms, as well as integration with cloud computing and artificial intelligence [22]. The transformation not only covers the digitization of production and distribution but also encourages the creation of business models that are more adaptive to rapid changes in the digital environment. Moreover, digital technologies enhance the resilience of MSMEs in developing countries and provide a stronger foundation for their future sustainability [23].

Digitalization enables MSMEs to enter global supply chains, reduce transaction costs, and reach new customers across geographical boundaries [24]. Utilizing technologies such as cloud, data analytics, and e-commerce helps improve customer experience, efficiency, revenue, and expand markets [25].

Digitalisation of MSMEs became a policy priority in Indonesia, with a stated target of bringing 30 million MSMEs into the digital ecosystem by 2024. Empirical research in Indonesia also found that the use of e-payment and e-commerce services was positively associated with MSME supply chain performance [26]. However, SMEs often lag

behind larger firms in digitalization because of limitations in information technology resources, employee skills, and digital strategy, which may constrain the performance benefits expected from digital transformation [27].

2.3. Geo-Marketing in Digital Marketing

Geo-marketing is a marketing approach that utilizes geographic data to develop more targeted communication, promotion, distribution, and market segmentation strategies. Geo-marketing models can be used by managers to formulate strategies for determining supermarket locations by considering store characteristics, competitor conditions, and the surrounding environment, while also providing an overview of the supermarket's sales potential [28]. Geo-marketing is the application of geographical and spatial data to marketing strategy in order to improve decision-making and customer targeting [29]. Tudor further stated that Geo marketing is useful for businesses in terms of: (i) adapting quickly to changes in demand, (ii) improving last-minute logistics, and (iii) outperforming the competition in crowded markets due to real-time mapping of consumer movements and environmental conditions.

Geo-marketing combines geographic data with marketing information to support decisions about market coverage and customer targeting. Geographic information systems (GIS) enable spatial analysis of potential markets, while GPS-enabled mobile applications allow businesses to deliver promotions based on customers' real-time locations [30], [31]. The objective is to deliver promotions that are personalized, contextually relevant, and aligned with customers' local preferences.

For MSMEs, geo-marketing presents an opportunity to increase promotional visibility and effectiveness even with limited resources. Empirical evidence on location-based mobile advertising suggests that contextually relevant location information can strengthen users' attitudes toward targeted promotions and improve their marketing effectiveness [9]. Applying geomarketing in combination with statistical methods, provides opportunities to generate added value while incorporating spatial aspects into marketing analysis. Such an approach can also serve as a decision-support tool for managers in selecting new store locations, thereby enabling firms to sustain their competitive advantage in the marketplace [32]. In addition, this strategy also helps MSMEs in segmenting promotional areas, determining the location of new branches or outlets, and adjusting promotional messages to the local cultural context.

2.4. Digital Competitiveness of Local Products

More than two-thirds of SMEs have increased their digitalization efforts to stay in business or potentially outperform their competitors [22]. In the era of the digital economy, competitiveness is no longer only determined by price and product quality, but also by the ability of businesses to utilize digital technology to reach markets, build brands, and improve operational efficiency.

The notion of digital competitiveness refers to the extent to which businesses or organizations are able to perform effectively in digital markets by leveraging information and communication technologies in a strategic manner [33]. [34] emphasizes that competitive advantage can be achieved through two key approaches: product differentiation and cost leadership. Within the digital economy, both strategies can be reinforced through the application of technologies such as e-commerce, digital marketing tools, big data analytics, and content management systems (CMS). Studies further suggest that an organization's digital competitiveness depends largely on its capacity to adapt swiftly to dynamic markets, shifts in consumer digital behavior, and the adoption of new technologies actors that are strongly shaped by innovation and organizational agility [35], [36], [37].

For micro, small, and medium enterprises (MSMEs), the pursuit of digital competitiveness often comes with unique obstacles. Constraints in infrastructure, limited digital literacy, and the lack of modern marketing practices remain major challenges. Even so, a growing body of research shows that local products are able to gain competitive leverage in digital markets when supported by appropriate strategies. Empirical findings reveal that MSMEs utilizing digital platforms such as e-catalog applications, social media networks, and e-commerce marketplaces tend to achieve higher online visibility and improved efficiency in marketing activities [38], [39], [40]. In addition, the ability to reach broader markets, reduce costs, and benefit from network effects has been shown to produce significant and immediate impacts on the performance of emerging startups [41].

Digital competitiveness in the context of MSMEs and local products can be measured through online visibility, market reach, growth in digital sales, marketing efficiency, and customer satisfaction. Online visibility refers to a business's

presence on search engines, digital directories, social media, and e-commerce platforms, while market reach reflects its ability to access local, regional, and national customers through these channels. Growth in digital sales shows the extent to which marketplaces, websites, and social media contribute to revenue. Marketing efficiency captures the ability to promote products at relatively low cost while reaching a broad audience, and digital customer satisfaction reflects customers' experiences with online shopping, digital interactions, and the speed of service. [42] stated the importance of technology-based innovation in winning the digital market through value strategies, which is in line with the CMS platform and geo-marketing approaches.

2.5. Theoretical Foundation and Hypothesis Development

The research model is grounded in a parsimonious combination of technology-acceptance, resource-based, and value-co-creation perspectives. The Technology Acceptance Model (TAM) explains why perceived usefulness and ease of use support continued technology utilization and favorable user evaluations [43]. In the MSME context, a CMS that is perceived as useful, manageable, and operationally supportive is therefore expected to be positively associated with both digital competitiveness and platform satisfaction.

H1: CMS-Based E-Catalog Platform Adoption is positively associated with MSME Digital Competitiveness.

H2: CMS-Based E-Catalog Platform Adoption is positively associated with Platform Satisfaction.

The Resource-Based View conceptualizes valuable and organizationally embedded capabilities as potential sources of competitive advantage [44]. Geo-marketing capability allows MSMEs to use location information for local targeting, market-reach decisions, and context-relevant promotion. It is therefore expected to be positively associated with digital competitiveness. Location accuracy and relevance may also improve users' evaluation of the platform because the service better fits their marketing tasks and local customer context.

H3: Geo-Marketing and Location-Based Services are positively associated with MSME Digital Competitiveness.

H4: Geo-Marketing and Location-Based Services are positively associated with Platform Satisfaction.

Service-Dominant Logic views value as realized through use and interaction rather than embedded in technology alone [45]. Accordingly, satisfaction indicates that users perceive the platform as relevant, usable, and supportive of their activities. Higher satisfaction is therefore expected to be positively associated with the MSME's ability to use the platform for market reach, promotion, adaptation, and competitive positioning.

H5: Platform Satisfaction is positively associated with MSME Digital Competitiveness.

Because CMS adoption and geo-marketing are each hypothesized to predict platform satisfaction, which in turn predicts digital competitiveness, the framework also implies two indirect relationships. Platform Satisfaction is therefore evaluated as a potential mediator between (a) CMS adoption and digital competitiveness and (b) geo-marketing and digital competitiveness [46]. The proposed conceptual framework is presented in figure 1.

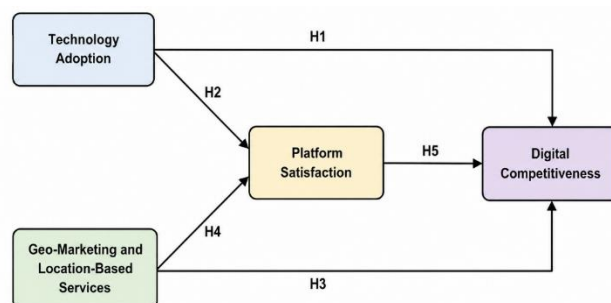


Figure 1. Conceptual framework and hypothesized relationships

3. Methodology

This research comprised two connected methodological components. Phase 1 was platform development: the WarungUKM CMS-based e-catalog was developed using ADDIE through needs analysis, architecture and interface design, CMS and geo-marketing feature development, implementation, and formative evaluation. The resulting

platform provides product-catalog management, promotional functions, GIS-based business-location mapping, and location-based marketing services. Phase 2 was empirical evaluation: after implementation, MSME users completed a survey assessing the constructs in the proposed research model. Thus, ADDIE explains how the evaluated artifact was produced, whereas the explanatory quantitative design and PLS-SEM explain how relationships among user perceptions were assessed.

The empirical phase used a cross-sectional explanatory quantitative design to assess predictive associations among CMS-Based E-Catalog Platform Adoption, Geo-Marketing and Location-Based Services, Platform Satisfaction, and MSME Digital Competitiveness. PLS-SEM was applied in SmartPLS because the model involves multiple latent constructs and emphasizes explained variance and prediction. Given the observational, cross-sectional design, path coefficients are interpreted as statistical associations or predictive relationships rather than causal effects.

The study population comprised MSMEs in Central Java using digital e-catalog platforms. Purposive sampling produced an analytical sample of 200 MSME owners or managers who had used a CMS-based e-catalog for at least six months and had experience with location-based promotion. Data were collected using a closed-ended questionnaire with a five-point Likert scale (1 = strongly disagree to 5 = strongly agree). These eligibility criteria ensured respondents had sufficient experience to evaluate the platform, but they also excluded non-users, early-stage users, unsuccessful adopters, and MSMEs without geo-marketing experience. Consequently, the design may restrict variability and yield more favorable assessments than would be observed across the broader MSME population; this boundary is considered when interpreting and generalizing the findings.

Before model estimation, the 200 selected records were screened for completeness and valid response ranges. No missing values were present in the analytical variables, all substantive responses fell within the five permitted Likert categories, and no imputation was performed. Respondent identifiers were unique. Because PLS-SEM does not require multivariate normality, distributional inspection was used descriptively rather than as an exclusion rule. [Table 1](#) summarizes the demographic and platform-use profile of the 200 respondents retained after this screening process.

Table 1. Respondent characteristics (n = 200)

Characteristic	Category	n	%
Gender	Female	113	56.5
	Male	87	43.5
Age	<25 years	10	5.0
	25-34 years	24	12.0
	35-44 years	60	30.0
	45-54 years	91	45.5
	>54 years	15	7.5
Business scale	Micro	162	81.0
	Small	38	19.0
Employees	Owner only	88	44.0
	2-5	89	44.5
	6-10	19	9.5
	>10	4	2.0
Platform use	<6 months	50	25.0
	6-12 months	114	57.0
	1-2 years	29	14.5
	>2 years	7	3.5

Most respondents were female (56.5%), aged 45-54 years (45.5%), and operated micro-scale businesses (81.0%). In terms of staffing, 88.5% were either owner-only businesses or employed two to five people, while 57.0% had used the platform for 6-12 months. This profile indicates that the analytical sample was dominated by micro-enterprises with relatively recent but sufficient exposure to the platform.

To clarify the technological artifact evaluated by these respondents, [figure 2](#) presents the WarungUKM system architecture. The architecture is organized into user, application/CMS, geo-marketing, and data layers, showing how catalog management and location-based services are integrated within a single platform.

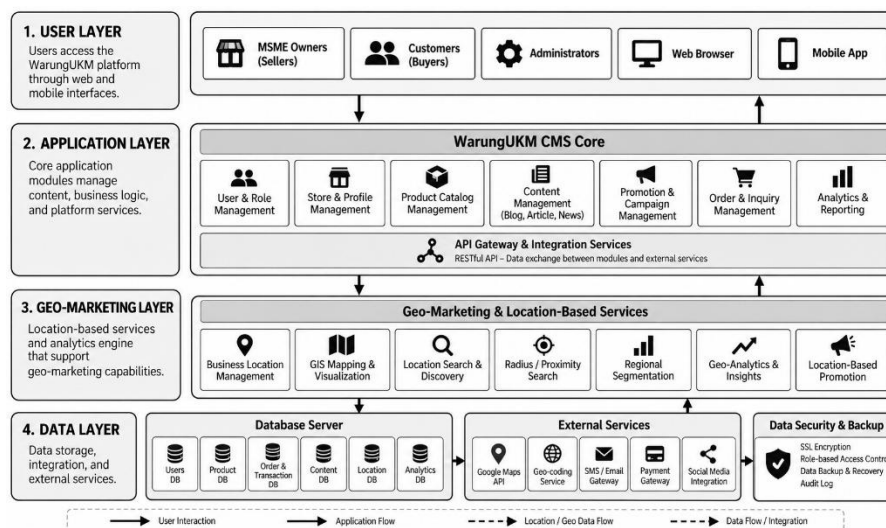


Figure 2. System Architecture of the Platform

PLS-SEM assessment proceeded in two stages. The reflective measurement model was evaluated using indicator loadings, Cronbach's alpha, composite reliability, Average Variance Extracted (AVE), the Fornell-Larcker criterion, and the Heterotrait-Monotrait ratio (HTMT). The structural model was evaluated using inner Variance Inflation Factor (VIF), path coefficients, t-statistics and p-values from 5,000-resample bootstrapping, R-squared, Q-squared, and f-squared. VIF was assessed separately from discriminant validity. Effect magnitude was interpreted from f-squared rather than from path coefficients alone. Because the proposed framework implies mediation, indirect effects through Platform Satisfaction were also estimated. The Tenenhaus GoF is retained only as a descriptive legacy index and is not treated as definitive evidence of model validity, consistent with methodological cautions in PLS-SEM research [47].

The questionnaire contained 27 substantive items written in Indonesian and organized according to the conceptual domains of the research model. Table 2 presents the English rendering of each item and its disposition in the final measurement model. Item wording was developed and adapted from the technology-acceptance literature [43], geo-marketing and location-intelligence literature [11], [13], [32], platform value and satisfaction literature [45], and digital-transformation and competitiveness literature [14], [15], [33], [35]. No separate pilot-validation sample was used; measurement adequacy was evaluated in the analytical sample through indicator reliability, internal consistency, convergent validity, and discriminant validity. Indicators not retained in the reported measurement model are identified to make the instrument-selection process transparent.

Table 2. Measurement instrument and item disposition

Construct	Code	Item wording (English rendering)	Status
CMS Adoption	TA1	Digital platform use improves my business operational efficiency.	Retained
	TA2	The system helps me achieve sales targets more effectively.	Retained
	TA3	Digital technology adoption improves my business profitability.	Retained
	TA4	The platform is easy to learn even without advanced IT skills.	Retained
	GM1	Competitive pressure encourages me to use new technology.	Retained
Geo-Marketing/Location Services	GM2	I believe my business data are adequately protected.	Not retained
	GM3	I intend to use this technology routinely.	Retained
	GM4	Digital technology provides an advantage over previous methods.	Retained
	GM5	The system is relatively easy to use compared with alternatives.	Retained
	GM6	I am aware of location-based features when posting products.	Retained
	GM7	The platform provides accurate location information.	Retained
	GM8	Location services help promote products locally.	Not retained
	GM9	I intend to use location features routinely in marketing.	Retained
	PS1	The system meets my product-catalog management needs.	Retained
Platform Satisfaction	PS2	I feel comfortable using this platform routinely.	Retained
	PS3	The CMS-based platform interface is easy to understand.	Retained
	PS4	Overall, I am satisfied with this platform.	Retained
	DC1	The platform helps me reach more customers.	Retained
Digital Competitiveness	DC2	My products have become better known since using digital platforms.	Retained
	DC3	I feel more competitive when using digital technology.	Retained

	DC4	The platform helps increase my product sales.	Retained
	DC5	Digital technology helps improve my business competitiveness.	Not retained
	DC6	Digital technology expands my market reach.	Retained
	DC7	My MSME can compete because of digital platforms.	Retained
	DC8	My MSME can adapt to technological change.	Retained
	DC9	Digital platforms introduce products cost-efficiently.	Not retained
	DC10	I can use social media for promotion.	Retained

4. Results and Discussion

4.1. Construct Reliability and Validity Testing

To ensure the quality of the research instrument before conducting structural analysis, reliability and construct validity testing were conducted using the Partial Least Squares Structural Equation Modeling (PLS-SEM) approach. Evaluation of the measurement model (measurement model) is a crucial stage that must be done to confirm that the indicators used are able to measure latent constructs accurately and consistently.

Testing includes four main criteria: loading factor to assess the reliability of individual indicators, Cronbach's alpha as a traditional internal consistency measure, composite reliability as a more appropriate alternative to PLS-SEM, and Average Variance Extracted (AVE) to evaluate convergent validity. This study measures four main constructs namely MSME CMS-Based E-Catalog Platform Adoption, Geo-Marketing and Location-Based Services, Platform Satisfaction, and MSME Digital Competitiveness. Table 3 reports the retained indicator loadings together with Cronbach's alpha, composite reliability, and AVE for each construct.

Table 3. Reliability and validity of constructs

Variable and Indicator	Indicators	Loading Factor	Cronbach's alpha	Composite reliability	Average variance extracted
CMS-Based E-Catalog Platform Adoption	TA1	0.818	0.846	0.848	0.683
	TA2	0.849			
	TA3	0.816			
	TA4	0.823			
Geo Marketing and Location-Based Service	GM1	0.761	0.899	0.902	0.624
	GM3	0.822			
	GM4	0.785			
	GM5	0.760			
	GM6	0.807			
	GM7	0.829			
	GM9	0.761			
Platform Satisfaction	PS1	0.803	0.827	0.830	0.658
	PS2	0.837			
	PS3	0.810			
	PS4	0.795			
Digital Competitiveness	DC1	0.829	0.912	0.916	0.619
	DC2	0.765			
	DC3	0.772			
	DC4	0.763			
	DC6	0.831			
	DC7	0.759			
	DC8	0.761			
	DC10	0.811			

The results of the reliability analysis and construct validity show excellent measurement quality for all research variables. The loading factor value of all indicators is above the 0.7 threshold with a range of 0.759-0.849, which indicates that each indicator has a significant contribution in forming its latent construct. The loading factor criteria above 0.7 indicate satisfactory individual variable reliability in accordance with the recommendations of [48] The internal reliability aspect is shown through the excellent Cronbach's alpha value, ranging from 0.827 to 0.912. All of these values exceed the minimum standard of 0.7 and even reach the highly reliable category above 0.8. Similarly,

composite reliability shows high consistency with values of 0.830-0.916, confirming that each construct has excellent composite reliability.

The AVE values (0.619–0.683) exceed the 0.5 benchmark [49], confirming that the constructs account for over 50% of indicator variance. This indicates a reliable measurement model, ready for structural analysis in the geo-marketing MSME study. Figure 3 provides a publication-ready visual summary of the retained outer loadings reported in table 3. All retained indicators exceed the 0.70 reference threshold, with loadings clustered between 0.759 and 0.849. Figure 3 supports visual inspection of indicator reliability and complements, rather than replaces, the numerical coefficients reported in table 3.

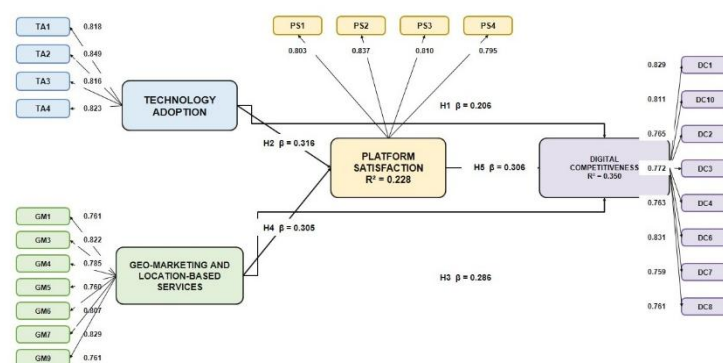


Figure 3. Outer Loading

4.2. Discriminant Validity

Following the confirmation of reliability and convergent validity, discriminant validity was examined through the Fornell-Larcker criterion, which ensures that each construct captures a unique dimension and is not confounded with other constructs in the model. Table 4 reports the square roots of AVE on the main diagonal and the inter-construct correlations in the off-diagonal cells.

Table 4. Fornell-Larcker criterion

	CMS-Based E-Catalog Platform Adoption	Digital Competitiveness	Geo Marketing and Location- Based Services	Satisfaction with the Platform
CMS-Based E-Catalog Platform Adoption	0.827			
Digital Competitiveness	0.377	0.787		
Geo Marketing and Location- Based Services	0.205	0.436	0.790	
Platform Satisfaction	0.376	0.488	0.364	0.811

Table 4 shows the discriminant validity test using the Fornell–Larcker criterion indicates that all constructs in the model demonstrate distinctiveness and satisfactory discriminant validity. The criterion is fulfilled as the square root of the Average Variance Extracted (AVE) on the main diagonal exceeds the correlation values between constructs presented in the off-diagonal elements. The MSME CMS-Based E-Catalog Platform Adoption construct shows the highest AVE square root of 0.827, indicating that this construct has very strong internal variance and is able to explain more than

68% of the variance of its indicators. Satisfaction with the Platform came in second place with a value of 0.811, followed by Geo Marketing and Location-Based Services (0.790), and MSME Digital Competitiveness (0.787). All of these values are above the minimum threshold of 0.707, confirming excellent convergent validity. From an inter-construct correlation perspective, the strongest relationship exists between MSME Digital Competitiveness and Platform Satisfaction (0.488), indicating that these two constructs are substantially conceptually related yet empirically distinct. An equally strong relationship is seen between MSME Digital Competitiveness and Geo Marketing and Location- Based Services (0.436), suggesting that geo-marketing strategies contribute significantly to the achievement of digital competitiveness.

The lowest correlation was found between MSME CMS-Based E-Catalog Platform Adoption and Geo Marketing and Location-Based Services (0.205), indicating that these two constructs have very clear conceptual differences. This

finding confirms that CMS-Based E-Catalog Platform Adoption and geo- marketing implementation are distinct dimensions of MSMEs' digital transformation, although both contribute to digital competitiveness.

Overall, fulfillment of the Fornell-Larcker criterion supports discriminant validity by indicating that each construct shares more variance with its indicators than with other constructs. This result does not test multicollinearity. Collinearity among structural predictors was therefore assessed separately using inner VIF before interpretation of the path coefficients. Because the Fornell-Larcker criterion can be less sensitive to some discriminant-validity problems, the Heterotrait-Monotrait ratio (HTMT) was assessed as a complementary criterion. [Table 5](#) presents the pairwise HTMT values used for this additional check.

Table 5. Heterotrait-Monotrait Ratio (HTMT) matrix

	CMS-Based E-Catalog Platform Adoption	Digital Competitiveness	Geo Marketing and Location- Based Services	Satisfaction with Platform
CMS-Based E-Catalog Platform Adoption				
Digital Competitiveness	0.422			
Geo Marketing and Location- Based Services	0.235	0.477		
Satisfaction with the Platform	0.443	0.552	0.417	

[Table 5](#) shows excellent discriminant validity for all research constructs. As a more sensitive and accurate criterion as Fornell- Larcker, HTMT provides additional confirmation that each construct is sufficiently unique in the structural model. All HTMT values were well below the conservative threshold of 0.90, with a range of 0.235-0.552, confirming no discriminant validity issues. Even using the stricter criterion of 0.85, all values were within acceptable limits, demonstrating the robustness of the model's discriminant validity.

The highest HTMT value occurs between Platform Satisfaction and MSME Digital Competitiveness (0.552), indicating a fairly strong conceptual linkage but still within safe limits. This is logical given that platform satisfaction is an important antecedent for achieving digital competitiveness. The lowest value was found between Geo Marketing and Location- Based Services and MSME CMS-Based E-Catalog Platform Adoption (0.235), indicating a very clear conceptual difference between the two constructs.

The HTMT findings also confirm that the moderate relationship between MSME Digital Competitiveness with Geo Marketing (0.477) and MSME CMS-Based E-Catalog Platform Adoption (0.422) indicates these constructs are interrelated yet still distinctive. HTMT results that are consistent with the Fornell-Larcker analysis provide double validation of the quality of the measurement model, so that structural analysis can proceed with high confidence in the validity and reliability of the constructs used. [Table 6](#) reports the inner VIF values for each endogenous equation.

Table 6. Inner VIF values for the structural model

Endogenous construct	Predictor	Inner VIF
Platform Satisfaction	CMS Adoption	1.044
Platform Satisfaction	Geo-Marketing	1.044
Digital Competitiveness	CMS Adoption	1.172
Digital Competitiveness	Geo-Marketing	1.160
Digital Competitiveness	Platform Satisfaction	1.294

[Table 6](#) shows that all inner VIF values are below commonly used thresholds, indicating that collinearity among predictor constructs is not a material concern. This assessment is analytically distinct from the Fornell-Larcker and HTMT evaluations of discriminant validity.

4.3. Common Method Bias Diagnostics

The first unrotated factor accounted for 39.1% of total item variance, below the commonly used 50% screening threshold, and six components had eigenvalues above 1. Full-collinearity VIF values ranged from 1.235 to 1.539, below 3.3. Together, these diagnostics do not indicate a dominant single-method factor or pathological full collinearity. Nevertheless, the tests cannot eliminate all common-method or single-informant bias, so the limitation remains relevant to interpretation. [Table 7](#) summarizes the Harman single-factor result and the construct-level full-collinearity VIF values.

Table 7. Common method bias diagnostics

Diagnostic	Construct/statistic	Value	Interpretation
Harman single-factor	Variance explained by first factor	39.1%	Below 50% screening threshold
Full-collinearity VIF	CMS Adoption	1.235	Below 3.3
Full-collinearity VIF	Digital Competitiveness	1.539	Below 3.3
Full-collinearity VIF	Geo-Marketing	1.282	Below 3.3
Full-collinearity VIF	Platform Satisfaction	1.441	Below 3.3

4.4. Structural Model

In this study, statistical significance was evaluated through a non-parametric bootstrapping technique that facilitates the calculation of p-values, path coefficients, and t- statistics for each relation proposed in the hypotheses [50]. The implementation of the PLS-SEM method provides significant advantages in generating optimized estimates based on the research sample for accurate prediction of endogenous constructs. However, this approach has the fundamental disadvantage of not presenting conventional goodness-of-fit indices that are commonly utilized in assessing the feasibility of structural models.

Structural-model assessment prioritized R-squared, Q-squared, path significance, inner VIF, and f-squared, as recommended for prediction-oriented PLS-SEM. The Tenenhaus GoF was calculated to permit comparison with earlier PLS-SEM studies; however, it is reported only as a descriptive supplementary index because GoF is not a definitive test of model validity and may not distinguish valid from misspecified models [47].

4.5. Structural Model Evaluation

The structural-model evaluation focused on explained variance and predictive relevance. R-squared assessed variance explained in the endogenous constructs, Q-squared assessed in-sample predictive relevance, and f-squared quantified each predictor's incremental contribution. The legacy GoF calculation is presented descriptively and is not used as the primary basis for accepting the model. Table 8 reports the R-squared, adjusted R-squared, and Q-squared values for the two endogenous constructs.

Table 8. R-squared, adjusted R-squared, and Q-squared

	R-square	R-square adjusted	Q-square
Digital Competitiveness	0.350	0.340	0.209
Satisfaction with the Platform	0.228	0.220	0.145

Table 8 shows good structural model performance with variations in predictive ability between endogenous constructs. The MSME Digital Competitiveness construct has the highest R² value of 0.350, indicating that 35% of the construct variance can be explained by the predictor variables in the model. The adjusted R² value (0.340) which is very close to R² indicates good model stability without significant overfitting, with a difference of only 0.010.

The Satisfaction with Platform construct showed an R² value of 0.228, explaining 22.8% of the variance with an adjusted R² of 0.220 (a difference of 0.008). The consistency between R² and adjusted R² on both constructs confirmed that the model did not experience overfitting and had good generalizability. Positive Q² values for both endogenous constructs (0.209 and 0.145) confirm that the model has sufficient predictive relevance. Q² above zero indicates that the model can predict observational data not used in the model estimation with good accuracy. GoF calculation:

- Average R² = (0.350 + 0.228) ÷ 2 = 0.289
- Average AVE = (0.683 + 0.624 + 0.658 + 0.619) ÷ 4 = 0.646
- GoF = $\sqrt{(0.289 \times 0.646)} = \sqrt{0.187} = 0.432$

The calculated GoF value was 0.432. Although this exceeds the historical 0.36 benchmark [51], it should not be interpreted as proof of strong global validity. Model interpretation instead rests on the measurement-model results, collinearity diagnostics, explained variance, predictive relevance, effect sizes, and significance of the hypothesized paths [47].

4.6. Hypothesis Testing

Figure 4 presents the PLS-SEM structural model and the estimated predictive relationships among constructs. Path coefficients, p-values, and R-squared values summarize the model's explanatory performance; they do not establish causality because the data are cross-sectional and observational.

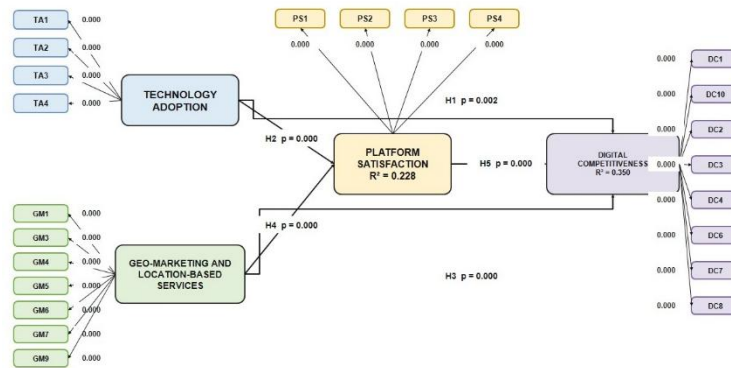


Figure 4. Structural model testing

Hypothesis testing was performed using a bootstrapping procedure with 5,000 resamples, and the results were evaluated based on path coefficients, t-statistics, and p-values at a 0.05 significance level. Table 9 reports the standardized path coefficients, t-statistics, p-values, and support decisions for H1-H5.

Table 9. Path coefficients and p-values

Hypothesis	Path	Path (β)	t- value	p- values	Decision
1	CMS-Based E-Catalog Platform Adoption → Digital Competitiveness	0.205	3.027	0.002	Supported
2	CMS-Based E-Catalog Platform Adoption → Platform Satisfaction	0.316	4.201	0.000	Supported
3	Geo Marketing and Location-Based Services → Digital Competitiveness	0.286	3.917	0.000	Supported
4	Geo Marketing and Location-Based Services → Platform Satisfaction	0.305	4.078	0.000	Supported
5	Satisfaction With Platform → Digital Competitiveness	0.306	3.898	0.000	Supported

Table 9 shows a positive association between CMS Adoption and Digital Competitiveness ($\beta = 0.205$, $t = 3.027$, $p = 0.002$); H1 is supported. The corresponding f-squared value is 0.054, indicating a small incremental contribution. CMS Adoption is positively associated with Platform Satisfaction ($\beta = 0.316$, $t = 4.201$, $p < 0.001$); H2 is supported. Its f-squared value is 0.123, indicating a small incremental contribution. Geo-Marketing and Location-Based Services are positively associated with Digital Competitiveness ($\beta = 0.286$, $t = 3.917$, $p < 0.001$); H3 is supported. The f-squared value is 0.105, indicating a small incremental contribution. Geo-Marketing and Location-Based Services are positively associated with Platform Satisfaction ($\beta = 0.305$, $t = 4.078$, $p < 0.001$); H4 is supported. The f-squared value is 0.111, indicating a small incremental contribution. Platform Satisfaction is positively associated with Digital Competitiveness ($\beta = 0.306$, $t = 3.898$, $p < 0.001$); H5 is supported. Its f-squared value is 0.114, indicating a small incremental contribution.

Platform Satisfaction has the largest standardized path coefficient among the direct predictors of Digital Competitiveness, but coefficient rank should not be conflated with practical effect magnitude. The f-squared statistics show small incremental contributions for the two CMS Adoption paths and small-to-moderate contributions for Geo-Marketing and Platform Satisfaction. The practical implication is therefore to treat CMS functionality, location-based capability, and user satisfaction as complementary rather than to infer that one component alone produces competitiveness. The f-squared values range from 0.054 to 0.123. Under conventional benchmarks, these results indicate small incremental effects; none reaches the conventional moderate threshold. Accordingly, practical magnitude is discussed from f-squared rather than inferred from the standardized path coefficient alone. Table 10 consolidates the f-squared effect sizes for the five structural relationships so that statistical significance can be interpreted alongside incremental effect magnitude.

Table 10. Effect sizes (f-squared) for structural relationships

Predictor	Endogenous construct	f-squared	Interpretation
CMS Adoption	Platform Satisfaction	0.123	Small
Geo-Marketing	Platform Satisfaction	0.111	Small
CMS Adoption	Digital Competitiveness	0.054	Small
Geo-Marketing	Digital Competitiveness	0.105	Small
Platform Satisfaction	Digital Competitiveness	0.114	Small

4.7. Indirect-Effect and Mediation Assessment

Two indirect effects implied by the research framework were assessed using the reported path estimates and their standard errors. Because the original case-level SmartPLS bootstrap output was unavailable, uncertainty was estimated transparently using 100,000-draw Monte Carlo confidence intervals derived from the reported coefficients and standard errors. This procedure is an approximation and is not presented as a replacement for nonparametric case-resampling bootstrapping [46].

Both confidence intervals exclude zero, supporting positive indirect relationships through Platform Satisfaction. Because the corresponding direct paths remain positive and statistically significant, the pattern is consistent with complementary partial mediation. The result suggests that satisfaction explains part, but not all, of the association of CMS adoption and geo-marketing with digital competitiveness. Causal mediation is not claimed because temporal ordering and unmeasured confounding cannot be established with the cross-sectional design. Table 11 presents the two estimated indirect effects together with their 95% Monte Carlo confidence intervals.

Table 11. Indirect effects through Platform Satisfaction

Indirect path				Indirect beta	95% Monte Carlo CI	Mediation	
CMS Adoption	→	Platform Satisfaction	→	Digital Competitiveness	0.097	[0.038, 0.172]	Complementary partial
Geo-Marketing	→	Platform Satisfaction	→	Digital Competitiveness	0.093	[0.036, 0.167]	Complementary partial

4.8. Importance-Performance Analysis

To complement the mediation analysis, the direct and indirect effects were combined to obtain total effects on Digital Competitiveness, and these effects were paired with the IPMA performance scores. This comparison distinguishes constructs that already perform relatively well from those with greater improvement potential. Table 12 summarizes the direct, indirect, total-effect (importance), and performance values used in the subsequent importance-performance interpretation.

Table 12. Direct, indirect, and total effects on Digital Competitiveness

Predecessor construct	Direct effect	Indirect via satisfaction	Total effect / IPMA importance	Performance
CMS Adoption	0.205	0.097	0.302	66
Geo-Marketing	0.286	0.093	0.379	57
Platform Satisfaction	0.306	-	0.306	67

Using the values summarized in table 12, figure 5 plots each predecessor construct by total-effect importance on the horizontal axis and performance on the vertical axis. Geo-Marketing has the highest total effect (0.379) but lower performance (57), whereas CMS Adoption and Platform Satisfaction show similar total effects (0.302 and 0.306) with higher performance scores (66 and 67). This separation visually highlights Geo-Marketing as the principal sample-relative improvement opportunity.

Figure 5 plots the reconciled total effects and performance scores. Geo-Marketing has the highest total effect (0.379) but lower performance (57), whereas CMS Adoption and Platform Satisfaction have similar total effects (0.302 and 0.306) and higher performance (66 and 67). The corrected ranking follows directly from Table 12 and removes the earlier label reversal.

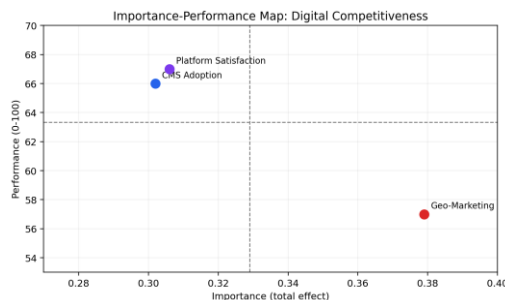


Figure 5. Importance-Performance Map

Platform Satisfaction combines a total effect of 0.306 with the highest performance score (67). Geo-Marketing combines the highest total effect (0.379) with the lowest performance score (57), creating the largest sample-relative importance-performance gap. CMS Adoption has a total effect of 0.302 and performance of 66; its importance is lower than Geo-Marketing after direct and indirect effects are reconciled. IPMA therefore identifies Geo-Marketing, rather than CMS Adoption, as the principal sample-relative improvement opportunity. This is a descriptive prioritization and not evidence that reallocating resources will causally improve competitiveness.

5. Discussion

Provide a statement that what is the results support the five hypothesized predictive relationships and the two indirect relationships specified before analysis. CMS adoption and geo-marketing are each positively associated with both Platform Satisfaction and Digital Competitiveness, while Platform Satisfaction is positively associated with Digital Competitiveness. These findings suggest a connected mechanism in which technical adoption and location-based capability relate to competitiveness both directly and indirectly through users' evaluation of the platform.

The positive associations involving CMS Adoption are consistent with TAM [43], platform characteristics related to usefulness and ease of use can support favorable evaluations and continued application. Nevertheless, the small f-squared values indicate that CMS Adoption alone explains only a limited incremental share of the endogenous constructs, underscoring the importance of complementary marketing and user-experience capabilities.

The results should not be interpreted as a retrospective confirmation of multiple theories that were not used to derive the hypotheses. Instead, the CMS-related paths are interpreted within the TAM foundation established in Section 2.5, while organizational readiness and environmental support remain contextual factors for future model extension.

The positive Geo-Marketing relationships are consistent with the Resource-Based View [44], under which location-based market knowledge can function as an organizationally embedded capability. The findings indicate association rather than proof that geo-marketing creates sustainable advantage, particularly because the sample contains experienced adopters and does not include an untreated comparison group.

The association between Geo-Marketing and Platform Satisfaction suggests that accurate and context-relevant location features may improve users' evaluation of platform usefulness. This interpretation follows the task-relevance rationale specified before hypothesis testing and avoids introducing Media Richness Theory or Uses and Gratifications Theory only after observing significant results.

The positive relationship between Platform Satisfaction and Digital Competitiveness is consistent with Service-Dominant Logic [45], which views value as realized through use. The mediation estimates further suggest that satisfaction accounts for part of the predictive relationship of CMS adoption and geo-marketing with competitiveness, while the remaining significant direct paths indicate that other mechanisms are also involved.

Practically, the study provides a roadmap for MSMEs to build digital maturity in stages starting from basic adoption, developing specialized capabilities, and ultimately integrating them to deliver superior customer experiences. For practitioners, the findings suggest that consulting and mentoring programs should assess technology readiness, organizational capacity, and market context simultaneously, treating digital transformation as an integrated process rather than separate interventions.

This requires a collaborative approach involving technology providers, marketing specialists, and business strategists to create an integrated solution.

For policymakers, the findings suggest the need for a policy framework that supports ecosystem development rather than isolated technology deployment. Government programs for MSME digitalization need to include capacity building in geo-marketing capabilities and platform management, not just providing access to technology. This requires a partnership with the private sector to create a comprehensive support system that includes technology, training, and market access.

6. Conclusion

The study finds positive statistical associations among CMS-Based E-Catalog Platform Adoption, Geo-Marketing and Location-Based Services, Platform Satisfaction, and MSME Digital Competitiveness in the sampled platform users. Platform Satisfaction has the largest direct standardized coefficient for Digital Competitiveness, while f-squared results indicate that the incremental contributions of the individual predictors are small. Indirect-effect estimates are consistent with complementary partial mediation through Platform Satisfaction.

Theoretically, the study connects TAM, the Resource-Based View, and Service-Dominant Logic in a focused framework specified before hypothesis testing. The results do not establish a new unified theory; rather, they provide context-specific evidence that technology adoption, location-based capability, and value-in-use are complementary dimensions of MSME platform utilization. The findings suggest that MSME digital strategy involves coordinating CMS functionality, location-based marketing, and platform experience. This interpretation is bounded by the cross-sectional design and experienced-user sample and should therefore be evaluated through longitudinal and comparative research.

From a capability perspective, the observed associations are compatible with the view that competitiveness depends on combinations of digital resources rather than isolated technology investment. Dynamic-capability explanations remain a promising extension rather than a theory directly tested by the present cross-sectional model. Practically, the study provides a roadmap for MSMEs to build digital maturity in stages starting from basic adoption, developing specialized capabilities, and ultimately integrating them to deliver superior customer experiences. For practitioners, the findings suggest that consulting and mentoring programs should assess technology readiness, organizational capacity, and market context simultaneously, treating digital transformation as an integrated process rather than separate interventions.

This requires a collaborative approach involving technology providers, marketing specialists, and business strategists to create an integrated solution. For policymakers, the findings suggest the need for a policy framework that supports ecosystem development rather than isolated technology deployment. Government programs for MSME digitalization need to include capacity building in geo-marketing capabilities and platform management, not just providing access to technology. This requires a partnership with the private sector to create a comprehensive support system that includes technology, training, and market access.

6.1. Research Limitations

This study has several methodological and contextual limitations that need to be acknowledged. First, the cross-sectional design used limits the ability to draw definitive causal inferences, although the relationships found have been supported by solid theory. The temporal nature of digital transformation cannot be comprehensively captured through a snapshot approach at one point in time, so the dynamics of change and evolution of MSMEs' digital capabilities are not explored in depth.

Second, self-reported measures may introduce common-method and social-desirability bias. Third, purposive eligibility required at least six months of CMS-based e-catalog use and prior geo-marketing implementation. This requirement ensured informed evaluations but excluded non-adopters, unsuccessful adopters, and early-stage users, potentially restricting construct variability and producing a more favorable assessment of adoption. The findings therefore generalize primarily to experienced platform users in the sampled Central Java context, not to the full MSME population. Fourth, variations by industry, organizational size, and digital maturity were not tested as moderators.

Fourth, the research model has not explored in depth external factors that may affect the effectiveness of CMS-Based E-Catalog Platform Adoption, such as government support, regional digital infrastructure, or the level of competition within the industry. Fifth, the cost and return on investment dimensions of CMS-Based E-Catalog Platform Adoption are not considered in the model, even though the financial aspect is a major consideration for MSMEs in decision making. Sixth, this study does not explore potential negative effects or resistance factors that may hinder the digital transformation process.

6.2. Future Research Recommendations

Future research should validate the model longitudinally and across randomized or stratified samples that include non-adopters, early abandoners, unsuccessful adopters, and MSMEs using multiple commercial platforms. Repeated observations should establish temporal ordering and track capability development. Subjective Digital Competitiveness indicators should be triangulated with audited sales growth, platform traffic, product-view counts, click-through rates, inquiries, and verified conversion rates. Adequately powered MGA or interaction models should compare micro, small, and medium enterprises, major sectors, baseline digital maturity, and managerial technology literacy after establishing measurement invariance. Future engineering evaluation should benchmark spatial-query latency, geocoding accuracy, radius-search precision, API reliability, and alternative segmentation methods, including Voronoi service areas where appropriate. Case-level outputs should also be retained for PLSpredict or holdout validation.

7. Declarations

7.1. Author Contributions

Conceptualization: A.B.S., D.D., D.R. and S.S.; Methodology: A.H.; Software: A.B.S.; Validation: A.B.S., D.D., D.R., S.S., A.H.; Formal Analysis: A.B.S., D.D., and D.R.; Investigation: F A.B.S., D.D., and D.R Data Curation: A.S.; Writing Original Draft Preparation: A.B.S., D.D., D.R., and A.H.; Writing Review and Editing: A.B.S., D.D., D.R., S.S., and A.H.; Visualization: A.B.S.; All authors have read and agreed to the published version of the manuscript.

7.2. Data Availability Statement

The data presented in this study are available on request from the corresponding author.

7.3. Funding

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7.4. Institutional Review Board Statement

Not applicable.

7.5. Informed Consent Statement

Not applicable.

7.6. Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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