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Literature Review: Implementation of Extended Reality for Micro, Small, and Medium Enterprises in Indonesia

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Abstract
Extended Reality (XR), encompassing Virtual Reality (VR) and Augmented Reality (AR), constitutes immersive computer-generated technologies. While predominantly implemented in larger enterprises, XR adoption in Micro, Small, and Medium Enterprises (MSMEs) is notably sparse. XR's projected significance in product marketing, such as Meta Company and industry experts, this paper investigates XR adoption in Indonesian MSMEs from 2020 to 2023. Our review identifies ten instances of XR implementation in MSMEs, primarily in early developmental stages with limited user experience. The application of the (TAM) underscores the importance of user-centric evaluations in the adoption process. The balance between affordability, technological readiness, and consumer appeal will be key factors influencing the future dynamics of XR adoption in the business sector. Theoretical implications suggest a potential shift in marketing dynamics for MSMEs, while practical implications underscore the need for enhanced XR integration strategies to unlock the technology's full potential in empowering smaller enterprises.

Keywords: Extended Reality; Virtual Reality; Augmented Reality; MSMEs

Tinjauan Literatur: Implementasi Extended Reality untuk Usaha Mikro, Kecil, dan Menengah di Indonesia

Abstrak
Extended Reality (XR), yang mencakup Virtual Reality (VR) dan Augmented Reality (AR), merupakan teknologi yang dihasilkan komputer yang imersif. Meskipun sebagian besar diterapkan di perusahaan besar, adopsi XR di Usaha Mikro, Kecil, dan Menengah (UMKM) sangat jarang. Mengingat signifikansi proyeksi XR dalam pemasaran produk, seperti Perusahaan Meta dan pakar industri, penelitian ini menyelidiki adopsi XR di UMKM Indonesia dari tahun 2020 hingga 2023. Tinjauan kami mengidentifikasi sepuluh contoh penerapan XR di UMKM, terutama pada tahap pengembangan awal dengan pengalaman pengguna yang terbatas. Penerapan Model Penerimaan Teknologi (TAM) menggarisbawahi pentingnya evaluasi yang berpusat pada pengguna dalam proses adopsi. Keseimbangan antara keterjangkauan, kesiapan teknologi, dan daya tarik konsumen akan menjadi faktor kunci yang memengaruhi dinamika adopsi XR di masa depan di sektor bisnis. Implikasi teoretis menunjukkan potensi perubahan dalam dinamika pemasaran untuk UMKM, sementara implikasi praktis menggarisbawahi perlunya strategi integrasi XR yang ditingkatkan untuk membuka potensi penuh teknologi dalam memberdayakan perusahaan kecil.

Kata Kunci: Extended Reality, Virtual Reality, Augmented Reality, UMKM

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INTRODUCTION

Micro, Small, and Medium Enterprises (MSMEs) constitute a vital component of the Indonesian economic sector, contributing significantly to the nation's economic growth despite their modest scale (Agustiningsih, Anindhita, & Arisanty, 2017). The importance of MSMEs extends beyond economic growth; they play a pivotal role in reducing unemployment rates, aligning with the Theory of Schumpeter Effect (TSE) or the attractiveness effect, as elucidated by Prasetyo (2021). TSE posits a negative correlation between entrepreneurship, particularly within MSMEs, and unemployment, underscoring the government's crucial role in supporting these entities. However, despite governmental assistance, integrating new technologies within MSMEs is constrained by limited capital and knowledge of emerging technologies. To address this, corporate entities offering new technologies and academic and government representatives often engage directly with MSMEs, providing on-the-ground socialization efforts for new technologies (Redjeki & Affandi, 2021). Noteworthy technologies already embraced by MSMEs in Indonesia include QRIS codes and Electronic Wallet Payment to facilitate cashless transactions. Additionally, digital marketing strategies have gained traction across various platforms like Facebook, Google My Business, Tokopedia, Gojek, and Shopee. Although this adoption has proven effective in bolstering sales, it remains predominantly concentrated in larger urban areas, with limited diffusion to smaller locales (Daud et al., 2022; Lianggono, 2021).

In the continually evolving landscape of modern technology, opportunities for Micro, Small, and Medium Enterprises (MSMEs) in Indonesia are burgeoning. Among the technologies with transformative potential, Extended Reality (XR) emerges as a pivotal catalyst for advancing SMEs across various facets of business. Extended Reality (XR) encompasses immersive environments and human-machine interactions created by the fusion of real and virtual elements through computer technology and human wearables. The various forms of XR include Augmented Reality (AR), Mixed Reality (MR), and Virtual Reality (VR), with possibilities for combinations between these three realms (Rauschnabel et al., 2022). As we explore XR's impact on SMEs, we delve into the emerging landscape of metaverse technology and its profound implications for marketing in the ever-evolving digital era. The primary objective is to augment user experiences by blending digital and physical realms. By overlaying virtual elements onto the physical environment through the device's camera or sensors, XR creates a multisensory, interactive, and immersive experience.

The transformative potential of XR technology for Small and Medium Enterprises (SMEs) spans diverse dimensions. Interactive and engaging marketing campaigns empower SMEs to overcome the challenge of building a compelling business image and capturing consumer attention. Jalo et al. (2022) emphasize the significance of XR, collectively known as extended reality (XR), in both consumer and enterprise markets. XR includes augmented reality (AR) and virtual reality (VR), and it has been predicted to experience substantial growth (Grand View Research, 2021; IDC, 2020). While initial predictions often covered various use cases, including consumer applications, a noticeable shift toward the enterprise sector has occurred. The study highlights that XR use in organizations, particularly SMEs,

requires further investigation. AR and VR are identified as technologies that organizations, especially larger companies, could potentially capitalize on, aligning with the broader trend of digitalization critical for competitiveness (Berg & Vance, 2017; Porter & Heppelmann, 2019; Torro, Jalo, & Pirkkalainen, 2021). However, SMEs have lagged behind more prominent companies in digital transformation, primarily due to resource constraints and focused competencies, affecting their innovation capability and readiness to digitize operations (Denicolai, Zucchella, & Magnani, 2021). This lag in technology adoption raises concerns, given that SMEs constitute most businesses and employ most people (Jayani, 2021).

In Virtual Reality (VR), users are immersed in a completely virtual environment, interacting solely within this computer-generated world. The graphics are predominantly artificial, designed to provide a realistic feel despite being virtual. VR experiences often require specialized devices such as VR Boxes or Oculus for complete immersion. Users can navigate their virtual surroundings 360 degrees, making VR particularly popular in gaming applications (Alcañiz, Bigné, & Guixeres, 2019). Developing and accessing VR experiences typically involve specific peripherals, such as VR Boxes or Oculus (Pahlevi, Sayono, & Hermanto, 2021). Meanwhile, Augmented Reality (AR) introduces virtual elements into the real world, creating illusions in digital devices without fully immersing users in computer-generated graphics. AR enables users to interact in both dimensions simultaneously. Examples include popular applications like Pokemon-GO, where virtual elements are integrated into the real world using digital devices. Additionally, AR is commonly observed in apps with various filters that create the illusion of altered surroundings (Balco, Bajzík, & Škovierová, 2022).

The development of both VR and AR relies on powerful tools such as Unity, Unreal, ARKit, ARCore, A-Frame, ARToolKit, or WebXR. While these tools provide substantial capabilities, individuals aspiring to create XR content must possess a solid understanding of virtual environment development, coding skills, and knowledge of AR Marker functionality. In professional settings, VR and AR development challenges include a lack of formal training, technical limitations, restricted access to specific tools, and misconceptions about the medium (Krauß, Boden, Oppermann, & Reiners, 2021). Understanding the intricacies of XR development tools and overcoming associated challenges are crucial steps in unlocking the potential of Extended Reality for various applications, including its implementation within the landscape of Micro, Small, and Medium Enterprises (MSMEs) in Indonesia. Forbes highlights the accelerated popularity of Augmented Reality in 2020, fueled by the widespread implementation of 5G connectivity. IDC's projection of the AR and Virtual Reality (VR) market, generating profits of $143.3 million in 2020, underscores the rising significance of AR in the business sector. The convergence of enhanced connectivity and technological advancements makes AR and VR feasible and impactful tools even for SMEs. Contrary to common misconceptions, XR is not an exclusive domain for large enterprises. SMEs are encouraged to seize the moment by integrating XR into their business strategies. The perception that XR is prohibitively expensive or tailored only for larger corporations needs to be dispelled. The increasing

accessibility of XR technologies, driven by advancements and decreasing costs, gives SMEs an opportune moment for business growth.

The Ministry of Cooperatives and Small and Medium Enterprises of Indonesia reported a staggering 65.47 million MSMEs as of 2019, with micro-businesses constituting 98.67% of this figure. Undoubtedly, MSMEs are pivotal in sustaining approximately 97% of the country's productive workforce (Mahdi, 2022). The first quarter of 2022 witnessed a notable 3.32% increase in internet penetration in Indonesia, reaching 77.02% of the population. As online activities surged, SMEs transitioned from offline to online sales, intensifying competition in e-marketplaces. SMEs must explore innovative marketing strategies to compete in the increasingly competitive landscape. Despite their significant contribution, MSMEs grapple with persistent challenges, primarily regarding capital and business development. Limited financial resources often hinder micro-enterprises growth into small or medium-sized businesses. This constraint further impedes technological investments, leaving many MSMEs reliant on manual methods for crucial business functions such as marketing, bookkeeping, and asset management (Prasetya, 2022; Rustiman, Mahdi, & Kosasih, 2021; Veranita et al., 2021).

As technological advancements progress, a new challenge emerges on the horizon for MSMEs—the metaverse (Pranata et al., 2022; Tahir, Ahmad, Nurjannah, Rijal, & Hasan, 2021; Tambunan, 2019). Promising an immersive and collaborative experience beyond current internet capabilities, the metaverse has captured the attention of major corporations like Meta, Microsoft, and Volvo. This dynamic landscape presents opportunities and threats for consumers and businesses (Allam, Sharifi, Bibri, Jones, & Krogstie, 2022; Mystakidis, 2022). While large corporations currently dominate the metaverse, an inevitable shift towards wider adoption necessitates adaptation from small businesses. Virtual Reality (VR) and Augmented Reality (AR) have gained extensive traction across diverse sectors, with notable applications in the business domain. Primarily utilized for marketing purposes, VR and AR offer unique customer experiences, enabling individuals to visualize products or services in three dimensions before purchasing. This immersive experience instills greater customer confidence regarding the items they intend to buy, eliminating the necessity for physical interactions with marketers (Fischer, Seidenstricker, & Poeppelbuss, 2021).

In business, XR is increasingly employed by renowned brands like Volvo and Gucci for marketing purposes. For example, Volvo uses Virtual Reality through its ARCAR platform to provide customers with a mixed-reality on-road driving experience. This platform, accessible via a headset, allows users to virtually drive a specific Volvo car model embedded in the ARCAR system (Ghiurău, Baytaş, & Wickman, 2020). In 2022, Volvo incorporated VR technology into its marketing strategy by introducing mobile applications that potential buyers could download. These VR apps allow users to experience the benefits of testing a new car, explore various Volvo car models, and simulate a test drive—all without the need to visit a physical dealership. An updated app version enhances the user experience with additional 3D features (Hood, 2019; Syberfeldt, Holma, Danielssona, Wangb, & Brewsterc, 2016). On the other hand, Gucci utilizes augmented reality in its shoe brand division, enabling customers to visualize how shoes look on their feet by focusing the

camera on them. Through intuitive swiping gestures, customers can explore various shoe styles and view them in 3D, thanks to the movement-tracking capabilities of AR technology (Campbell, 2021). Beyond marketing, XR also makes significant educational strides, aiding student learning (Endarto & Martadi, 2022; Lázaro & Duart, 2023). Integrating XR and AI in online education has proven beneficial in several ways, enabling self-paced learning, the simulation of real-life experiences, and enhanced collaboration, even in challenging circumstances. One notable advantage of XR in education is its ability to customize courses and curricula to meet individual student needs. However, there is a proposed shift towards implementing XR for marketing purposes within the business sector. In summary, XR—particularly in Virtual Reality (VR) and Augmented Reality (AR) is revolutionizing traditional business practices by offering innovative and engaging marketing experiences. The applications discussed highlight XR's potential to enhance customer interactions and provide immersive product experiences, ultimately shaping the future of business engagement and consumer relations.

Drawing parallels with the experiences of online shops and food delivery services initiated by Gojek and Grab, it becomes evident that not all MSMEs readily embrace digital platforms offered by technology (Astro & Ghazali, 2022; Nurlinda et al., 2020). The readiness of MSMEs to embrace digitalization is often catalyzed by initiatives from tech-based startups, exemplified by the Shopee Education Center for MSMEs and Gojek's incentives for partner MSMEs in 2021 (CNBC Indonesia, 2021; Shopee, 2024). While implementing XR seems like a significant investment that SMEs may have difficulties affording, XR has been rising in popularity for small-scale use in Indonesia. XR has been introduced as a learning media for students and marketing and shopping media for businesses. The increasing ease of use is an essential aspect of the rising popularity of XR usage. While people needed expensive devices to use XR features a few years ago, nowadays, people can use some XR features only by using commonly owned smartphones or low-priced XR devices. Thus, XR technology provide novel experiences for consumers with affordable price. SMEs can utilise this technology to increase their competitiveness.

Recognizing the potential benefits awaiting MSMEs in the metaverse, this paper explores the development of Extended Reality (XR) technology within MSMEs in Indonesia. Given the scarcity of literature addressing XR in the business sector, especially within MSMEs, this study also focuses on understanding the application of VR and AR as part of XR implementation. The insights are drawn primarily from community service articles that have applied these technologies to meet MSMEs' needs. The current metaverse ecosystem is an extension of the evolving Extended Reality landscape, presenting business challenges and uncertainties. Navigating this uncharted territory requires business owners and managers to stay abreast of technical competence, understand online user environments, and create unique offerings. Despite a standardized approach, encouraging company adoption is imperative for MSMEs to thrive in the metaverse (Rauschnabel, Felix, Hinsch, Shahab, & Alt, 2022; Silvestri, 2020). In light of the limited literature on XR implementation in the business sector and the scarcity of studies discussing XR in MSMEs,

this paper aims to contribute valuable insights into the adoption and impact of Extended Reality technologies in the Indonesian MSME landscape.

METHOD

This research methodology follows a review protocol based on PRISMA guidelines to conduct a literature review on the adoption of Extended Reality (XR) technology, including Augmented Reality (AR) and Virtual Reality (VR), in Micro, Small, and Medium Enterprises (MSMEs) in Indonesia. The review protocol and the flowchart of article selection used in this study are presented in Table 1 below.

Table 1. *Protocol Review*

Article Selection Method	PRISMA Guidelines
Search Keywords	Extended Reality, MSMEs, Indonesia
Inclusion Criteria	1. Year Range: 2018 – 2024 2. Type of Publication: Articles and Proceedings 3. Article Language: Indonesian and English 4. Open Access 5. General topics on the application of extended reality
Data Source	Google Scholar
Search Strategy	(“Extended Reality”) AND (“MSMEs”) AND (“Indonesia”)

The mapping procedure based on PRISMA guidelines is shown in Figure 1.

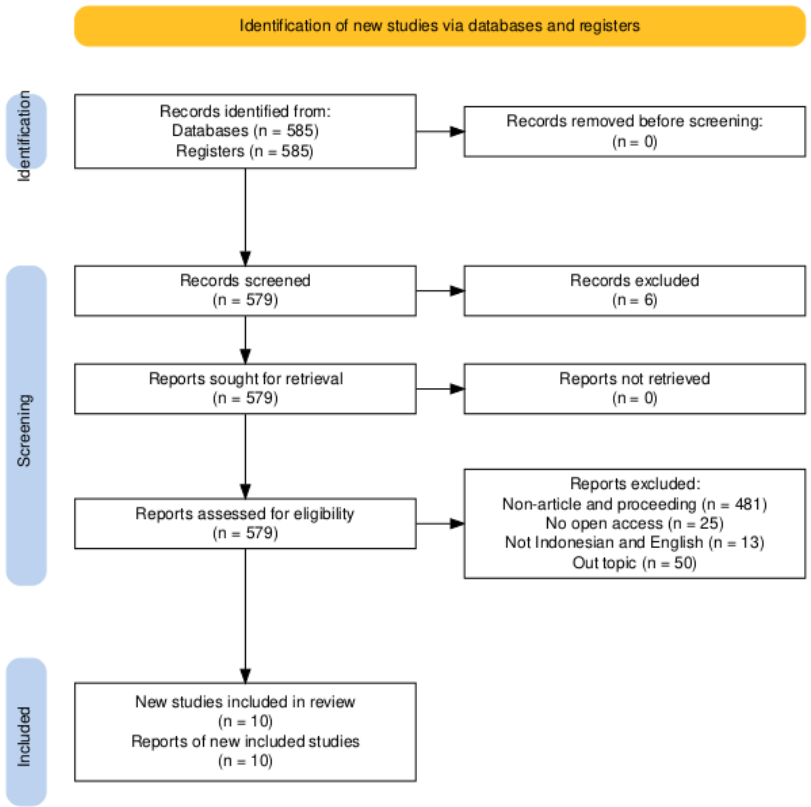

Figure 1. PRISMA Model Article Selection Flowchart

The first step of this methodology is to gather literature related to technology adoption in business contexts. This initial collection focuses on materials published between 2018 and 2024 to ensure a comprehensive understanding of recent developments in technology adoption. The study selects literature that discusses MSMEs in Indonesia to ensure their relevance and applicability to the Indonesian MSME context. The literature was collected using Google Scholar with the keywords ("Extended Reality") AND ("MSMEs") AND ("Indonesia"), narrowing the search results to include only literature published from 2018 to 2024. Subsequently, the selection process was refined to include only open-access articles and proceedings written in Indonesian or English, focusing on applying XR, AR, and VR technologies within specific industries. Literature that analyzes extended reality applications in general without addressing specific sectors was excluded. This criterion was established because the study also compares the application of extended reality across various industries. This focused approach is crucial to emphasize the specific technologies central to this research clearly.

The data source for this research is Google Scholar, as the service allows users to search for scholarly articles or journals in various publication formats, including PDFs, making it easier for users to obtain ideas or insights for creating high-quality academic works (Rafika, Putri, & Widiarti, 2017). Publish or Perish software is used to extract metadata from Google Scholar. Publish or Perish is a software program that collects and analyzes academic citations. It utilizes various data sources to gather raw citations, then analyzes them and presents multiple citation metrics, including the number of papers, total citations, and the h-index.

To guide and structure the analysis of the collected literature, the Technology Acceptance Model (TAM), as proposed by Fauzi & Sheng (2022), is employed. This model provides a theoretical framework designed to assess the adoption and acceptance of technology, offering a structured approach for evaluating the factors influencing users' decisions. By methodically progressing through these steps, this research aims to synthesize relevant findings and insights pertaining to the adoption of XR, AR and VR in Indonesian MSMEs. The application of the TAM model further enhances the analytical framework, allowing for a comprehensive and structured evaluation of the literature, thereby providing valuable insights into the dynamics of XR, AR and VR adoption within the specific context of Indonesian MSMEs. This methodology ensures a focused and thorough review of the existing body of knowledge, laying a solid foundation for understanding the intricacies of XR, AR and VR adoption in the unique setting of MSMEs in Indonesia.

FINDINGS AND DISCUSSION

There are 10 literatures that speak about the implementation of Extended Reality on MSMEs in Indonesia. All the literature is listed in Table 2.

Table 2. *Article Reviewed*

No	Authors	Business Categories	Industry	Types of XR	Obstacle	Benefit
1	Basori, Triyono, Hidayat, Dewi, & Sensato (2023)	Medium Business	Tourism	VR and AR	Technological limitations in accurately replicating the maritime environment, Need for advanced and accessible hardware, High development costs, Requirement for robust internet connectivity and infrastructure.	Enhances conservation awareness by virtually replicating the park's maritime environment, Promotion of Sustainable Tourism, Community Engagement and Participation
2	Fauzan & Priowirjanto (2023)	Medium Business	E-commerce	VR and AR	Need for Comprehensive Regulation, Digital Literacy and User Adaptation, Balancing Innovation with User Protection, Cultural and Social Acceptance	New Opportunities for Education and Socialization, Enhanced User Experience, Innovative Marketing and Sales Channels, Global Reach and Accessibility
3	Weking, Suyoto, & Santoso (2020)	Micro Business	Food and Beverage	AR	Technical Challenges in AR Implementation , Cultural Representation and Accuracy of the Indonesian traditional food, Market Penetration and User Adoption	Potential for Community Engagement, Leads to a more immersive and engaging user experience, Enhanced User Experience
4	Miranto, Rante, Sukaridhoto , Pasila, &	Medium Business	Textile	VR	Creating an intuitive control system for virtual reality for designing	Allows people from all over the world to access and experience the

No	Authors	Business Categories	Industry	Types of XR	Obstacle	Benefit
	Aliwarga (2020)				batik is complex, Ensuring the virtual exhibition ran smoothly, Development of Interactive Elements	batik exhibition, Supporting Local Artisans, Potential to foster international interest in Indonesian culture
5	Fathoni, Maryani, Mahardhika , & Wirautama (2021)	Medium Business	Fashion and Textile	AR	Requires a high level of technical expertise, Developing an intuitive and user-friendly AR, Effectiveness of the product, Data Security and Privacy of the user	Significantly improve customer interaction with batik products, Wider Market Reach, Cultural Preservation and Promotion, Offer personalized experiences to users
6	Huda & Sumarno (2021)	Medium Business	E-commerce	AR	Requires specialized technical skills and suitable hardware, Mobile Platform Compatibility, Convincing MSME producers to use and adopt the AR application might be a challenge	Successful Application Testing of the AR app, Efficient Presentation of the MSME Products, Enhanced Consumer Engagement, Support for MSME Economic Development
7	Subawa, Widhiasthin i, Astawa, Dwiatmadja , & Permatasari (2021)	Medium Business	Tourism	VR	The effectiveness of VRM may vary based on cultural preferences and behaviors of tourists, Regulatory and	Insights into consumer behavior change after Covid-19, Understandin g how VRM is integrated into tourism

No	Authors	Business Categories	Industry	Types of XR	Obstacle	Benefit
					Ethical Considerations, Resistance to Change, Technological Accessibility	marketing, Strategic Implications for Businesses
8	Franzeli & Istiono (2023)	Medium Business	Pharmaceutical	VR	Motion Sickness Issues, Difficulty in VR Device Usage Duration, Technology Acceptance Model (TAM) evaluation indicates mixed reactions from trial participants	Enhanced VR Training Module, Increased User Comfort, Awareness and Utilization of VR Technology
9	Manurung & Suharyanto (2024)	Medium Business	Automotive	AR	Require user training, Need marker detection accuracy, User hardware compatibility Issues, Needs to design an intuitive and user-friendly interface	Enhanced User Interaction, Efficient Spare Part Recognition for User, Innovative Technology Integration
10	Suryawijaya , Setiawan, Rahmawati, Laurent, & Putra (2024)	Medium Business	Textile	AR	User hardware compatibility issues, High cost, Enough Lighting Requirements, User Adaptation and Training, Limited Platform Support	Adaptation to Changing Consumer Behavior after Covid-19, Enhanced Product Presentation, Increased Purchase Conversions for Distributors, Support for MSMEs and Economic Progress

This literature review offers a comprehensive overview of Extended Reality (XR), Virtual Reality (VR), and Augmented Reality (AR) implementation in Indonesian business, with a specific focus on Micro, Small, and Medium Enterprises (MSMEs). Drawing insights

from 10 articles, this study reveals diverse integration methods of XR technologies in the Indonesian business landscape. It highlights emerging trends, challenges, and opportunities for MSMEs, showcasing how these immersive technologies enhance operational efficiency, customer engagement, and overall business performance.

The research conducted by Basori et al. (2023) and Subawa et al. (2021) delves into the challenges and benefits of implementing immersive technologies in the tourism industry, providing a comprehensive view of obstacles and advantages. Basori et al. (2023) focus on the maritime environment, highlighting technological limitations in replicating it accurately, the need for advanced hardware, high development costs, and the necessity for robust internet connectivity and infrastructure. Despite these challenges, the study emphasizes benefits such as enhancing conservation awareness, promoting sustainable tourism practices, and fostering increased community engagement. Subawa et al. (2021) contribute insights into the tourism sector's use of Virtual Reality Marketing (VRM), identifying obstacles including variability in effectiveness based on cultural preferences, regulatory and ethical considerations, resistance to change, and technological accessibility issues. On a positive note, the research outlines benefits such as understanding post-Covid-19 changes in consumer behavior, insights into the integration of VRM into tourism marketing, and strategic implications for businesses. Collectively, these findings offer a nuanced understanding of the obstacles and potential advantages in incorporating immersive technologies within the broader landscape of the tourism industry.

The research conducted by Huda & Sumarno (2021) and Fauzan & Priowirjanto (2023) delves into the multifaceted landscape of the e-commerce industry, providing a comprehensive exploration of obstacles and benefits associated with the implementation of Augmented Reality (AR) applications. Huda & Sumarno (2021) identifies challenges, including the demand for specialized technical skills and suitable hardware, issues with mobile platform compatibility, and potential resistance from Micro, Small, and Medium Enterprises (MSMEs) in adopting AR applications. Despite these hurdles, the study emphasizes successful application testing, efficient presentation of MSME products, enhanced consumer engagement, and vital support for the economic development of MSMEs as noteworthy benefits. Simultaneously, Fauzan & Priowirjanto (2023) contribute insights into obstacles such as the need for comprehensive regulations, challenges in digital literacy and user adaptation, the delicate balance between innovation and user protection, and considerations of cultural and social acceptance. In a positive light, the research highlights benefits including new opportunities for education and socialization, enhanced user experiences, innovative marketing and sales channels, and the potential for global reach and accessibility. Together, these combined findings offer a nuanced understanding of the intricate challenges and promising advantages associated with integrating Augmented Reality within the dynamic framework of the e-commerce sector.

The research findings by Weking et al. (2020) offer valuable insights into the challenges and advantages associated with the integration of Augmented Reality (AR) within the food and beverages industry, with a specific emphasis on Indonesian traditional cuisine. The identified obstacles include technical challenges in the implementation of AR,

the nuanced consideration of cultural representation and accuracy concerning Indonesian traditional food, and the broader challenges related to market penetration and user adoption. Despite these obstacles, the study underscores the potential for community engagement and highlights how AR can lead to a more immersive and engaging user experience within the realm of food and beverages. The findings suggest that the integration of AR technology in the industry has the capacity to enhance the overall user experience, bridging cultural representation with technical challenges to create a more engaging and immersive interaction with Indonesian traditional cuisine.

The research findings by Miranto et al. (2020) provide a comprehensive understanding of the challenges and benefits associated with the integration of virtual reality (VR) and augmented reality (AR) technologies within the textile industry, specifically focusing on the design and exhibition of batik. Similarly, research conducted by Suryawijaya et al. (2024) within the textile industry highlights obstacles including user hardware compatibility issues, high costs, lighting requirements, user adaptation and training, and limited platform support. Shared obstacles across both studies encompass user hardware compatibility issues, high implementation costs, the need for sufficient lighting, user adaptation and training, and limited platform support. Despite these challenges, both studies highlight significant benefits, such as the adaptation to changing consumer behavior post-Covid-19, enhanced product presentation, increased purchase conversions benefiting distributors, and vital support for Micro, Small, and Medium Enterprises (MSMEs) and overall economic progress within the textile industry. Additionally, Fathoni et al. (2021) contribute valuable insights to the challenges and benefits associated with immersive technologies, particularly within the fashion and textile industries. This research provides a more comprehensive perspective by emphasizing both sectors. Identified obstacles in the study include the need for a high level of technical expertise, the development of an intuitive and user-friendly AR system, concerns regarding the effectiveness of the product, and considerations for data security and user privacy. Conversely, the study underscores numerous benefits, including significantly improved customer interaction with batik products, a broader market reach, cultural preservation and promotion, and the capacity to offer personalized experiences to users. This collective research presents a more intricate and holistic understanding of the challenges and potential advantages linked to the integration of immersive technologies in the dynamic landscape of both the textile and fashion industries.

The research findings by Franzeli & Istiono (2023) provide significant insights into the challenges and benefits associated with the integration of Virtual Reality (VR) technology within the pharmaceutical industry. The identified obstacles include motion sickness issues, which can be a common concern in VR environments, difficulty in maintaining prolonged usage of VR devices, and mixed reactions from trial participants in the Technology Acceptance Model (TAM) evaluation. Despite these challenges, the study emphasizes several noteworthy benefits. The implementation of VR technology offers an enhanced training module, providing a more immersive and effective learning experience for pharmaceutical professionals. Additionally, the research highlights increased user comfort with the utilization of VR, addressing concerns related to motion sickness and device usage

duration. Furthermore, the findings indicate a positive impact on awareness and utilization of VR technology within the pharmaceutical industry, potentially paving the way for more widespread adoption and improved training methodologies in the future.

The research findings by Manurung & Suharyanto (2024) present a comprehensive examination of the challenges and benefits associated with the implementation of immersive technologies in the automotive industry. The identified obstacles encompass the need for user training to effectively utilize the technology, marker detection accuracy as a critical factor, user hardware compatibility issues, and the necessity to design an intuitive and user-friendly interface. Despite these challenges, the study underscores several significant benefits. The incorporation of immersive technologies results in enhanced user interaction, providing a more engaging and effective user experience within the automotive context. Moreover, the technology facilitates efficient spare part recognition for users, streamlining processes and enhancing overall operational efficiency in the industry. The findings also emphasize the innovative integration of technology, showcasing how immersive technologies contribute to advancements within the automotive sector.

Table 3. *Recapitulation of XR implementation on MSMEs in Indonesia*

MSME Industry	Obstacle	Benefit
Tourism	High development costs and need for robust internet connectivity.	Enhances conservation awareness and sustainable tourism.
E-commerce	Need for comprehensive regulation.	Provides global reach and accessibility.
Food and Beverage	Technical challenges in AR implementation.	More immersive and engaging user experience.
Fashion and Textile	Development of user-friendly AR systems.	Improves customer interaction with products.
Pharmaceutical	Issues with motion sickness and VR device usage.	Enhanced VR training modules.
Automotive	Hardware compatibility and interface design challenges.	Integration of innovative technology.

Based on our reviewed literature on the implementation of Extended Reality (XR) in Micro, Small, and Medium Enterprises (MSMEs) across various industries in Indonesia reveals consistent challenges, including the need for user-friendly systems and hardware compatibility, with concerns about data security. Despite these challenges, diverse benefits are identified, such as enhanced user experiences, global reach, and improved customer interactions. Cultural factors play a crucial role in the effectiveness of XR implementation, necessitating an understanding of industry-specific and regional nuances. The post-Covid-19 business landscape is marked by an adaptation to changing consumer behavior, with XR technologies seen as essential for aligning with evolving market trends. The application of

the Technology Acceptance Model (TAM) underscores the importance of user-centric evaluations in the adoption process. Industry-specific insights highlight tailored solutions for tourism, e-commerce, food and beverage, fashion and textile, pharmaceutical, and automotive sectors. Overcoming obstacles, such as high development costs or technical challenges, leads to tangible benefits, including sustainable tourism, global business expansion, immersive user experiences, and innovative technology integration.

The adoption of XR, AR and VR doesn't seem significant yet but with the price of AR and VR tools decreasing exponentially year by year (Farsi et al., 2021), usage of AR and VR for product marketing purposes will expand and depending on the mindset of the people at that time, the products offered by large industries may be more popular and in demand by consumers compared to MSMEs (Alcañiz et al., 2019). This shift can lead to a paradigm where products offered by large industries become more popular and in higher demand among consumers compared to those from MSMEs (Alcañiz et al., 2019). The evolving consumer mindset and preferences at that time will play a pivotal role in determining the success and market share of businesses leveraging XR technologies. MSMEs face a significant challenge in ensuring their products remain competitive, appealing, and accessible in this changing landscape. To address this, proactive measures such as investing in XR technologies, developing innovative marketing strategies, and enhancing user experiences may become crucial for MSMEs to stay relevant and competitive in the market. The balance between affordability, technological readiness, and consumer appeal will be key factors influencing the future dynamics of XR adoption in the business sector.

CONCLUSION

The adaptation of Extended Reality in Indonesia is still in its early stages. In conclusion, the literature review on the implementation of Extended Reality (XR), particularly Augmented Reality (AR) and Virtual Reality (VR), in Micro, Small, and Medium Enterprises (MSMEs) in Indonesia highlights both challenges and opportunities across diverse industries. The findings underscore common hurdles such as the need for user-friendly systems, hardware compatibility, and concerns about data security. Despite these challenges, the potential benefits of XR technologies are diverse, ranging from enhanced user experiences to global business reach. Indonesia’s MSMEs have great potential and some of them even produce high-quality products at a competitive price. To improve the competitiveness of MSMEs, especially when the era of Metaverse is getting closer, academics and government officials need to help introduce more XR-based technologies to more MSMEs and also develop more Extended Reality-based ecosystems that can be used by MSMEs. Our research is still limited on academic papers of research or community services, and may not cover industrial solutions or Corporate Social Responsibilities that happened on field of AR and VR to help MSMEs.

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