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The Impact of Augmented Reality Adoption and Omnichannel Implementation on Global Market Expansion Orientation

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ABSTRACT

The rapid evolution of digital technology in Industry 4.0 requires micro, small, and medium enterprises (MSMEs) in the apparel sector to adopt innovative strategies for sustaining competitiveness and expanding market reach. However, regional MSMEs often face constraints related to digital literacy, fragmented channels, and limited fintech integration. This study examines the impact of Augmented Reality (AR) adoption and Omnichannel implementation (conceptualized as a multidimensional capability bundle) on the Global Market Expansion Orientation of apparel MSMEs. Using a sequential explanatory mixed-methods design, the qualitative phase first explored operational constraints through in-depth interviews with five key MSMEs in Karanganyar Regency. Subsequently, a quantitative survey was administered to 240 apparel MSMEs selected via purposive sampling, and analyzed using Partial Least Squares Structural Equation Modeling (PLS-SEM). An applied field pre-post exposure was also conducted using a simple low-cost AR hologram print prototype to evaluate changes in customer engagement. The findings demonstrate that both Omnichannel implementation significantly and positively influence MSMEs' Global Market Expansion Orientation. Furthermore, the AR prototype field test confirmed a significant increase in product understanding and purchase intention. The theoretical contribution of this study lies in establishing a Dual Strategic Innovation Model tailored for resource constrained regional MSMEs, offering practical insights for integrating accessible immersion tools with cross-channel operational routines.

Keyword: *agile marketing; augmented reality; fintech;HR transformation; omnichannel; SME*

INTRODUCTION

Digital transformation has become an unavoidable competitive imperative for micro, small, and medium enterprises (MSMEs) navigating Industry 4.0. Beyond merely acquiring software or digital tools, digital transformation fundamentally alters value creation logic, customer engagement paradigms, and organizational capabilities enabled by modern technologies (Bharadwaj et al., 2013; Matt et al., 2015; Vial, 2019). For apparel MSMEs, this shift is accelerated by changing consumer behaviors: modern buyers increasingly demand

rich, interactive product visualization, rapid inquiry responses, seamless purchasing, and consistent brand experiences across both physical and digital touchpoints. Nevertheless, many local MSMEs continue to operate with fragmented marketing channels, insufficient digital literacy, and underutilized financial technology (fintech), which collectively constrain their market competitiveness and restrict opportunities for broader market expansion.

In regional Indonesia, apparel MSMEs in Karanganyar Regency (Central Java) represent a pivotal creative-economy driver. These enterprises rely heavily on unique local designs, flexible small batch production, and artisanal craftsmanship. Despite this inherent potential, practical barriers such as adopting modern immersive technology, maintaining synchronized omnichannel marketing, and building digitally capable human resources—remain substantial. This creates a critical disconnect between the strategic opportunities offered by digital innovation and the daily operational realities of resource-constrained MSMEs.

Augmented Reality (AR) has emerged as an impactful technological innovation capable of bridging the experiential gap between online browsing and physical product interaction. By overlaying 3D digital objects onto the physical world, AR provides interactive product visualization accessible via everyday mobile devices (El Kabtane et al., 2020; Zaher et al., 2018). In e-commerce, AR enhances perceived interactivity and reduces buyer evaluation uncertainty (Pollack, 2021). While technical applications like mobile AR for local heritage motifs (e.g., Batik) have been developed (Pratomo, 2018), empirical research on low-cost, practical AR implementations such as a simple AR hologram print (sablon hologram) attached to physical apparel remains severely limited within regional MSME contexts.

Concurrently, omnichannel strategy provides a holistic managerial framework for unifying fragmented channels. Omnichannel emphasizes complete integration across physical stores, online marketplaces, social commerce, and direct messaging, ensuring customers experience unified product information, pricing, and service across all touchpoints (Rigby, 2021; Chaffey & Ellis-Chadwick, 2022). Achieving effective omnichannel execution requires an interconnected capability bundle. Agile marketing capability enables rapid experimentation and customer feedback responsiveness (Moi & Cabiddu, 2021; Nguyen et al., 2022). Fintech utilization provides the transactional backbone through digital payment processing, frictionless checkouts, and basic financial data trails (Kumar & Gupta, 2021; Tiwari et al., 2021). Human resource (HR) transformation ensures that owners and staff possess the digital literacy and change readiness required to execute digital routines sustainably (Chen et al., 2021; Parida et al., 2019; Ghobakhloo & Hong, 2021; Kraus et al., 2021).

Despite advances in SME digital transformation literature, two significant research gaps persist. First, prior AR studies predominantly examine mature digital ecosystems or large corporate entities, offering limited empirical guidance on how small apparel firms can deploy accessible, low-cost AR prototypes embedded directly in physical garments. Second, existing literature rarely combines immersive technological innovation (AR) and cross-channel operational capabilities (Omnichannel, Agile Marketing, Fintech, and HR Transformation) into an integrated strategic framework for regional MSMEs aiming for global market reach.

To address these gaps, this study proposes and empirically validates a Dual Strategic Innovation Model. The model positions AR adoption as a visual engagement innovation and Omnichannel implementation as an operational capability bundle, examining their joint impact on the Global Market Expansion Orientation of apparel MSMEs. The novelty of this study lies in: (1) integrating micro-level technological immersion with macro-level channel operational coordination; (2) testing an accessible AR hologram print prototype in a field setting; and (3) contextualizing these dynamics within regional apparel MSMEs in Karanganyar Regency. Based on these theoretical foundations, the study advances the following hypotheses:

H1: Omnichannel implementation capability positively affects Global Market Expansion Orientation in apparel MSMEs.
H2: Augmented Reality (AR) adoption positively affects Global Market Expansion Orientation in apparel MSMEs.

RESEARCH METHODOLOGY

This study adopts a sequential explanatory mixed-methods design combining qualitative exploration, quantitative structural equation modeling, and an applied field prototype exposure (Creswell & Plano Clark, 2018). The study was conducted in Karanganyar Regency, Central Java, Indonesia.

Research Phases & Sampling Strategy

Methodological Design: The research was executed across three sequential phases:

1. Qualitative Exploration Phase:

In-depth semi-structured interviews and on-site observations were conducted with owners and managers of five leading apparel MSMEs in Karanganyar. Informants were selected based on operational history, active multi-channel presence, and willingness to participate in digital innovation trials. Interviews were recorded, transcribed, and analyzed in ATLAS.ti through inductive coding and thematic synthesis to identify qualitative operational themes.

2. Quantitative Testing Phase:

A cross-sectional survey was administered to 240 apparel MSME owners/managers. The target population comprised approximately 600 registered apparel MSMEs, according to official data from the Cooperatives and MSMEs Agency of Karanganyar Regency (Dinas Koperasi dan UMKM Kabupaten Karanganyar). Rather than random sampling, a purposive sampling strategy was employed based on three explicit inclusion criteria: (a) operational duration of at least two years, (b) active marketing through both offline and digital touchpoints, and (c) active exposure to digital payments and fintech platforms. Data were collected through structured questionnaires using 5-point Likert-type scales (1 = Strongly Disagree to 5 = Strongly Agree).

3. **Applied Prototype Exposure**:

To evaluate immediate customer engagement changes, a field exposure trial was conducted using a simple low-cost AR hologram print prototype across three participating MSMEs (N = 60 customer interactions). Customer engagement metrics (perceived interactivity, product understanding, purchase intention) were recorded pre- and post-interaction.

Construct Measurement

Measurement items were adapted from established literature in SME digital transformation, omnichannel strategy, AR adoption, fintech, and HR capabilities (Chen et al., 2021; Homburg et al., 2017; Kumar & Gupta, 2021; Moi & Cabiddu, 2021; Nguyen et al., 2022; Pollack, 2021; Rigby, 2021). Table 1 outlines the operational definitions and measurement indicators.

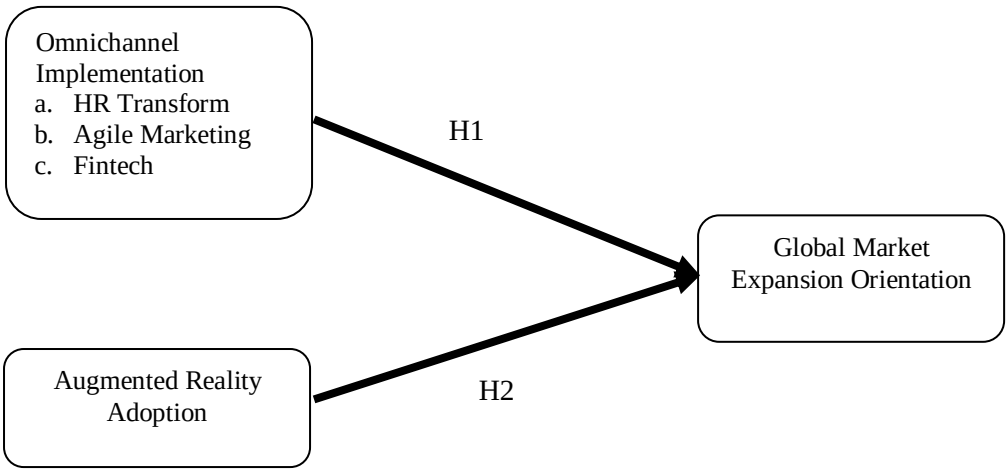


Figure 1. Research Framework

For hypothesis testing, the quantitative survey data are analyzed using partial least squares structural equation modeling (PLS-SEM) in SmartPLS 3. PLS-SEM is appropriate for predictive models with multiple constructs and potential second-order capability bundles, and is commonly used in SME and digital transformation research. The analysis follows standard assessment procedures: evaluation of indicator reliability, internal consistency (Cronbach's alpha and composite reliability), convergent validity (average variance extracted), followed by structural model assessment using bootstrapped path coefficients, explained variance (R^2), effect sizes (f^2), and predictive relevance (Q^2). Qualitative and quantitative findings are integrated at the interpretation stage using a joint display logic, enabling convergence and complementarity between statistical patterns and contextual mechanisms.

The research process anticipates practical challenges typical of MSME field research, such as variation in digital literacy, limited time availability of MSME owners, and differences in digital infrastructure across locations. Compared with single-method studies, the chosen approach offers two advantages: it grounds measurement and model development in local implementation realities, and it provides empirical testing and applied validation through the AR prototype exposure.

Table 1. Operational Definitions and Example Measurement Indicators

Construct	Conceptual definition (context: apparel MSMEs)	Example indicators (Likert items)	Scale	Key references
Augmented Reality (AR) adoption	The MSME's readiness and actual use of AR to provide interactive 3D product visualization and information overlays accessible via common devices (e.g., smartphones), including a simple AR hologram print prototype for	AR is used to enhance product visualization; customers can access AR content easily; AR increases perceived interactivity; AR content can be implemented with manageable cost and effort.	1–5 Likert	El Kabtane et al. (2020); Pollack (2021); Zaher et al. (2018)

	apparel.			
Omnichannel implementation (HR transform, Agile Marketing & Fintech)	The MSME's capability to coordinate online–offline channels and supporting processes so that customers experience consistent products, content, service, and transactions across touchpoints.	Consistent product information across channels; integrated communication (store/marketplace/social media/chat); ability to move between channels (e.g., browse online, buy offline); consistent pricing/promotion; unified brand experience.	1–5 Likert	Chaffey & Ellis-Chadwick (2022); Rigby (2021); Homburg et al. (2017)
Global market expansion orientation	The MSME's strategic intent and readiness to serve non-local markets through digital channels, including cross-regional/cross-border reach, product standardization readiness, and market learning orientation.	Intention to reach customers outside the local region; readiness for cross-border or inter-island delivery; willingness to adapt products/packaging to broader markets; use of digital channels to target wider audiences; learning about global trends and customer needs.	1–5 Likert	Nambisan et al. (2019); Kraus et al. (2021); Vial (2019)

Source: processed data, 2025

Analytical Method & Data Integration

Quantitative survey data were analyzed using Partial Least Squares Structural Equation Modeling (PLS-SEM) in SmartPLS 3. PLS-SEM is highly suitable for predictive modeling with complex capability constructs in SME research. Measurement model diagnostics evaluated indicator reliability, internal consistency (Cronbach's alpha, Composite Reliability), and convergent/discriminant validity (AVE, HTMT ratio). Structural paths were assessed using bootstrapped t-statistics (5,000 resamples), R^2, f^2 effect sizes, and Q^2 predictive relevance. Qualitative themes from ATLAS.ti and quantitative SEM path outputs were synthesized using joint display logic to offer complementary explanations.

RESULTS AND DISCUSSION

The dataset is to consist of 240 apparel MSME owners/managers operating in Karanganyar Regency, selected based on a minimum two-year operating history and the presence of both offline and online marketing activities. In the final manuscript, respondent characteristics reported to contextualize the adoption environment, including business age, number of employees, dominant sales channels (offline store, marketplace, social media, messaging), and fintech usage (digital payments and related services). Table 2 provides a recommended structure for presenting the respondent profile and channel/fintech readiness.

Table 2. Respondent and Business Profile

Characteristic	Category	n	%
Business age	2-5 years	125	52
	6-10 years	101	42
	>10 years	14	6
Number of employees	1-4	124	52
	5-9	76	32

	≥10	40	16
Primary sales channel	Offline store	201	84
	Marketplace	9	4
	Social media	30	12
	Website	0	0
Fintech usage	Digital payments only	0	0
	Digital Payments & cash	231	96
	Cash only	9	4
International market experience	Never	28	12
	Inter-island only	178	74
	Cross-border (export)	34	14

Source: processed data, 2025

As presented in Table 2, the demographic profile reflects a mature ecosystem where the majority of businesses (52%) have been operating for 2-5 years. Interestingly, while 84% still rely on offline stores as their primary channel, there is a visible shift towards hybrid models, with 4% actively using marketplaces. However, the reliance on digital payment and cash remains dominant (96%), signaling that fintech adoption is really good phase.

Before testing structural relationships, the measurement model evaluated to confirm that the constructs are measured reliably and validly. In PLS-SEM, indicator loadings should generally exceed 0.70, and internal consistency should meet conventional thresholds (Cronbach's alpha and composite reliability above 0.70). Convergent validity is supported when average variance extracted (AVE) exceeds 0.50, typically below 0.85 or 0.90 depending on the strictness required. Table 3 provides for reporting these diagnostics. Establishing measurement quality is particularly critical in MSME research because self-reported surveys can be sensitive to differences in respondent interpretation and digital literacy.

Table 3. Measurement Model Assessment

Construct	Cronbach's α	Rho_A	Composite reliability	AVE
AR adoption	0.700	0.737	0.755	0.792
Omnichannel implementation	0.748	0.772	0.831	0.799
Global market expansion orientation	0.873	0.874	0.904	0.612

Source: processed data, 2025

As shown in Table 3, all constructs met the required thresholds. The Composite Reliability (CR) values ranged from 0.755 to 0.904, well above the 0.70 cut-off, indicating robust internal consistency. Furthermore, the Average Variance Extracted (AVE) for all variables exceeded 0.50, confirming that our measurement instruments validly represent the theoretical concepts of AR adoption and Omnichannel capability.

The core of this study was to examine the "Dual Innovation" drivers. The structural model analysis (PLS-SEM) revealed compelling results regarding the pathways to global market expansion. After measurement validation, the structural model tested to examine how AR adoption and omnichannel implementation (as a capability bundle) relate to global market expansion orientation. Bootstrapping used to assess the significance of path coefficients. The final report should include path coefficients (β), t-values, p-values, and confidence intervals, as well as explained variance (R^2) for endogenous constructs and effect sizes (f^2). If omnichannel is modeled as a higher-order construct with dimensions (product/channel integration, agile marketing responsiveness, fintech-enabled financial access, and HR transformation), the manuscript should clearly state whether a reflective–

reflective or formative measurement approach is used and justify the choice based on theory and empirical diagnostics (e.g., collinearity/VIF for formative indicators). Table 4 provides for reporting the structural results.

Table 4. Structural Model Results

Path	β	t	p	Adjusted R^2
Omnichannel implementation → Global market expansion orientation	0.408	6.662	0.000	0.405
AR adoption → Global market expansion orientation	0.458	4.166	0.000	0.410

Source: processed data, 2025

First, Omnichannel implementation proved to be a critical driver. The analysis supports H1, showing a positive and significant effect on Global Market Expansion Orientation (β=0.408, t=6.662, p<0.001). The Adjusted R^2= 0.405 indicates that 40.5% of the variance in global market expansion orientation can be explained by omnichannel implementation within this study, while the remaining proportion warrants further empirical investigation. This suggests that MSMEs capable of integrating their HR, fintech, and marketing channels are statistically more ready to scale up. Second, AR Adoption emerged as an equally powerful predictor. Supporting H2, the path coefficient (β =0.458, t=4.166, p<0.001) indicates that adopting immersive technology significantly boosts an MSME's confidence and strategic intent to enter broader markets. The combined model explains approximately 41% (*Adjusted* R^2=0.410) of the variance in expansion orientation, a substantial figure for social science research in the MSME context.

In line with the proposed dual strategic innovation logic, the expected pattern is that both AR adoption and omnichannel implementation show positive associations with global market expansion orientation. AR can reduce uncertainty in product evaluation by providing interactive 3D visualization and storytelling, thereby increasing customer engagement and willingness to purchase an effect commonly highlighted in AR and customer experience research (Homburg et al., 2017; Pollack, 2021). Omnichannel capability, meanwhile, addresses fragmentation by enabling consistent customer experience across touchpoints and by connecting demand generation with fulfillment and payment processes (Chaffey & Ellis-Chadwick, 2022; Rigby, 2021). In MSMEs, this integration is likely strengthened by agile marketing responsiveness, fintech-enabled transaction convenience, and HR to execute digital routines (Chen et al., 2021; Kumar & Gupta, 2021; Moi & Cabiddu, 2021).

The pre-post exposure to the AR hologram print prototype provides an applied check on whether AR generates engagement improvements beyond self-reported adoption attitudes. The final manuscript should report which engagement indicators were used, the sample size of participating customers, and the magnitude of pre-post changes (mean difference, standard deviation, test statistic, and effect size). Table 5 provides a template for this reporting. A significant engagement increase would support the practical feasibility of AR for apparel MSMEs, particularly if the prototype is easy to deploy and does not require high-cost infrastructure. If the engagement change is small or inconsistent, this may indicate usability barriers, customer readiness issues, or a need for better AR content design and onboarding.

Table 5. Pre-Post Engagement Assessment for AR Prototype

Indicator	Pre mean (SD)	Post mean (SD)	Δ	Test statistic	p	Effect size
Perceived interactivity	2.86 (0.54)	4.55 (0.42)	+1.69	16.44	<0.001	3.52
Perceived	3.10 (0.55)	4.55 (0.53)	+1.45	14.15	<0.001	2.68

product understanding						
Purchase intention	2.60 (0.69)	4.37 (0.54)	+1.77	12.18	<0.001	2.85
Willingness to share/recommend	2.57 (0.80)	4.34 (0.61)	+1.78	17.45	<0.001	2.49

Source: processed data, 2025

Most notably, Perceived Interactivity saw the highest jump (Δ = +1.69), moving from a passive baseline to a highly engaging experience. This quantitative leap explains why the Purchase Intention also increased significantly (t=12.18). The extremely strong effect sizes (d > 2.0) confirm that for local apparel products, Augmented Reality (AR) is not merely a novelty, but a functional tool capable of reducing customer hesitation.

Qualitative findings integrated to explain why certain quantitative relationships are strong or weak. Based on the interview protocol and the regional MSME context, relevant themes may include channel fragmentation (multiple platforms managed separately), constraints in content production and consistency, trust and literacy challenges in fintech adoption, and HR capability gaps in managing digital tools. Conversely, qualitative evidence may reveal local strengths such as product uniqueness, flexible customization, and strong community-based customer networks that can amplify the benefits of omnichannel and AR when supported by simple implementation guidance. Table 6 provides a structure linking qualitative themes with implications for the quantitative model.

Table 6. Qualitative Themes and Implications

Theme (from ATLAS.ti coding)	Illustrative evidence	Implication for dual innovation model / toolkit
Channel fragmentation and inconsistent content	"I often struggle to sync prices across platforms; sometimes a promo is active on the website but still shows the normal price on social media, leading to customer complaints."	Prioritize content and product data consistency across channels as a foundational step of omnichannel implementation.
Time and capability constraints for rapid marketing iteration	"We want to test new marketing trends, but our small team is overwhelmed with daily operations like packing and shipping, leaving no time for creative experiments."	Introduce simple agile marketing routines (weekly experiment cycles, customer feedback loops) suitable for MSME scale.
Fintech trust/literacy barriers and reconciliation issues	"I am still hesitant to fully rely on digital payments because reconciling the daily transaction reports with our bank statements is confusing and time-consuming."	Provide onboarding guidance for digital payments and basic fintech bookkeeping to enable seamless omnichannel transactions.
HR digital literacy gap and role overload	"My staff are great at face-to-face sales, but they lack the digital skills to manage multiple chat channels, often resulting in slow responses and missed orders."	Develop short modular training and role templates to support HR transformation readiness.
Customer curiosity toward interactive product experience	"Customers are always asking for more 'real' views of the products online; they seem bored with static photos and want something more immersive to look at."	Position AR hologram print as a low-cost engagement trigger integrated with omnichannel storytelling.

Source: processed data, 2025

The interviews revealed that the high statistical impact of Omnichannel (H1) is a response to the "Channel fragmentation" pain point. Informants explicitly stated that without integrated systems, they are overwhelmed by "inconsistent content" across platforms. The quantitative success of AR (H2) essentially answers the "Customer curiosity" theme found in the qualitative data. As one participant noted, customers are bored with static photos; the AR prototype satisfied this need for "real" visualization, directly validating the surge in Product Understanding scores in the pre-post test.

This pattern of statistical readiness coexisting with reported HR overload lends fresh empirical texture to SME digital-transformation literature that identifies human capital as the binding constraint on technology-enabled growth (Ghobakhloo & Hong, 2021; Kraus et al., 2021; Rachinger et al., 2019; Scuotto et al., 2020). Where much of this literature treats the HR constraint as an inferred background condition, the present mixed-methods design makes the tension directly visible within a single study: the same MSMEs whose quantitative responses drive a significant path toward Global Market Expansion Orientation simultaneously describe themselves, qualitatively, as under-resourced in executing the digital routines the model assumes. We interpret this not as contradiction but as extension: strategic orientation and operational are shown to be dissociable states, a "readiness capability gap" that single-method studies have not been able to document, and one that substantiates rather than merely restates Ghobakhloo and Hong (2021) call for capability-building interventions.

However, the study also uncovered a "Human Resource digital gap." While the statistical model assumes readiness, the qualitative evidence warns that staff often feel "overloaded" when managing multiple digital channels. This finding implies that the Dual Innovation model works best when accompanied by simplified, modular training for employees, not just technology installation. Overall, the study's theoretical contribution in treating AR and omnichannel not as isolated innovations but as complementary strategic levers: AR enhances product-level experience and engagement, while omnichannel operationalizes a coherent customer journey and transaction system. Practically, this integration implies that MSME digitalization programs should avoid one-off technology adoption and instead support capability building across marketing responsiveness, payment infrastructure, and HR. This aligns with broader SME digital transformation literature that emphasizes ecosystems, leadership, and capability development as key success factors (Ariyadi et al., 2023;Ghobakhloo & Hong, 2021; Kraus et al., 2021; Rachinger et al., 2019; Scuotto et al., 2020).

CONCLUSION AND RECOMMENDATION

This research establishes that the digital competitiveness and internationalization trajectory of regional apparel MSMEs are inextricably linked to a Dual Strategic Innovation approach. The empirical evidence underscores that omnichannel implementation capability serves as a critical operational catalyst, significantly driving Global Market Expansion Orientation (Adj. $R^2 = 0.405$). This confirms that a synchronized ecosystem (comprising agile marketing routines, seamless fintech integration, and robust HR transformation) is indispensable for bridging local operations with broader market demands. Concurrently, the adoption of Augmented Reality (AR) accounts for a substantial 41.0% of the variance in expansion orientation (Adj. $R^2 = 0.410$). The field exposure validates that integrating low-cost AR hologram prints directly into physical apparel mitigates buyer doubtness, significantly elevating product comprehension and purchase intention. Rather than functioning as isolated digital novelties, AR adoption and omnichannel strategies operate as interdependent levers: AR provides the immersive engagement necessary to attract distant consumers, while omnichannel capabilities ensure the structural consistency required to fulfill cross-border transactions.

For MSME practitioners, the expected implication is that digital competitiveness is unlikely to improve through isolated technology adoption. Instead, AR implemented as part of a coherent customer journey: AR content connected to product information, pricing, promotions, and transaction flows across channels. Omnichannel execution can be made feasible when MSMEs adopt simple agile marketing routines frequent experimentation and feedback-based adjustments while fintech tools provide frictionless payments and basic financial tracking. HR transformation is equally critical; even low-cost digital tools require training, role clarity, and change readiness to become sustainable routines.

For policymakers and ecosystem stakeholders, the study suggests that MSME digitalization programs structured as integrated capability-building interventions rather than fragmented technology workshops. Local government, universities, and industry partners can support adoption by providing modular training on omnichannel consistency, agile marketing practices, fintech onboarding, and basic AR content creation. The planned practical outputs, including an AR implementation infographic as intellectual property, are intended to reduce adoption barriers and to provide an accessible pathway for MSMEs to experiment with AR as an engagement tool.

The study is subject to limitations commonly faced in MSME research. Survey-based measures can be sensitive to self-report bias, the context is geographically specific, and cross-sectional relationships may not fully capture long-term transformation dynamics. Future research should consider longitudinal designs, the inclusion of objective performance metrics, broader sector comparisons beyond apparel, and experiments comparing different AR formats (e.g., marker-based vs. WebAR) to identify the most cost-effective approaches for MSMEs pursuing global market expansion.

Taken together, this study's central contribution is the empirical validation of a Dual Strategic Innovation Model that positions AR adoption and omnichannel capability not as isolated technologies but as complementary strategic levers, jointly and independently predictive of MSME global market expansion orientation, an integration that prior digital transformation research has largely examined separately (Ariyadi et al., 2023; Ghobakhloo & Hong, 2021; Pollack, 2021). Theoretically, the study extends this literature in two ways: first, by demonstrating that a low-cost, physically embedded AR format can generate engagement effects comparable to or exceeding those reported for fully digital AR applications, challenging the assumption that meaningful immersive engagement requires costly digital infrastructure (Alam et al., 2021); and second, by identifying a readiness capability gap that reveals strategic orientation and operational execution capacity as empirically dissociable constructs in MSME contexts. Practically, the novelty of this study lies in translating these theoretical insights into an accessible, field-validated implementation pathway (a low-cost AR hologram print prototype paired with a structured omnichannel capability checklist) that offers regional apparel MSMEs a concrete, low-barrier entry point into digitally enabled global market expansion.

Furthermore, this study delivers distinct theoretical and practical advancements. The primary novelty resides in the conceptualization and field-validation of an accessible Dual Strategic Innovation Model specifically engineered for resource-constrained regional enterprises. Theoretically, this research extends the SME digital transformation discourse by (1) demonstrating that physically embedded, low-cost AR formats can stimulate high-impact consumer engagement comparable to capital-intensive digital infrastructures, and (2) empirically documenting a “readiness capability gap” revealing that an MSME’s strategic intent to expand often outpaces its operational human resource capacity. From a practical standpoint, the study translates these insights into a tangible, low-barrier implementation pathway. By pairing low-cost AR hologram prototypes with a structured omnichannel operational checklist, this research equips regional MSME practitioners and policymakers

with a scalable blueprint to achieve sustainable global market integration

REFERENCES

Ardito, L., Petruzzelli, A. M., & Ghisetti, C. (2021). Open innovation in SMEs: A dynamic approach to modern business challenges. Journal of Business Research, 132(3), 610–623.

Ariyadi, M. Y., Augtiah, I., & Kurniawan, W. (2023). Small business in a small city: The implementation of augmented reality. Sebelas Maret Business Review, 9(1), 13–19.

Bharadwaj, A., El Sawy, O. A., Pavlou, P. A., & Venkatraman, N. (2013). Digital business strategy: Toward a next generation of insights. MIS Quarterly, 37(2), 471–482.

Brynjolfsson, E., & McAfee, A. (2014). The second machine age: Work, progress, and prosperity in a time of brilliant technologies. W. W. Norton & Company.

Chaffey, D., & Ellis-Chadwick, F. (2022). Digital marketing: Strategy, implementation, and practice (8th ed.). Pearson.

Chatterjee, S., Rana, N. P., & Dwivedi, Y. K. (2021). Big data in SMEs: A systematic literature review and research agenda. Information Systems Frontiers, 23(6), 1367–1386.

Chen, Y., Zhao, L., & Wang, L. (2021). Human resource transformation in the era of digital finance. Human Resource Management, 60(3), 303–317.

Creswell, J. W., & Plano Clark, V. L. (2018). Designing and conducting mixed methods research (2nd ed.). Pustaka Pelajar.

Dubey, R., Gunasekaran, A., Childe, S. J., & Papadopoulos, T. (2020). Agile supply chain management in SMEs: A systematic review. International Journal of Production Economics, 228(1), 107735.

Elia, G., Margherita, A., & Passiante, G. (2020). Digital transformation in European SMEs: A comparative analysis. Journal of Business Research, 119(1), 623–634.

El Kabtane, H., El Adnani, M., Sadgal, M., & Mourdi, Y. (2020). Virtual reality and augmented reality at the service of increasing interactivity in MOOCs. Education and Information Technologies, 25, 2871–2897.

Ghobakhloo, M., & Hong, T. S. (2021). Industry 4.0 in SMEs: A systematic review of adoption challenges and implementation frameworks. Journal of Manufacturing Systems, 60(1), 98–113.

Greenhalgh, T., Wherton, J., Papoutsi, C., & Shaw, S. (2020). Technology adoption in SMEs: A qualitative synthesis. Journal of Small Business Management, 58(3), 1–25.

Homburg, C., Jozić, D., & Kuehnl, C. (2017). Customer experience management: Toward implementing an evolving marketing paradigm. Journal of Marketing, 81(6), 77–96.

Kamalaldin, A., Linde, L., Sjödin, D., & Parida, V. (2020). IoT-based business models for SMEs: A framework for value creation. Technovation, 96–97(1), 102073.

Kraus, S., Durst, S., Ferreira, J. J., & Veiga, P. M. (2021). Digital innovation in SMEs: A systematic review and future research directions. Technological Forecasting and Social Change, 162(1), 120332.

Kumar, V., & Gupta, S. (2021). Impact of fintech on small businesses: A global perspective. Electronic Markets, 31(2), 253–268.

Li, F., & Chan, H. C. (2019). Digital transformation of business ecosystems: Evidence from the Chinese online gaming industry. International Journal of Information Management, 49(1), 228–241.

Martínez-López, F. J., Anaya-Sánchez, R., & Molinillo, S. (2021). Digital marketing strategies in SMEs: A practical guide. Springer.

Matt, C., Hess, T., & Benlian, A. (2015). Digital transformation strategies. Business & Information Systems Engineering, 57(5), 339–343.

Moi, L., & Cabiddu, F. (2021). Leading digital transformation through an Agile Marketing

Capability: The case of Spotahome. Journal of Management and Governance, 25(4), 1145–1177.

Nambisan, S., Wright, M., & Feldman, M. (2019). Digital entrepreneurship in SMEs: A taxonomy and research agenda. MIS Quarterly, 43(3), 729–770.

Nguyen, T. H., Nguyen, H. V., & Nguyen, H. D. (2022). Agile marketing in SMEs: A study of Vietnamese firms. Journal of Business Research, 139(1), 112–124.

Parida, V., Sjödin, D., & Reim, W. (2019). Digital capabilities in SMEs: A review and research agenda. Journal of Business Research, 98(1), 250–262.

Pollack, J. (2021). Augmented reality in e-commerce: A systematic review. Journal of Business Research, 132(1), 698–713.

Pratomo, C. (2018). Implementasi vuforia sdk pada augmented reality untuk pengenalan motif batik berbasis ios (Doctoral dissertation, STMIK AKAKOM YOGYAKARTA).

Rachinger, M., Rauter, R., & Müller, C. (2019). Digitalization and SME leadership: A conceptual framework. Journal of Small Business Management, 57(2), 1–20.

Rigby, D. K. (2021). Omnichannel retail: How to succeed in the changing marketplace. Harvard Business Review, 99(1), 1–10.

Scuotto, V., Del Giudice, M., & Carayannis, E. G. (2020). Digital ecosystems for SMEs: A systematic literature review. Journal of Business Research, 117(1), 38–49.

Sousa-Zomer, T. T., Neely, A., & Martinez, V. (2022). Digital transformation in SMEs: A holistic perspective. Technological Forecasting and Social Change, 174(1).

Tiwari, P., Saha, R., & Shankar, R. (2021). Fintech and financial inclusion in India: An empirical study. Journal of Financial Services Research, 60(3), 301–318.

Vial, G. (2019). Understanding digital transformation: A review and a research agenda. The Journal of Strategic Information Systems, 28(2), 118–144.

Zaher, M., Greenwood, D., & Marzouk, M. (2018). Mobile augmented reality applications for construction projects. Construction Innovation, 18(2), 152–166.