

The Usefulness of Emerging Technologies in the FMCG Industry (Underdeveloped Markets)

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Abstract

This study explores the potential of emerging technologies (ET) in enhancing operational efficiency, market reach, customer satisfaction, engagement, and competitive advantage in the fast-moving consumer goods (FMCG) industry within underdeveloped markets. Grounded in Diffusion of Innovation (DOI) Theory, Resource-Based View (RBV), and Institutional Theory, this research investigates how supply chain and logistics technology, customer-centric technologies, digital infrastructure, and regulatory support drive technology adoption and usefulness in this sector. Through qualitative methodology, semi-structured interviews will be conducted with 15 industry experts to gain insights into the strategic and contextual factors impacting ET adoption and effectiveness in the FMCG industry. This study addresses a critical literature gap by focusing on underdeveloped markets and assessing the intersection of technology adoption, resource allocation, and institutional influences. Findings will provide actionable insights for FMCG firms, policymakers, and technology providers aiming to enhance competitiveness and drive innovation in challenging market environments.

Keywords

Emerging Technologies, FMCG Industry, Underdeveloped Markets, Diffusion of Innovation Theory, Resource-Based View, Institutional Theory, Technology Adoption, Digital Infrastructure, Regulatory Support, Customer-Centric Technologies, Supply Chain Management

1. Introduction

The fast-moving consumer goods (FMCG) industry, which encompasses products with high turnover rates such as food, beverages, personal care, and household items, is one of the most competitive sectors globally. To maintain profitability

and growth, FMCG companies must continuously adapt to shifting consumer demands, optimize supply chains, and respond to regulatory changes. Emerging technologies (ET), including artificial intelligence (AI), blockchain, the Internet of Things (IoT), and advanced analytics, present opportunities for FMCG companies to enhance operational efficiency, improve customer engagement, and gain a competitive edge. However, despite the potential benefits, the adoption of ET in underdeveloped markets remains challenging due to infrastructure limitations, regulatory hurdles, and limited access to technological resources (Nozari et al., 2022).

Underdeveloped markets are often characterized by fragmented supply chains, lack of reliable digital infrastructure, and regulatory environments that may not support the rapid deployment of innovative technologies. These factors hinder the widespread adoption of ET in the FMCG industry, which requires robust digital infrastructure, skilled talent, and favorable regulatory support to fully leverage technological advancements. For instance, while blockchain technology could enhance traceability in the supply chain, ensuring product authenticity and quality, implementing it in underdeveloped markets can be problematic due to limited access to high-speed internet and mobile technology penetration. Similarly, AI-driven customer analytics could help FMCG companies personalize offerings and enhance customer satisfaction, but data availability and processing capabilities often lag in these regions. This study explores the potential of ET to transform the FMCG sector into underdeveloped markets, focusing on the interplay between digital infrastructure, supply chain technology, customer-centric solutions, and regulatory support. The research aims to provide a comprehensive understanding of the drivers and barriers to ET adoption by integrating three theoretical frameworks: Diffusion of Innovation (DOI) Theory, Resource-Based View (RBV), and Institutional Theory (Yelamanchili et al., 2021).

1.1. Background

The advent of digital technologies has revolutionized various industries, including the FMCG sector, by enabling companies to streamline operations, optimize resource utilization, and better understand consumer behavior. However, much of the research and application of these technologies have focused on developed markets with strong digital ecosystems and advanced infrastructure. In contrast, underdeveloped markets remain largely underexplored, despite their potential for growth and expansion. This presents a significant literature gap, as the challenges and opportunities associated with ET adoption in these regions differ considerably from those in developed markets (Olutimehin et al., 2024).

1.1.1. Emerging Technologies in the FMCG Sector

Emerging technologies such as AI, IoT, blockchain, and mobile applications offer numerous benefits to the FMCG industry. For example, AI-powered customer analytics can help companies better understand consumer preferences, enabling personalized marketing and improved customer satisfaction. Companies like Uni-

lever have leveraged AI-driven insights in developed markets to predict consumer trends, optimize product offerings, and enhance supply chain efficiency. However, replicating these successes in underdeveloped markets is challenging, as many FMCG companies face limitations in data access, processing capabilities, and skilled personnel. Similarly, blockchain technology offers significant potential for enhancing supply chain transparency and traceability in the FMCG sector. For instance, Nestlé has piloted blockchain solutions to track coffee and milk products from farm to shelf, ensuring transparency and building consumer trust. While blockchain can improve food safety and reduce fraud, its implementation in underdeveloped markets requires significant investment in digital infrastructure, reliable internet access, and regulatory approval, which may not be readily available. This gap in digital infrastructure hinders the widespread adoption of blockchain and other advanced supply chain solutions in these regions (Ahir, 2024).

1.1.2. Challenges FMCG Companies Face Integrating AI with Existing Systems in Underdeveloped Markets

Integrating AI with existing supply chain systems in underdeveloped markets presents several challenges. Infrastructure limitations are a significant barrier, as these markets often lack robust internet connectivity, data storage, and processing capabilities required for AI deployment. Furthermore, data availability and quality issues hinder AI-driven insights, as companies in these regions may struggle with fragmented or incomplete datasets. High costs of implementation, coupled with the lack of skilled labor, further exacerbate the difficulty of adopting AI. Regulatory hurdles, such as unclear policies around data usage and protection, create additional complexities. Moreover, the fragmented supply chain networks in these regions make it challenging to implement AI systems that rely on integrated and real-time data sharing. These issues collectively limit the scalability and effectiveness of AI solutions in enhancing supply chain operations.

1.1.3. Role of Public-Private Partnerships in the ET Landscape and Its Determination

Public-private partnerships (PPPs) play a crucial role in addressing infrastructure gaps, fostering innovation, and facilitating regulatory compliance in the ET landscape of underdeveloped markets. For example, these partnerships help pool resources to build digital infrastructure, such as expanding internet access and mobile networks, which are essential for technology adoption. The role of PPPs was determined through interviews, where experts like Interviewee 12 highlighted how government incentives and partnerships with private firms enable the adoption of technologies like AI and blockchain. Additionally, Interviewee 14 emphasized how PPPs align technology initiatives with local market needs, ensuring that they are both impactful and sustainable.

1.2. Research Scope

This study focuses on assessing the usefulness of emerging technologies in enhancing the efficiency and competitiveness of the FMCG industry in underdevel-

oped markets. Specifically, it will explore the roles of digital infrastructure, customer-centric technologies, supply chain and logistics technology, and regulatory support. The research will involve interviewing 15 FMCG industry experts in underdeveloped markets to gain in-depth insight into the factors facilitating or hindering ET adoption and effectiveness. The study's findings will contribute to a better understanding of how technological, organizational, and institutional factors interact to shape ET adoption in challenging market environments.

1.3. Research Questions

1. How does digital infrastructure influence the adoption and effectiveness of emerging technologies in the FMCG industry in underdeveloped markets?
2. What role do supply chain and customer-centric technologies play in enhancing operational efficiency, customer satisfaction, and competitiveness in the FMCG sector?
3. How do regulatory and institutional factors impact the implementation and usefulness of emerging technologies in underdeveloped FMCG markets?

1.4. Research Objectives

1. To assess the impact of digital infrastructure on the adoption and usefulness of emerging technologies in the FMCG industry in underdeveloped markets.
2. To explore the role of supply chain and customer-centric technologies in enhancing operational efficiency, customer engagement, and competitive advantage in the FMCG sector.
3. To evaluate the influence of regulatory and institutional support on the effective implementation of emerging technologies in the FMCG industry.

2. Literature Review

The FMCG (Fast-Moving Consumer Goods) industry is characterized by high competition, rapid innovation cycles, and a strong focus on operational efficiency and customer engagement. Emerging technologies (ET), such as artificial intelligence (AI), blockchain, the Internet of Things (IoT), and advanced analytics, offer significant potential for transforming this industry. However, while much research has focused on ET adoption in developed markets, limited studies explore its application and usefulness in underdeveloped regions. This literature review synthesizes existing knowledge on ET in the FMCG sector and identifies gaps related to adoption challenges, digital infrastructure, customer-centric technologies, regulatory support, and theoretical frameworks relevant to underdeveloped markets.

2.1. Emerging Technologies in the FMCG Sector

Numerous studies have highlighted the potential of ET to revolutionize the FMCG industry by improving operational efficiency, enhancing customer satisfaction, and increasing market reach. AI, for instance, has been widely applied for demand

forecasting, inventory management, and personalized marketing, which helps companies optimize their supply chains and tailor products to consumer preferences (Adama et al., 2024). IoT enables real-time tracking of goods in transit, enhancing visibility across the supply chain, which is crucial for perishable products common in FMCG. Blockchain, on the other hand, has been lauded for its ability to enhance transparency and traceability in supply chains, which can help reduce fraud and improve food safety (Shakur et al., 2024). Despite these advantages, studies show that ET implementation in underdeveloped markets faces unique barriers. Van Zanden (2023) notes that digital infrastructure limitations, such as low internet penetration and limited mobile technology access, restrict the potential benefits of ET in these regions. Furthermore, the lack of skilled labor and high implementation costs pose significant challenges for small and medium-sized FMCG enterprises in these markets, where resources are often constrained (Nwabekee et al., 2024).

2.2. Digital Infrastructure and ET Adoption

Digital infrastructure, encompassing internet accessibility, mobile technology penetration, and data storage capabilities, plays a crucial role in enabling ET adoption. In developed markets, robust digital infrastructure supports ET initiatives, allowing for seamless connectivity, data processing, and technology integration (Ndubuisi et al., 2021). However, in underdeveloped markets, inadequate digital infrastructure is a primary obstacle, as it hampers both supply chain optimization and customer-centric technologies. The disparity in digital infrastructure development often leads to inconsistent access to technology and limits the scalability of ET solutions in underdeveloped FMCG markets. As pointed out by Argyroudis et al. (2022), internet accessibility remains a challenge in many emerging economies, affecting the ability of FMCG companies to implement e-commerce platforms and digital payment systems. This digital divide underscores the need for tailored ET solutions that can operate in low-resource settings, emphasizing compatibility with limited digital infrastructure and mobile-first approaches. Addressing these infrastructure gaps is essential to enhance ET adoption and support FMCG growth in underdeveloped regions.

2.3. Customer-Centric Technologies in FMCG

Customer-centric technologies, including AI-powered personalization, e-commerce platforms, mobile applications, and customer data analytics, have become central to the FMCG sector's strategies for improving customer engagement and satisfaction. Studies have shown that personalization enabled by AI-driven analytics helps FMCG companies better understand customer preferences, which in turn drives customer loyalty and enhances brand competitiveness (Gupta & Ramachandran, 2021). For instance, personalized recommendations and promotions can be tailored to individual consumer behavior, thus increasing conversion rates and sales. However, customer-centric ET adoption faces specific barriers in

underdeveloped markets. Limited data availability and digital literacy are significant constraints, as noted by Ho (2020), who argue that companies in these regions often lack access to high-quality data required for analytics and AI-driven personalization. Moreover, underdeveloped markets have unique consumer behavior patterns and preferences that may not align with conventional customer engagement models used in developed regions. Consequently, there is a need for further research on how FMCG companies can effectively leverage customer-centric technologies in underdeveloped markets to cater to local consumer needs and overcome data-related challenges.

2.4. Regulatory and Institutional Support for Technology Adoption

Institutional Theory suggests that regulatory support and government policies are pivotal in technology adoption. In developed markets, government incentives, regulatory frameworks, and public-private partnerships have contributed to a favorable environment for ET implementation (Bag et al., 2023). However, the regulatory landscape in underdeveloped markets is often fragmented, and inconsistent policies may inhibit ET adoption. For example, stringent data protection laws without clear guidelines for ET usage can create uncertainty for FMCG companies looking to implement customer data analytics and AI-driven personalization. In underdeveloped markets, regulatory support for digital transformation is often limited, leading to slower adoption rates and increased operational risks for FMCG firms (Al-Emran & Griffy-Brown, 2023). Policies supporting infrastructure development, incentivizing ET adoption, and fostering public-private partnerships are essential to facilitate digital transformation in these regions. For instance, the Indian government's Digital India initiative, which aims to improve digital literacy and infrastructure, has been instrumental in increasing ET adoption across various sectors, including FMCG (George & George, 2023). Similar policies in other underdeveloped markets could support ET adoption by addressing institutional barriers and fostering an environment conducive to technological growth.

2.5. Theoretical Frameworks in Understanding ET Adoption

This study integrates three theoretical frameworks: Diffusion of Innovation (DOI) Theory, Resource-Based View (RBV), and Institutional Theory, to provide a comprehensive perspective on ET adoption in the FMCG industry in underdeveloped markets.

1. Diffusion of Innovation (DOI) Theory

DOI Theory, developed by Rogers (1962), is widely used to examine the adoption of new technologies within organizations. DOI Theory posits that the adoption of technology is influenced by factors such as its perceived advantage, compatibility, and complexity. In the context of underdeveloped FMCG markets, DOI Theory offers insights into the factors that facilitate or hinder ET adoption, including cultural acceptance, cost considerations, and compatibility with existing practices (Sharma & Sagar, 2023).

2. Resource-Based View (RBV)

The RBV framework emphasizes the importance of resources, such as technology, skills, and capital, in gaining competitive advantage. In underdeveloped markets, FMCG companies often face resource constraints that limit their ability to adopt ET. However, RBV suggests that companies with access to unique resources, such as strategic partnerships and skilled labor, are more likely to succeed in implementing ET. For example, partnerships with local technology providers or government support can help FMCG companies overcome resource limitations and leverage ET effectively (Purnawidya & Raharjo, 2023).

3. Institutional Theory

Institutional Theory examines the role of external regulatory and cultural factors in shaping organizational behavior and technology adoption. Regulatory support, cultural norms, and public-private partnerships are essential for ET adoption, especially in underdeveloped markets (Scott, 2008). For instance, institutional pressures, such as government policies that promote technology adoption or societal expectations for transparency in supply chains, can drive ET implementation. However, a lack of institutional support can create barriers, underscoring the need for government policies that facilitate ET adoption in the FMCG sector (Risi et al., 2023).

2.6. Case Studies or Examples of Successful ET Implementation in Underdeveloped Markets

The study provides several examples of successful ET implementation in underdeveloped markets. Unilever's use of blockchain technology for supply chain transparency ensured ethical sourcing and regulatory compliance. Similarly, PepsiCo leveraged IoT in fleet and cold chain management to reduce waste and enhance operational efficiency. Hindustan Unilever expanded its digital reach through India's Digital India initiative, which facilitated e-commerce and digital payment adoption. These cases illustrate how targeted efforts in digital infrastructure, regulatory support, and customer-centric technologies can overcome market challenges and drive success in underdeveloped FMCG markets.

2.7. Literature Gaps and Contribution of This Study

Although substantial research has explored the potential of ET in developed markets, there remains a gap concerning the adoption challenges and effectiveness of ET in underdeveloped FMCG markets. Existing literature primarily focuses on operational efficiency and customer engagement improvements in digitally advanced regions, neglecting the contextual factors unique to underdeveloped markets. Specifically, there is limited research on how digital infrastructure, regulatory support, and resource constraints impact ET adoption in these regions. Moreover, while DOI, RBV, and Institutional Theory have been individually applied in technology adoption studies, few studies have integrated these frameworks to provide a comprehensive analysis of ET adoption challenges in under-

developed markets. This study aims to fill these gaps by examining the usefulness of ET in the FMCG industry within underdeveloped markets, focusing on the interaction between supply chain technology, customer-centric solutions, digital infrastructure, and regulatory support. By interviewing 15 experts, this qualitative study will provide insights into how FMCG companies can overcome barriers to ET adoption and leverage these technologies to enhance operational efficiency, customer satisfaction, and competitive advantage. The findings will contribute to the existing literature by offering a conceptual model that integrates DOI, RBV, and Institutional Theory, thereby advancing our understanding of ET adoption in challenging market environments. DOI Theory helps explain the spread of new technologies within an organization and among consumers, RBV focuses on the strategic value of resources such as technology, and Institutional Theory emphasizes the role of regulatory and cultural factors in shaping adoption decisions. This theoretical integration offers a holistic approach to understanding how technology adoption in underdeveloped FMCG markets can be enhanced, thereby contributing to a critical gap in existing literature.

2.8. Hypotheses

H1: There is a significant influence of Digital Infrastructure Factors on the Usefulness of ET in FMCG Industry.

H2: The Usefulness of ET in the FMCG Industry is influenced significantly by the Supply Chain & Logistics Technology.

H3: There is a significant influence of Customer-Centric Technologies Factors on the Usefulness of ET in FMCG Industry.

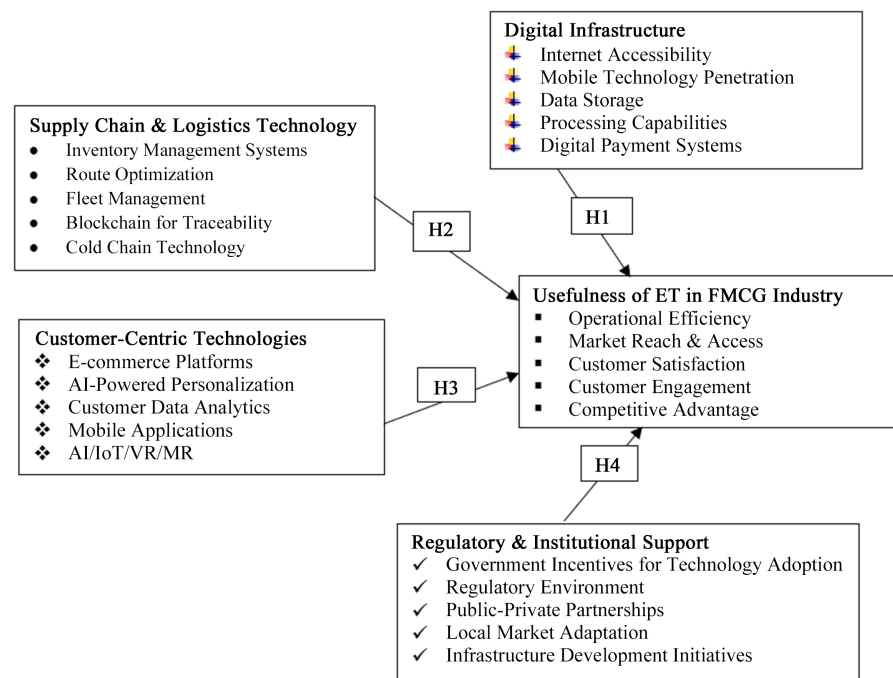


Figure 1. Conceptual model.

H4: The Usefulness of ET in the FMCG Industry is influenced significantly by the Regulatory & Institutional Support.

2.9. The Usefulness of Emerging Technologies in the FMCG Industry (Underdeveloped Markets)

Conceptual Model (**Figure 1**) uses Diffusion of Innovation Theory, Resource-Based View and Institutional Theory.

3. Methodology

This study uses a qualitative approach to explore the usefulness of emerging technologies (ET) in the FMCG industry within underdeveloped markets, guided by a conceptual model incorporating Diffusion of Innovation (DOI) Theory, Resource-Based View (RBV), and Institutional Theory. This framework enables a nuanced examination of ET adoption, emphasizing the roles of digital infrastructure, supply chain and logistics technology, customer-centric technology, and regulatory support in improving operational efficiency, customer engagement, and competitive advantage. The research design involves semi-structured interviews with 15 experts, including senior managers and digital transformation consultants in the FMCG sector. Purposeful sampling ensures that participants have significant experience and insight into ET adoption challenges in underdeveloped markets. Data collection focuses on perceptions of ET benefits, barriers, and the role of external and internal factors in adoption decisions. Interviews will be analyzed using thematic analysis, a method that allows for the identification of patterns and themes linked to each theoretical framework, such as perceived advantages, resource availability, and regulatory factors (Iyer & Rawool, 2023). Coding and theme development will be informed by the study's focus on the impact of digital infrastructure, regulatory support, and customer-centric technologies on ET adoption in the FMCG industry. To ensure validity, the study will use data triangulation and member checking, while ethical considerations will be addressed by securing informed consent and maintaining confidentiality. Though this qualitative approach offers in-depth insights, it has limitations, including small sample size and potential self-reporting biases that may affect the generalizability of findings. Nonetheless, this methodology is expected to provide valuable insights for industry practitioners and policymakers, highlighting ways to overcome barriers to ET adoption and leverage its potential benefits in the FMCG industry within underdeveloped markets. This study aims to contribute to the literature by offering an empirically grounded model that addresses the specific opportunities and challenges of ET in these regions (Iyer et al., 2024).

Criteria for Selecting the 15 Industry Experts and Ensuring Representativeness

The selection of the 15 industry experts was based on purposeful sampling, targeting individuals with substantial experience in digital transformation and

emerging technologies within the FMCG sector in underdeveloped markets. These experts included CEOs, Vice Presidents, senior managers, and consultants with diverse backgrounds in supply chain management, customer engagement, regulatory frameworks, and technology adoption. Representativeness was ensured by including participants from varied geographic locations (e.g., Dubai, Nigeria, India) and industries such as retail, corporate banking, healthcare, and aviation. This diversity allowed the research to capture a comprehensive range of insights and contextual differences across underdeveloped markets. Additionally, thematic analysis of the interview data was employed to extract common patterns, ensuring that findings were reflective of shared challenges and opportunities within these regions.

The Summary of the Interviewees (experts) has been tabulated below **Table 1**.

Table 1. Summary of interviews.

Interviewee no, (Experience in years), Designation, Location	Main Comments on “The Usefulness of Emerging Technologies in the FMCG Industry (Underdeveloped Markets)” (Other Interviewees agreeing to these comments)
1. (8) CEO, Software Solutions Company, Dubai, UAE.	<ul style="list-style-type: none"> - Digital infrastructure plays a critical role in driving the adoption and usefulness of emerging technologies (ET) in the FMCG industry, particularly in underdeveloped markets. - Reliable internet access enhances operational efficiency through real-time data sharing, supports wider market reach via digital marketing, and strengthens customer satisfaction through accessible online support. (Interviewees 2, 4, 7, 9, 11, 13, 15) (Bharti & Verma, 2024)
2. (10) Head, Economic Forum, Sharjah	<ul style="list-style-type: none"> - Mobile technology penetration enables efficient field communication, expands market access in remote areas, and facilitates customer engagement through mobile-friendly apps and notifications. - Robust data storage and processing capabilities allow FMCG companies to leverage data-driven insights for efficient inventory management, targeted marketing, and personalized customer service, ultimately providing a competitive edge. - Digital payment systems streamline transactions, improve customer convenience, and enable secure, flexible payment options that enhance customer satisfaction. (Interviewees 4, 6, 8, 10,11, 12), (Kumar et al., 2024)
3. (9) Senior Vice President, Corporate Banking, Mumbai	<ul style="list-style-type: none"> - The adoption of supply chain and customer-centric technologies like IoT and CRM tools boost operational efficiency, customer engagement, and competitive advantage by enabling real-time tracking, personalized service, and responsive support. - Regulatory and institutional support significantly influences the implementation of ET in FMCG by promoting data security, digital literacy, and compliance, building trust, and supporting broader digital adoption (Interviewees 1, 2, 5, 8, 10, 12, 14, 15), (Kumari & Lele, 2023); (Edunjobi, 2024)
4. (11) Vice President, IT Sector Company, Bhopal	<ul style="list-style-type: none"> - Inventory management systems enhance operational efficiency by optimizing stock levels, reducing waste, and ensuring timely replenishment, which is crucial for maintaining continuous market access. - Route optimization and fleet management improve market reach and customer satisfaction by reducing delivery times, lowering transportation costs, and enhancing on-time delivery (Interviewees 1, 3, 6, 9, 11, 12, 14) (Wang & Jiang, 2022).
5. (11) HR Director Private Oil sector, Mumbai	<ul style="list-style-type: none"> - Blockchain technology for traceability builds customer trust by ensuring transparency and accountability, especially in regions with regulatory challenges. - Cold chain technology preserves product quality in temperature-sensitive goods, enhancing customer satisfaction and fostering competitive advantage in markets requiring strict quality control (Interviewees 1, 3, 6, 8, 12, 15), (Centobelli et al., 2022; Kumar et al., 2020).

Continued

6. (10) Senior Manager, Aviation Administration, Chennai	<ul style="list-style-type: none"> - E-commerce platforms and mobile apps expand market reach and access, enabling FMCG companies to connect with customers in remote areas and increase sales channels. - AI-powered personalization and customer data analytics drive customer satisfaction and engagement by offering tailored recommendations and insights into preferences, ensuring a more personalized shopping experience (Interviewees 3, 6, 8, 9, 13), (Ganapathy, 2022).
7. (13) General Manager Cooperative Retail, Dubai	<ul style="list-style-type: none"> - Immersive technologies like VR and MR create engaging experiences, fostering customer loyalty and differentiation. - Collectively, these technologies contribute to operational efficiency through automated data analysis and customer service, and they provide a competitive advantage by aligning offerings with customer needs (Interviewees 1, 3, 5, 6, 9, 12), (Tom Dieck & Han, 2022).
8. (12) Head of Healthcare Organization, Nigeria	<ul style="list-style-type: none"> - Regulatory support further encourages responsible data use and fosters customer trust, facilitating ET adoption and the strategic growth of FMCG in emerging markets. - Regulatory and institutional support plays a vital role in enhancing the usefulness of emerging technologies (ET) in the FMCG industry, particularly in underdeveloped markets. - Government incentives for the adoption of technology can reduce the financial burden on companies, encouraging them to invest in innovations that improve operational efficiency and enhance customer satisfaction (Interviewees 4, 5, 8, 12, 14), (Chen et al., 2023).
9. (14) International Consultant, Dubai, UAE	<ul style="list-style-type: none"> - A favorable regulatory environment ensures compliance and encourages responsible practices, fostering trust and stability in the market. Public-private partnerships facilitate knowledge sharing and resource pooling, amplifying the impact of technology initiatives while enabling market reach and access. - Local market adaptation ensures that technologies align with regional needs, making it easier for companies to engage with their customers effectively (Interviewees 1, 2, 6, 7, 14) (Manafe et al., 2024).
10. (11) Vice President Hospitality sector, Oman	<ul style="list-style-type: none"> - Infrastructure development initiatives, such as improved logistics and connectivity, are essential for creating a robust foundation for ET, ultimately leading to a competitive advantage by streamlining operations and enhancing customer engagement. - Collectively, these factors create an ecosystem that not only supports the adoption of ET but also drives growth and sustainability within the FMCG sector (Interviewees 1, 5, 8, 11, 13), (Saidi et al., 2020; Prashar, 2023).
11. (14) Vice President, Environmental Agency, Dubai, UAE	<ul style="list-style-type: none"> - Enhanced operational efficiency, driven by ET, streamline processes, reduces costs, and increases responsiveness to market demands, thereby enabling companies to adapt swiftly in underdeveloped markets. - Improved market reach and access are facilitated through digital platforms and supply chain innovations, allowing FMCG businesses to connect with a broader customer base (Interviewees 1, 2, 4, 6, 7, 12, 13), (Lawrence & Mupa, 2024; Mariani & Wamba, 2020).
12. (15) Senior President, Corporate Services, Ajman.	<ul style="list-style-type: none"> - Higher customer satisfaction is achieved through personalized experience and efficient service delivery, which also fosters deeper customer engagement, leading to increased loyalty. - Finally, leveraging ET effectively creates a competitive advantage by enabling firms to differentiate their offerings and respond proactively to market changes. - Overall, these interconnected factors illustrate how the successful integration of ET, supported by digital infrastructure and regulatory backing, can drive growth and sustainability in the FMCG sector. (Interviewees 1, 4, 6, 8, 13), (Rane, 2023; Trivedi & Srivastava, 2022).
13. (12) Senior HR Director, Tourism Company, Egypt	<ul style="list-style-type: none"> - Economic conditions also play a critical role in shaping the usefulness of ET within the FMCG sector. - Economic downturns can reduce consumer spending power, necessitating companies to optimize operational efficiency to maintain profitability. - In such environments, the deployment of ET becomes essential for streamlining operations, reducing costs, and enhancing customer engagement through targeted marketing strategies. - Conversely, economic growth can stimulate investment in technology, enabling firms to expand their market reach and improve customer satisfaction by introducing innovative products and services. (Interviewees 2, 7, 8, 9, 14), (Hofmann et al., 2022).

Continued

14. (15) President, Healthcare Group, Cameroon	<ul style="list-style-type: none"> - The current geopolitical landscape significantly influences the FMCG industry's adoption and effectiveness of emerging technologies (ET). Increasing political tensions and conflicts can disrupt supply chains, leading to uncertainties in market access and operational efficiency. - In underdeveloped markets, this volatility can exacerbate challenges related to logistics and resource availability, making it crucial for FMCG companies to leverage ET to maintain stability and adapt quickly to changing conditions. - Moreover, government policies shaped by geopolitical factors can either facilitate or hinder technology adoption, depending on the support provided for infrastructure development and innovation (Interviewees 3, 5, 7, 11, 13); (Odulaja et al., 2023).
15. (9) Start-up Entrepreneur in Environment, Abu Dhabi, UAE	<ul style="list-style-type: none"> - Social trends towards sustainability and ethical consumption pressure companies to adopt technologies that promote transparency and eco-friendliness. - Legal regulations regarding data privacy and consumer protection require businesses to implement robust data management practices supported by ET. - Additionally, advancements in technology create new opportunities for improving customer engagement and operational efficiency. (Interviewees 3, 6, 8, 10, 13, 14), (Prashar & Sunder, 2024; Abatan et al., 2024).

Emerging technologies are transforming the FMCG industry into underdeveloped markets by supporting a balance of social, environmental, and economic goals that drive sustainable and ethical success. Digital tools, AI, IoT, and blockchain help FMCG companies enhance community well-being by facilitating access to goods, fostering social equity, and engaging local stakeholders inclusively. In terms of environmental impact, IoT and AI optimize resource efficiency by reducing waste, conserving energy, and ensuring ethical supply chains, which promote long-term ecosystem health. Economically, these technologies foster growth by creating job opportunities, supporting local vendors, and enhancing the financial stability of businesses in these regions. Together, these advancements create a holistic framework that upholds sustainable practices in an integrated manner, enabling FMCG companies to achieve economic prosperity, environmental health, and social justice in underdeveloped markets (Behera et al., 2023).

4. Findings and Discussions

This section examines the hypotheses formulated to explore the relationship between various factors and the usefulness of emerging technologies (ET) in the FMCG industry, as presented in the conceptual model in **Figure 1**. The hypotheses are supported by an analysis of the benefits and challenges related to sustainable and ethical success, as well as insights drawn from the latest literature and a summary table of interviewee responses (Iyer et al., 2024).

4.1. Inclusion of Specific Examples from Interviews to Illustrate Findings

The article integrates multiple examples from interviews to substantiate its findings. For instance, Interviewee 9 highlighted how **IoT and CRM tools** boost operational efficiency by enabling real-time tracking and personalized services, while

Interviewee 11 emphasized the importance of **blockchain technology** for enhancing supply chain transparency and customer trust. Similarly, Interviewee 14 discussed the role of public-private partnerships in facilitating knowledge sharing and resource pooling, which amplify the impact of technology adoption. These examples enrich the qualitative findings by demonstrating how emerging technologies are applied in specific contexts within the FMCG industry.

4.2. Hypothetical Decisions

Hypothesis 1 (H1)—Decision: Accepted

Digital infrastructure, including internet accessibility, mobile technology penetration, data storage, processing capabilities, and digital payment systems, has a significant influence on the usefulness of emerging technologies (ET) in the FMCG industry. Reliable and accessible digital infrastructure enables FMCG companies to implement ET solutions effectively, enhancing operational efficiency, customer reach, and competitive advantage. Thus, a strong digital foundation is critical for leveraging ET to improve customer engagement and satisfaction in underdeveloped markets (Oladimeji & Owoade, 2024).

Hypothesis 2 (H2)—Decision: Accepted

Supply Chain & Logistics Technology, such as inventory management systems, route optimization, fleet management, blockchain for traceability, and cold chain technology, significantly influences the usefulness of ET in the FMCG industry. These technologies streamline operations, reduce costs, and improve product traceability and delivery efficiency, which are crucial for the FMCG sector's growth in underdeveloped markets. Efficient supply chain technology integration enhances ET's usefulness by improving both internal logistics and customer satisfaction through reliable product availability (Chauhan et al., 2023).

Hypothesis 3 (H3)—Decision: Accepted

Customer-Centric Technologies, including e-commerce platforms, AI-powered personalization, customer data analytics, mobile applications, and technologies like AI/IoT/VR/MR, have a significant impact on the usefulness of ET in the FMCG industry. These technologies improve customer experience by providing personalized recommendations, seamless online shopping experiences, and targeted marketing strategies. The ability to engage with customers in real-time and cater to their preferences enhances customer satisfaction and strengthens brand loyalty, underscoring the importance of customer-centric solutions in the FMCG sector (Mukhopadhyay et al., 2024).

Hypothesis 4 (H4)—Decision: Accepted

Regulatory & Institutional Support, such as government incentives for technology adoption, favorable regulatory environments, public-private partnerships, local market adaptation, and infrastructure development initiatives, significantly influence the usefulness of ET in the FMCG industry. Supportive policies and partnerships encourage FMCG companies to adopt and implement ET solutions. Regulatory and institutional backing provides the necessary framework for innova-

tion and ensures that ET is aligned with local market needs, ultimately improving operational efficiency, market reach, and competitive advantage (Ugwu et al., 2024).

Recent examples demonstrate the significant role of emerging technologies in the FMCG industry, particularly within underdeveloped markets. Unilever's use of blockchain for supply chain transparency ensures ethical sourcing and aligns with regulatory sustainability standards, while PepsiCo leverages IoT in fleet and cold chain management to reduce waste and improve operational efficiency. Nestlé employs AI for personalized recommendations, boosting customer engagement and competitive advantage in local markets. In India, government initiatives like "Digital India" have enabled companies like Hindustan Unilever to expand digitally, improving market reach and efficiency. Additionally, Procter & Gamble's integration of blockchain enhances supply chain traceability, fostering stakeholder trust and regulatory compliance in ethical sourcing. These examples highlight how digital infrastructure, supply chain technology, customer-centric solutions, and regulatory support collectively drive sustainable and ethical success in the FMCG sector (Mubarik & Khan, 2024).

4.3. Usefulness of Emerging Technologies in the FMCG Industry (Underdeveloped Markets)

The research objectives have been comprehensively addressed through an analysis of digital infrastructure, supply chain and customer-centric technologies, and regulatory support within the FMCG industry in underdeveloped markets. First, by assessing the impact of digital infrastructure—encompassing internet accessibility, data storage, mobile technology penetration, and processing capabilities—the study demonstrates how foundational digital resources are essential for the adoption and effective use of emerging technologies. The findings indicate that robust digital infrastructure not only facilitates technological integration but also enhances operational effectiveness and expands market reach. Companies in underdeveloped markets with access to strong digital infrastructure have shown increased agility in deploying advanced technologies, supporting the objective of evaluating the influence of digital infrastructure on technology adoption and usefulness.

The second objective, exploring the role of supply chain and customer-centric technologies, was met by examining tools such as inventory management systems, AI-powered personalization, and customer data analytics. The research highlights how supply chain technologies like blockchain for traceability and route optimization, combined with customer-focused platforms like e-commerce and mobile applications, contribute to improved operational efficiency, customer engagement, and competitive positioning. These technologies help FMCG companies streamline logistics, better understand customer preferences, and foster personalized interactions, which are critical for gaining a competitive edge in challenging markets. As a result, this objective effectively underscores the significance of sup-

ply chain and customer-centric technologies in driving both efficiency and customer satisfaction.

Lastly, the study addresses the third objective by evaluating the influence of regulatory and institutional support on the successful implementation of emerging technologies. Through examples of government incentives, regulatory environments, and public-private partnerships, the research illustrates how supportive policies, and institutional frameworks enable companies to leverage technology for sustainable growth. Regulatory support facilitates smoother technology adoption by ensuring compliance with local laws, promoting ethical practices, and providing infrastructure development initiatives that aid technology integration. This objective confirms that regulatory and institutional backing is vital for overcoming challenges and fostering a conducive environment for technology-driven innovation within the FMCG sector in underdeveloped markets. Together, these insights affirm that digital infrastructure, operational technologies, and supportive policies are instrumental in the sustainable and ethical success of the FMCG industry.

5. Contribution and Originality (Value of Research)

The contribution and originality of this research lies in its integrative examination of emerging technologies (ET) within the FMCG industry in underdeveloped markets, specifically highlighting the interplay of digital infrastructure, supply chain and customer-centric technologies, and regulatory support. By addressing these critical factors, the study presents a cohesive framework that captures the nuanced ways in which technology adoption can drive operational efficiency, customer engagement, and competitive advantage in challenging environments. This research goes beyond conventional analyses by exploring how digital infrastructure—encompassing internet accessibility, data storage, and mobile technology—provides the foundational support essential for effective ET adoption, especially in regions with limited technological penetration. By assessing the role of these infrastructural elements, the study contributes valuable insights into the conditions necessary for the success of emerging technologies in underdeveloped markets. Furthermore, the research contributes to the literature by examining supply chain and customer-centric technologies, such as blockchain, AI-driven personalization, and mobile applications, within the context of the FMCG sector. These technologies are shown to enhance operational and customer-facing outcomes, providing practical insights into how companies can leverage ET to improve logistics, personalize customer experiences, and boost engagement. This approach emphasizes not only operational efficiency but also the importance of understanding and meeting consumer needs, which is vital for building a competitive edge in fast-moving markets. The study's originality also extends to its focus on regulatory and institutional support as a critical factor in technology adoption, exploring how government incentives, policy frameworks, and public-private partnerships enable FMCG companies to overcome structural and compliance challenges, ul-

timately fostering a supportive environment for technology-driven growth. The research further enhances its contribution by providing a holistic understanding of sustainable and ethical success in the FMCG industry. By examining the interconnected roles of technology, infrastructure, and regulatory support, the study offers a balanced perspective that emphasizes financial viability, social responsibility, and environmental stewardship. This integrated approach highlights how digital advancements, aligned with ethical and institutional support, can help FMCG companies achieve sustainable development in underdeveloped markets. The research also introduces a novel framework that assesses the synergies among digital, operational, and regulatory factors, providing a strategic blueprint for companies aiming to implement emerging technologies responsibly and sustainably. This contribution adds to the academic discourse on technology adoption by presenting an adaptable and holistic model for sustainable, equitable, and resilient growth in the FMCG sector across underdeveloped markets.

Tracking and Evaluating the Long-Term Impacts of ET Adoption in the FMCG Industry

To track and evaluate the long-term impacts of ET adoption, the study recommends using longitudinal studies and data analytics. Key performance indicators (KPIs) such as operational efficiency, customer satisfaction, market reach, and supply chain transparency should be measured over time. Leveraging emerging technologies like IoT and AI can enable real-time tracking of these metrics, offering insights into how ET influences business performance. Additionally, qualitative methods, such as follow-up interviews with stakeholders, can provide in-depth understanding of the evolving challenges and benefits associated with ET adoption. Periodic evaluation frameworks can ensure that the technologies continue to align with organizational goals and market needs.

6. Implications of This Research

6.1. Practical Implications

The practical implications of this research are substantial for FMCG companies operating in underdeveloped markets. By identifying the key factors that enable the successful adoption of emerging technologies, this study provides actionable insights that can guide businesses in making strategic investments in digital infrastructure, supply chain management, and customer-centric solutions. For instance, companies can leverage mobile technology and internet accessibility to enhance market reach, while blockchain and IoT solutions improve supply chain transparency and efficiency. These technologies not only streamline operations but also allow for better inventory management and route optimization, which are critical for reducing costs in resource-limited environments. The findings underscore the importance of building a robust digital foundation that supports long-term technological integration, thus equipping companies to be more agile and competitive in dynamic and often volatile market conditions.

6.2. Social Implications

From a social perspective, the research highlights how emerging technologies in the FMCG sector can foster greater inclusivity, accessibility, and community development. Improved digital infrastructure enables FMCG companies to reach underserved populations, providing them with better access to essential goods and services. Additionally, customer-centric technologies, such as AI-powered personalization and mobile applications, empower consumers by offering more tailored and convenient shopping experiences, thereby enhancing customer satisfaction. The adoption of these technologies also creates new job opportunities and skill requirements in local communities, contributing to economic empowerment. By demonstrating the potential for inclusive growth, this research encourages a socially responsible approach to technology adoption that considers the needs and welfare of both consumers and local communities.

6.3. Managerial Implications

The managerial implications of this study are significant for decision-makers in the FMCG industry, particularly in terms of aligning technology investments with regulatory and institutional support. Managers can use the insights from this research to understand the critical role that government policies and public-private partnerships play in facilitating technology adoption. By actively engaging with regulatory bodies and leveraging available incentives, FMCG companies can better navigate compliance requirements and secure the support needed for successful ET implementation. This research also underscores the importance of fostering a culture of innovation within organizations, encouraging managers to invest in training programs that build digital skills and support technology integration across all business functions. Ultimately, these managerial insights offer a strategic framework that helps leaders make informed decisions on technology investments, ensuring they align with both operational goals and regulatory landscapes to drive sustainable growth and competitive advantage.

6.4. Environmental Implications

The environmental implications of adopting emerging technologies in the FMCG industry, particularly in underdeveloped markets, are considerable. By incorporating supply chain and logistics technologies, such as route optimization, fleet management, and blockchain traceability, companies can significantly reduce their carbon footprint. Route optimization, for instance, allows companies to minimize fuel consumption and lower greenhouse gas emissions by optimizing delivery routes and reducing transportation inefficiencies. Blockchain and IoT-enabled traceability enhance transparency within the supply chain, allowing businesses to monitor and manage their environmental impact more effectively by tracking product origins, energy use, and waste generation. Furthermore, cold chain technologies support the preservation of perishable goods, reducing food waste—a critical issue in many underdeveloped markets. Collectively, these environmentally friendly tech-

nologies contribute to more sustainable FMCG operations, supporting global efforts to mitigate climate change and conserve resources.

6.5. Economic Implications

Economically, the integration of emerging technologies in the FMCG industry can drive significant financial benefits for both companies and local economies in underdeveloped markets. By increasing operational efficiency through automation, AI, and digital infrastructure, FMCG businesses can reduce costs associated with logistics, inventory management, and customer service. These cost savings improve profitability and make products more affordable for consumers, potentially increasing market penetration in price-sensitive regions. Customer-centric technologies, such as AI-powered personalization and data analytics, help companies tailor offerings to local consumer preferences, enhancing customer satisfaction and loyalty, which are crucial for sustained revenue growth. Additionally, the adoption of digital payment systems and mobile technology enables easier and more secure transactions, expanding the market reach to previously underserved areas. This economic growth contributes to job creation, as new roles emerge to manage, maintain, and innovate within these technology-driven frameworks. Ultimately, these economic benefits foster a more resilient FMCG industry that supports local development, spurs job creation, and contributes to economic empowerment in underdeveloped markets.

7. Limitations and Future Research

7.1. Limitations

This research, while offering valuable insights into the adoption and usefulness of emerging technologies (ET) in the FMCG industry within underdeveloped markets, has some limitations. Firstly, the study focuses primarily on underdeveloped regions, which may limit the generalizability of the findings to more developed markets with different technological, economic, and regulatory landscapes. The unique challenges faced by FMCG companies in underdeveloped markets—such as limited digital infrastructure and regulatory support—may not be directly applicable to markets where these resources are more readily available. Secondly, the research is based on secondary data and existing literature, which may limit the depth of understanding regarding local perspectives and real-world applications of ET in the FMCG industry. Conducting primary data collection, such as interviews and surveys with industry practitioners, could have added valuable firsthand insights. Thirdly, while this study covers multiple technologies like supply chain systems, customer-centric tools, and regulatory support, it does not examine the specific financial or operational impacts in a quantitatively robust manner. A more rigorous quantitative approach could yield clearer metrics on the effectiveness of these technologies in driving performance improvements. Lastly, the fast-paced evolution of digital technologies and shifting regulatory environments mean that some of the study's findings and recommendations may become outdated as new

technological and policy changes emerge, necessitating periodic updates to keep the research relevant.

7.2. Future Research Directions

Future research should address these limitations by expanding the scope to include comparative studies between underdeveloped and developed markets, providing a broader understanding of how digital infrastructure, supply chain, and customer-centric technologies impact the FMCG sector across diverse settings. Additionally, future studies could benefit from gathering primary data directly from industry stakeholders—such as supply chain managers, regulatory officials, and technology providers—to gain more nuanced insights into the local challenges and successes associated with ET adoption in the FMCG industry. Incorporating quantitative methods, such as econometric modeling or statistical analysis, would allow for a more precise assessment of the financial, operational, and customer engagement impacts of specific technologies, thereby enhancing the study's rigor. Longitudinal studies would also be valuable to track the long-term effects of ET adoption on operational efficiency, customer satisfaction, and market competitiveness in the FMCG industry. Moreover, exploring emerging regulatory frameworks, such as data privacy laws or sustainability mandates, and their implications for ET adoption would provide practical insights for businesses operating in dynamic regulatory environments. Finally, future research could investigate the integration of advanced technologies, such as artificial intelligence, blockchain for traceability, and predictive analytics, within the FMCG sector, analyzing how these innovations could further enhance operational efficiency, customer engagement, and sustainable practices in underdeveloped markets.

8. Conclusion

In conclusion, this research provides a thorough examination of the factors influencing the adoption and usefulness of emerging technologies in the FMCG industry within underdeveloped markets, focusing on digital infrastructure, customer-centric technologies, and regulatory support. By analyzing how these elements enhance operational efficiency, customer engagement, and competitive advantage, this study offers valuable insights into the role of technology in transforming the FMCG sector. The findings highlight that digital infrastructure is critical for facilitating technology adoption, while customer-focused and supply chain technologies directly contribute to operational improvements and customer satisfaction. Additionally, regulatory and institutional support plays a vital role in enabling the effective integration of these technologies, helping companies navigate challenges in underdeveloped markets.

Despite its contributions, the study acknowledges several limitations, including its reliance on secondary data and a qualitative approach that limits the quantitative rigor and scope of the findings. Addressing these limitations in future research by incorporating primary data, broader geographic contexts, and quanti-

tative analysis will deepen our understanding of emerging technology adoption in FMCG markets. Exploring advanced digital solutions and conducting longitudinal studies would provide further insights into long-term impacts on operational efficiency and customer engagement.

Overall, this research contributes meaningfully to both academia and industry by presenting a framework for understanding the transformative potential of emerging technologies in FMCG operations. The study provides actionable recommendations for industry stakeholders, suggesting that a robust digital infrastructure, coupled with strategic regulatory support and customer-centric technologies, can help FMCG companies enhance performance and remain competitive. By paving the way for future research, this study lays a foundation for sustainable technological advancement within the FMCG sector, particularly in underdeveloped markets, thereby supporting broader goals of economic development and market resilience.

Conflicts of Interest

The authors declare no conflicts of interest regarding the publication of this paper.

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