

Benefits and Barriers to Digital Supply Chain Adoption in Indian FMCG Firms

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Abstract— The digital transformation is a paradigm shift in the Fast-Moving Consumer Goods (FMCG) industry in India. This research paper examines the two forces of advantages and challenges that affect the process of adopting digital supply chains among Indian FMCG firms through the year 2026. Based on an exploratory methodology using secondary data analysis, the study synthesises macroeconomic reports and corporate disclosures of industry leaders such as Hindustan Unilever Limited (HUL) and ITC Ltd. Comparative performance benchmarking and thematic matrix analysis are used to assess the effect of digitisation on essential supply chain measures including inventory turnover, lead-time reduction, and rural market penetration. Although the operational advantages are substantial, the research finds that structural limitations — an endemic lack of specialised IT expertise (the “digital dilemma”), high capital investment requirements, and rural infrastructure deficits — continue to constrain industry-wide adoption. The results indicate that, while Industry 4.0 implementation is associated with substantial efficiency gains, targeted policy interventions, staged deployment plans, and sustained development of local IT expertise are critical to overcoming these systemic obstacles and achieving robust, sustainable growth.

Keywords—Digital Supply Chain, FMCG, Industry 4.0, Secondary Data Analysis, Logistics, HUL, ITC.

I. INTRODUCTION

One of the key pillars of the Indian economy is the Fast-Moving Consumer Goods (FMCG) sector, characterised by high-volume, low-margin products that must be distributed through vast and highly efficient systems. By 2026, consumer demand has grown more complex as the rural market, representing about 65 percent of India's population, has expanded rapidly. Serving this large and geographically dispersed population is not only a commercial necessity for market leaders but also a strategic driver of rural growth, employment creation, and improved standards of living. Succeeding in this complex terrain requires a systemic and urgent transition away from linear, legacy supply chain models toward digitalisation.

The adoption of digital technologies, often summarised as Industry 4.0, into supply chain management has moved from being a theoretical competitive edge to an operational necessity.

A Digital Supply Chain (DSC) draws on the Internet of Things (IoT), artificial intelligence (AI), big data analytics, and cloud computing to build an agile, transparent, and highly responsive ecosystem. For Indian FMCG leaders such as Hindustan Unilever Limited (HUL) and ITC Ltd., strong inventory management and demand forecasting are essential to reduce stock-outs, lower logistics costs, and maintain product availability. The shift toward a digital ecosystem enables real-time visibility across the value chain, directly improving downstream supply chain performance and overall retail efficiency.

The benefits of embracing a digital supply chain in the FMCG sector extend well beyond a single dimension. Digitisation allows companies to close the geographical gap between urban manufacturing centres and widely dispersed rural retail outlets, thereby unlocking underdeveloped markets through enhanced last-mile accessibility. More efficient data analytics support accurate demand prediction, better inventory management, and shorter lead times. Beyond direct operational efficiency, digital tracking systems also support sustainability goals, helping to embed circular-economy principles within the supply chain and contributing to long-term ecological and financial sustainability in line with the Sustainable Development Goals (SDGs).

Nonetheless, alongside these opportunities for sustainable digital transformation, notable strategic obstacles remain. The current position of Indian FMCG companies is best described as a digital dilemma, driven largely by a fundamental shortage of specialised IT knowledge needed to implement, administer, and support sophisticated Industry 4.0 systems. The high capital cost of building digital infrastructure poses a further obstacle, particularly for regional distributors and smaller nodes within the wider FMCG network. These financial and human-capital constraints are compounded by physical infrastructure shortages in rural areas, including unstable broadband connectivity, which interferes with the smooth movement of the real-time data essential to digital logistics processes.

A. Research Problem

Although the need to transition to Industry 4.0 paradigms is widely acknowledged, the Indian FMCG industry remains caught in a digital dilemma that constrains operational performance and further market growth.

While Digital Supply Chain (DSC) technologies — including real-time IoT tracking, AI-based demand forecasting, and automated warehousing — offer unprecedented agility and access to the rapidly growing rural consumer market, mass adoption of these technologies remains seriously limited. Structural barriers, including a dire lack of specialised IT skills, high start-up capital requirements, and continuing infrastructural gaps in rural areas, mean that the industry has yet to systematically overcome these compounding financial, technical, and infrastructural drawbacks, resulting in disjointed digital adoption that keeps the nationwide supply network from becoming fully optimised, sustainable, and resilient.

B. Need for the Study

As the Indian FMCG market moves toward 2026, the need to close the gap between digital aspirations and operational reality has never been greater. While existing literature has separately theorised the standalone advantages of digital marketing and the macroeconomic challenges of technology adoption, it lacks quantitative studies that simultaneously assess the direct effects of digitisation on supply chain performance against the weight of current obstacles such as the IT skill gap. This research addresses that gap by presenting fact-based, practical insight drawn from recent secondary market data. By measuring the extent to which specific barriers constrain digital adoption, the study aims to provide FMCG stakeholders, supply chain strategists, and policymakers with the empirical grounding needed to design targeted interventions, allocate capital efficiently, and build the human capital required for sustainable, long-term economic growth.

C. Objectives of the Study

- To examine the operational benefits of digital supply chain adoption among leading Indian FMCG firms, with particular reference to HUL and ITC.
- To identify the key structural barriers — human capital, financial, infrastructural, and data-security related — that constrain industry-wide digital adoption.
- To assess the implications of digitisation for rural market penetration, operational efficiency, and long-term sustainability, and to propose strategic measures to address the identified barriers.

D. Scope of the Study

The study is confined to an examination of secondary data drawn from the corporate disclosures and annual reports of leading Indian FMCG firms, principally Hindustan Unilever Limited (HUL) and ITC Ltd., supported by macroeconomic and industry reports up to 2026. It focuses on digital B2B integration, operational efficiency metrics, and systemic barriers to adoption at the industry level.

The study does not extend to primary field surveys of individual retail nodes or to FMCG markets outside India.

II. REVIEW OF LITERATURE

The fast-changing nature of the Fast-Moving Consumer Goods (FMCG) industry, particularly within the dynamic and vast environment of a developing country such as India, has driven a radical shift in supply chain management. The emergence of digital technologies has moved from being a competitive advantage to a mandatory operational requirement in a geographically dispersed environment where consumer demand is growing increasingly complex. The scholarly literature preceding 2026 presents a rich account of this digital transition: the operational and strategic advantages of the Digital Supply Chain (DSC) have been widely documented, while the obstacles to its pervasive adoption across market levels are equally significant in systemic, financial, and human-capital terms. The literature reviewed here is organised into four thematic strands: the antecedents and downstream benefits of digital adoption, the integration of digital marketing with supply chain visibility, the operational barriers to Industry 4.0, and the implications for sustainability and the circular economy.

A. Antecedents and Downstream Benefits of Digital Supply Chain Adoption

The adoption of disruptive digital technologies in supply chains is shaped by organisational and environmental antecedents that determine a firm's readiness for change. Mitra, Kapoor, and Gupta (2023) examined the principal antecedents of disruptive technology adoption in the digital supply chain within the Indian context, finding that organisational preparedness, top-management support, and competitive pressure in the highly contested Indian FMCG market are the key triggers of digitalisation. Firms that invest actively in advanced digital infrastructure were found to achieve markedly better supply chain dynamism and structural resilience, enabling them to absorb the demand fluctuations and seasonal surges typical of the Indian retail environment.

The measurable advantages of this technological shift are most visible at the downstream end of the supply chain, where it interacts directly with the consumer. Shiralkar, Bongale, Kumar, Kotecha, and Prakash (2021) evaluated the benefits of Information and Communication Technology (ICT) adoption on downstream supply chain performance in the retail sector, finding a strong positive relationship between ICT integration and key retail outcomes, including reduced inventory holding costs, fewer stock-outs, and improved real-time point-of-sale visibility.

By digitising information flows, FMCG firms are able to align upstream manufacturing with real-time retail demand, improving fulfilment rates and reducing systemic waste.

The usefulness of such digital frameworks extends well beyond metropolitan centres into traditionally fragmented and difficult-to-serve rural markets. Tibokbe and Shankar (2025) examined the role of emerging technologies in underdeveloped FMCG markets, concluding that mobile-based enterprise resource planning (ERP), geographic information system (GIS) mapping, and localised data caching help bridge infrastructural gaps. These digital solutions optimise routing, enable precise last-mile delivery monitoring, and support the collection of micro-market demand data in deep rural areas that were previously considered too costly or inaccessible to serve efficiently.

B. The Intersection of Digital Marketing and Supply Chain Visibility

In today's highly integrated digital economy, the supply chain cannot operate independently of consumer-facing digital marketing activity; the smooth alignment of demand creation (marketing) and demand fulfilment (supply chain logistics) is central to organisational success. Chowdhury, Ara, and Nath (2024) examined the challenges and opportunities of digital marketing adoption in the multinational FMCG sector, noting that digital marketing generates not only targeted consumer demand but also valuable datasets on localised consumer preferences, purchasing behaviour, and demographic trends. When applied to supply chain forecasting algorithms, this data produces a more responsive, demand-driven logistics network capable of anticipating market shifts before they occur.

However, aligning these two historically distinct digital functions carries its own operational challenges. Basit, Bhaumik, and Niazi (2025) applied a MICMAC-ISM (Interpretive Structural Modelling) approach to examine barriers to digital marketing adoption in the FMCG industry. Although contextualised in Pakistan, their findings are directly applicable to the Indian FMCG ecosystem given similar socio-economic and structural market conditions. Their modelling identified infrastructural deficits and a lack of data synchronisation between marketing and supply chain inventory systems as fundamental hindrances; in the absence of cross-departmental data interoperability, demand spikes generated by successful digital marketing campaigns can paradoxically create supply chain bottlenecks, localised stock-outs, and brand dilution.

C. Systemic Barriers to Industry 4.0 and the “Digital Dilemma”

Despite well-documented theoretical and practical advantages, the shift toward a fully digitised, end-to-end supply chain remains constrained by significant implementation obstacles. Prakash and Shukla (2024) analysed barriers to Industry 4.0 adoption in FMCG manufacturing within developing countries, identifying high initial capital expenditure (CAPEX), limited visibility of return on investment (ROI) for smaller regional distributors, and inflexible, legacy-bound organisational culture as key deterrents. The combination of cyber-physical systems, IoT sensors, and autonomous warehousing robotics requires financial investment that often places digitalisation out of reach for mid-tier FMCG firms.

Technology, however, is only as effective as the human capital responsible for operating it. George and George (2023) framed this systemic weakness as the digital dilemma of FMCG firms, showing that while the industry has historically excelled at physical logistics and brand management, it suffers from an acute shortage of in-house technical talent capable of handling complex data structures, cloud authentication systems, and machine-learning forecasting models. This talent shortage contributes to stalled digital projects, underutilised software investments, and heightened exposure to cybersecurity risk.

This hierarchy of implementation barriers is further supported by the quantitative modelling of Kabra, Ramesh, Jain, and Akhtar (2023), who ranked barriers to information and digital technology adoption using a fuzzy Analytic Hierarchy Process (AHP). Although their study was framed around humanitarian supply chain management, the barriers identified — data fragmentation, the absence of unified technology protocols among vendors, and inter-organisational resistance to information sharing — apply equally to the highly complex, multi-stakeholder Indian FMCG supply network.

D. Digitisation as a Pathway to Sustainability and the Circular Economy

A recurring theme in the scholarly literature up to 2026 is the close relationship between supply chain digitisation and environmental sustainability. Poddar, Priya, Ghosh, Singh, and Pandey (2024) examined circular economy integration within the Indian FMCG supply chain, noting that conventional FMCG supply chains are largely linear, resource-intensive, and prone to significant waste.

Digital tools such as blockchain ledgers for traceability and IoT tagging for real-time resource tracking are shown to be essential enablers of circular practices, allowing firms to implement efficient reverse logistics, monitor plastic packaging waste, and support ethical raw-material sourcing in response to both consumer and regulatory pressure.

Rane, Abhyankar, Kirkire, and Agrawal (2025) modelled the multidimensional effects of digitised and sustainable practices using a Fuzzy TOPSIS methodology to assess downstream effects on the Triple Bottom Line (TBL) of sustainability, finding that resolving digitisation barriers produces measurable improvements in economic, environmental, and social performance. Digitally optimised delivery routes and AI-driven forecasting were found to meaningfully reduce inventory waste and carbon footprint while improving baseline profitability. Kumar Dadsena and Pant (2023) extended this line of enquiry by examining barriers to supply chain digitisation through the lens of the United Nations Sustainable Development Goals, linking continued under-digitisation to missed progress on responsible consumption and production (SDG 12) and resilient industry, innovation, and infrastructure (SDG 9).

E. Research Gap

- Existing studies largely address digital marketing, sustainability, or adoption barriers in isolation, rather than jointly quantifying benefits and barriers within a single Indian FMCG framework.
- Limited empirical work simultaneously benchmarks operational efficiency gains against the severity of specific structural barriers using recent (post-2023) corporate and industry data.
- There is insufficient focus on how the “digital dilemma” of IT-talent shortage interacts with financial and rural infrastructural constraints to shape actual adoption outcomes.

F. Summary and Research Direction

The literature confirms that digital supply chain adoption delivers substantial operational and sustainability benefits for Indian FMCG firms, while also being constrained by a well-documented set of structural barriers. However, a gap remains in jointly and empirically assessing these two forces using recent secondary data from industry leaders. This study addresses that gap by benchmarking operational efficiency metrics against a structured barrier-severity matrix for the Indian FMCG sector.

III. RESEARCH METHODOLOGY

A. Research Design

The study adopts a descriptive and exploratory research design based solely on the analysis of secondary data. Given the scale of the Indian FMCG sector and the objective of evaluating technological trends in the years leading up to 2026, an observational approach using existing corporate and macroeconomic data was considered the most appropriate methodology. The study qualitatively and quantitatively examines the causal links between digital supply chain implementation and operational efficiency, while also gauging the intensity of structural barriers to adoption.

B. Data Collection and Sources

To ensure reliability, validity, and comprehensive industry coverage, data was drawn from a triangulated set of authoritative secondary sources:

- Corporate Annual Reports and Disclosures — including the HUL Shikhar app and ITC UNNATI network data, sourced from the Hindustan Unilever Limited Integrated Annual Report 2023–24 and ITC Ltd. disclosures.
- Industry and Macroeconomic Reports — including the McKinsey Global Institute report “Digital India: Technology to Transform a Connected Nation,” and current reports on the FMCG sector's contribution to rural economic growth.
- Peer-Reviewed Academic and Sectoral Studies — including KPMG and Deloitte Insights reports on logistics and inventory management at HUL and ITC, alongside recent logistics-sector and academic literature.

C. Variables and Metrics of Interest

Rather than sampling individual supply chain nodes, the study concentrates on aggregate industry metrics and leading corporate benchmarks, coded into three broad areas of analysis: digital integration metrics (online B2B platform scale, retailer onboarding, and real-time tracking capacity); operational efficiency indicators (average lead time, forecasting accuracy, inventory turnover ratio, and retail stock-out incidence); and systemic barrier metrics (the severity of constraints relating to IT expertise, capital expenditure, and rural infrastructure).

D. Analytical Framework

The aggregated secondary data was analysed using a systematised comparative and thematic approach comprising comparative performance benchmarking — appraising the operational efficiency ratios of conventional (legacy) supply chains against digitised (Industry 4.0) frameworks to quantify the downstream advantage of technology adoption — and thematic matrix generation, integrating operational and macroeconomic barriers into a unified severity matrix to evaluate their weighted effect across different layers of the FMCG industry, from multinational corporations to regional distributors. This non-experimental, secondary-data-based approach tests the theoretical constructs identified in the literature review against the operational realities and financial indicators of the Indian FMCG environment.

E. Limitations of the Study

The study relies entirely on secondary data drawn primarily from two industry leaders, HUL and ITC, and macroeconomic and sectoral reports; it does not incorporate primary field surveys of individual retail or distributor nodes. As a result, findings may not fully generalise to smaller, unlisted FMCG firms or to regional distributors whose digital adoption profiles differ from those of large multinational players. The study is also bounded by the availability and currency of published corporate and industry data up to 2026.

IV. RESULTS AND DISCUSSION

A. Overview of Data Analysis

This section presents the empirical findings derived from secondary data analysis of the Indian FMCG sector, drawing on the recent annual reports of industry leaders (principally HUL 2023–24 and ITC Ltd.), macroeconomic evaluations such as the McKinsey Digital India report, and current peer-reviewed industry analyses. The analysis proceeds in three stages: assessment of digital infrastructure and downstream integration, comparison of operational efficiency metrics between traditional and digitised supply chains, and evaluation of the systemic barriers to adoption.

B. Digital Infrastructure and Downstream Integration

Supply chain digitisation among leading FMCG firms has been driven largely through proprietary digital B2B platforms. Table I summarises the comparative scale of digital infrastructure across major players based on recent corporate disclosures.

TABLE I
DIGITAL B2B INTEGRATION IN LEADING FMCG FIRMS (2024–25)

FMCG Corporation	Primary Digital B2B Platform	Retailer Onboarding (Est.)	Key Supply Chain Features
Hindustan Unilever (HUL)	Shikhar App	> 1.3 million stores	AI-driven demand capture, automated replenishment, predictive inventory
ITC Limited	UNNATI / e-Choupal 4.0	> 600,000 nodes	Hyper-local demand forecasting, raw-material traceability, rural node mapping
Nestlé India	SmartBiz	> 450,000 outlets	Geo-tagging of delivery routes, automated distributor billing

Interpretation: Table I shows that leading FMCG firms are investing heavily in proprietary digital ecosystems. HUL's Shikhar app, covering more than 1.3 million rural and urban retail nodes, functions as a critical nerve centre for demand capture. By digitising demand capture at the retailer level, these firms bypass the latency-inducing layers of traditional distribution, supporting the literature's view that digitalisation substantially improves downstream retail visibility and rural market penetration.

C. Impact of Digitisation on Operational Efficiency Metrics

Table II, compiled from aggregated industry benchmarks in supply chain logistics reports (KPMG and Deloitte Insights, 2023–24), presents the comparative change in key supply chain performance metrics before and after the adoption of Industry 4.0 frameworks.

TABLE II
COMPARATIVE SUPPLY CHAIN METRICS: TRADITIONAL VS. DIGITISED MODELS

Operational Metric	Traditional (Legacy)	Digitised (Industry 4.0)	Estimated Improvement
Average lead time (factory to retail)	7 to 10 days	2 to 4 days	~60% reduction
Forecasting accuracy	65% – 70%	85% – 92%	+20% to +22%
Inventory turnover ratio (ITR)	4.5 – 5.0	7.0 – 8.5	High efficiency gain
Instances of retail stock-outs	12% – 15%	3% – 5%	~70% reduction

Interpretation: The data provides strong quantitative evidence of the benefits of digital adoption. The shift from legacy networks to data-driven, digitised networks with real-time analytics cuts average lead time by roughly 60 percent and materially improves forecasting accuracy. The corresponding reduction in retail stock-outs to below 5 percent supports stronger market share and higher consumer satisfaction, consistent with the study's underlying objectives.

D. Assessment of Adoption Barriers

While the operational benefits of digitisation are clearly measurable, the barriers to industry-wide implementation — particularly among mid-tier and regional firms — remain equally significant. Table III synthesises the severity of these barriers based on industry assessments and macroeconomic constraints identified under the Digital India initiative.

TABLE III
MATRIX OF SYSTEMIC BARRIERS TO DIGITAL SUPPLY CHAIN ADOPTION

Barrier Category	Specific Constraint	Severity	Primary Affected Group
Human Capital	Severe lack of in-house IT and data analytics expertise (“Digital Dilemma”)	Critical	Industry-wide; mid-tier firms most affected
Financial	High initial CAPEX for IoT sensors, cloud architecture, and AI software	High	Regional distributors, small-scale manufacturers
Infrastructural	Inconsistent broadband and power disruptions in rural nodes	Moderate to High	Rural last-mile delivery networks
Data Security	Vulnerability to cyber-attacks and lack of standardised data protocols	Moderate	Large multinational corporations

Interpretation: The most critical constraint is the digital dilemma — the sustained shortage of IT expertise needed to operate complex digital systems. Even where mid-tier FMCG firms have the financial resources to invest in advanced routing software, the absence of sufficient human capital to interpret and act on the resulting data limits the return on that investment. Rural areas continue to experience physical infrastructure shortages that disrupt the end-to-end data flow necessary for digital supply chains to function effectively.

E. Discussion of Findings

The comparative analysis between traditional and digitised supply chains supports the findings of Shiralkar et al. (2021) regarding downstream performance gains.

FMCG leaders that have deployed digital nerve centres and e-B2B systems, such as HUL's Shikhar and ITC's UNNATI, have achieved an estimated 60 percent reduction in lead time and pushed forecasting accuracy above 85 percent, largely by digitising demand capture at the retail node and bypassing the latency of legacy distribution networks. The resulting real-time visibility directly reduces retail stock-outs to below 5 percent, supporting stronger market share in volatile consumer markets, while the digital mapping of deep rural nodes affirms the thesis of Tibokbe and Shankar (2025) that emerging technologies are a key entry point into underdeveloped markets.

At the same time, the secondary data strongly supports the digital dilemma identified by George and George (2023). Even where financial resources for IoT sensors or AI software are available — particularly among premium-tier firms — the binding constraint remains the shortage of human resources needed to operate, secure, and optimise these systems. Mid-tier FMCG firms and regional distributors frequently lag in digital transformation not primarily because of hardware costs, but because they lack the in-house data analytics and IT capability to interpret the information these systems generate.

A further finding concerns the two-way divide within the industry: while multinational FMCG organisations can absorb the initial capital expenditure of a digital overhaul, smaller regional players cannot. This financial constraint, combined with rural infrastructure shortages such as unstable broadband and unreliable power, produces a disjointed digital ecosystem. Where rural infrastructural gaps prevent data synchronisation, the predictive value of the wider supply chain is undermined — a pattern consistent with the structural modelling of Basit et al. (2025).

V. CONCLUSION AND RECOMMENDATIONS

A. Summary of Findings

- *Objective 1* — Operational Benefits: Digitised supply chains at HUL and ITC show an estimated 60% reduction in lead time, forecasting accuracy improvements of up to 22 percentage points, and stock-out reductions from 12–15% to 3–5%.
- *Objective 2* — Key Structural Barriers: The “Digital Dilemma” (shortage of in-house IT expertise) was identified as the most critical barrier, followed by high capital expenditure and rural infrastructure deficits.
- *Objective 3* — Strategic Implications: Financial capacity alone does not guarantee successful digital adoption; human capital and rural infrastructure gaps materially constrain the translation of investment into operational performance.

B. Strategic Implications

The findings carry practical implications for FMCG firms, supply chain strategists, and policymakers. Companies should shift focus from technology acquisition alone toward building internal digital capability, while policymakers can support broader adoption through rural infrastructure investment and standardised digital trade protocols.

C. Conclusion

As the Indian FMCG industry moves toward the increasingly complex market landscape of 2026, adopting digital supply chains is no longer merely a strategic choice but a matter of competitive survival. This study, based on a thorough review of secondary macroeconomic data and corporate benchmarks, shows that digitalisation — supported by AI, IoT, and e-B2B platforms — has meaningfully improved inventory turnover, reduced lead times, and expanded access to rural markets. However, a truly seamless, industry-wide digital supply network remains constrained by structural barriers, most notably the shortage of specialised IT knowledge, compounded by high implementation costs and rural infrastructure gaps. The future competitiveness of Indian FMCG firms will depend less on their financial ability to acquire digital tools and more on their strategic capacity to build the human capital needed to operate them.

D. Practical Recommendations

- *Proactive Human Capital Development:* FMCG firms should shift from simply acquiring technology to actively developing human capital — forming ties with technical institutions for tailored supply chain analytics training and investing in upskilling existing logistics staff.
- *Staged and Stepwise Digital Implementation:* Mid-tier companies should avoid attempting a single large-scale transformation, instead adopting Software-as-a-Service (SaaS) solutions and pursuing incremental digitisation, beginning with high-impact, low-cost interventions such as localised inventory management before moving to AI-intensive automation.
- *Offline-First Architectures:* To address rural infrastructure shortages, FMCG IT teams should develop “offline-first” e-B2B applications that allow rural retailers to record inventory and demand data without an internet connection, syncing with central servers once connectivity is restored.

- *Ecosystem Integration:* FMCG firms should collaborate with national digital trade platforms, such as the Open Network for Digital Commerce (ONDC), to standardise data fields, distribute logistical load, and strengthen overall ecosystem stability.

E. Limitations and Future Research

This study is limited by its reliance on secondary data concentrated around two large FMCG leaders, HUL and ITC, which may not fully represent the experience of smaller or regional firms. Future research could extend this analysis through primary surveys of mid-tier and regional distributors, or through comparative studies across other emerging-market FMCG sectors facing similar digital dilemmas.

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