PREFACE TO THE EDITION

The current issue of the **International Journal of Administration and Management Research Studies (IJAMRS)** presents a collection of research contributions examining emerging challenges and strategic developments in administration and management, with particular emphasis on the Indian context. The articles explore how technological transformation, leadership capabilities, environmental responsibility, and supply chain vulnerabilities are reshaping organisational practices and public policy. Collectively, they emphasise the importance of evidence-based decision-making, adaptive management, and sustainable approaches to organisational and institutional development.

The growing role of digital infrastructure in improving access to finance is examined in the article on digital payments and MSME credit access in India. By exploring the potential of the Unified Payments Interface (UPI), digital transaction records, and the Account Aggregator framework, the study highlights how financial data can help reduce information asymmetry between lenders and small enterprises. Its proposed Digital Payment–Credit Pathway Framework offers a useful perspective on the conditions under which digital payment adoption can contribute to more inclusive formal credit access.

The issue also addresses the implications of artificial intelligence for public administration through an examination of reskilling and leadership in AI-enabled government services. The article argues that successful AI adoption requires more than technological investment; it also depends on the digital-technical, human-relational, and adaptive leadership capabilities of the public workforce. The proposed AI-Ready Public Workforce Capability Framework draws attention to the importance of continuous learning, evidence-based training, and institutional support in ensuring that technological transformation contributes meaningfully to public value.

In the field of healthcare management, the contribution on emotional intelligence, nurse burnout, and retention examines the relationship between leadership practices and workforce well-being. Recognising the pressures faced by nursing professionals, the article highlights the potential of emotionally intelligent and relational leadership to support job satisfaction, reduce burnout, and strengthen employees' intention to remain in the profession. Its proposed framework underscores the importance of leadership development as part of broader efforts to improve hospital management and workforce sustainability.

Environmental responsibility and competitive strategy form the focus of the article on sustainability in India's paint industry. The study explores how regulatory requirements, market expectations, and competitive pressures influence corporate sustainability practices. By examining developments in areas such as renewable energy, water stewardship, low-emission products, and packaging responsibility, it illustrates how sustainability can extend beyond regulatory compliance to become a strategic consideration. The proposed Sustainability–Competitiveness Pathway Framework provides a basis for understanding the relationship between green capabilities and economic, environmental, and social outcomes.

The final contribution examines supply chain resilience in India's pharmaceutical industry, focusing on dependence on imported active pharmaceutical ingredients and the policy response through Production Linked Incentive schemes and Bulk Drug Parks. Drawing lessons from the disruptions exposed by the COVID-19 pandemic, the study considers the progress and continuing limitations of domestic production initiatives. Its proposed Pharmaceutical Supply Chain Resilience Framework highlights the importance of reducing critical import vulnerabilities, strengthening domestic manufacturing capabilities, and improving preparedness for future disruptions.

Although the articles address distinct sectors and management challenges, they share a common concern: how organisations and institutions can respond effectively to changing technological, economic, social, and regulatory environments. From improving financial inclusion and preparing public servants for AI-enabled administration to strengthening healthcare leadership, advancing sustainable business practices, and building resilient pharmaceutical supply chains, the contributions demonstrate the interconnected nature of contemporary management decisions.

This issue is intended to provide valuable insights for academics, research scholars, management professionals, public administrators, healthcare leaders, entrepreneurs, and policymakers. It also seeks to encourage further research into the practical application of conceptual frameworks and the development of management strategies suited to evolving institutional and industry requirements.

The Editorial Team expresses its sincere appreciation to the authors for their contributions and to the reviewers for their scholarly evaluation and constructive feedback. We hope that the articles in this issue will stimulate meaningful academic discussion, encourage interdisciplinary research, and support informed decision-making across diverse areas of administration and management.

Dr. Biju John M
Chief editor

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Digital Payments and MSME Credit Access in India: UPI, Data Trails and the Formalisation of Small Business Finance

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Abstract

Micro, small and medium enterprises (MSMEs) are central to India's output, exports and employment, yet many remain excluded from formal credit because lenders lack reliable information about their cash flows. The rapid spread of the Unified Payments Interface (UPI) has changed this situation by creating digital records of everyday business transactions. Alongside the Account Aggregator framework and other elements of India's digital public infrastructure, these records could allow lenders to assess small firms on the basis of their actual cash flows rather than collateral. This paper examines whether and how digital payment adoption improves MSME access to formal credit. It is based on an integrative review of research in finance, development economics and information systems, supplemented by official data and policy documents. The review finds consistent evidence that the information asymmetry between lenders and small firms is the core barrier to MSME credit and that digital transaction data can reduce it. Emerging evidence from India links growth in digital payments to an expansion of credit, particularly from fintech lenders. Drawing on credit rationing theory and the lending technologies framework, the paper proposes the Digital Payment–Credit Pathway Framework, which traces how payment data become credit access and identifies the conditions and risks that shape this process. Implications for MSME owners, lenders and policymakers are discussed.

Keywords: - MSME Finance, Digital Payments, UPI, Financial Inclusion, Account Aggregator

I. INTRODUCTION

Micro, small and medium enterprises (MSMEs) are a pillar of the Indian economy. A government document reports that the MSME share of gross value added reached 30.1% in 2022–23 and that MSMEs contributed 45.73% of exports in 2023–24 (Press Information Bureau [PIB], 2024), and more than 7.83 crore enterprises had registered on the government's Udyam portals by February 2026 (IBEF, 2026). Despite their importance, MSMEs have long faced difficulty obtaining formal credit. Many operate informally, keep limited financial records and lack collateral, so banks find it costly to assess and monitor them. A study for the International Finance Corporation estimated a large gap between MSMEs' debt requirements and the formal credit available to them (International Finance Corporation [IFC], 2019), and a 2025 report by the Small Industries Development Bank of India put the credit gap at about Rs 30 lakh crore (Outlook Business, 2025). Firms that cannot obtain formal credit turn to informal lenders at high cost or forgo investment, which constrains their growth (Beck & Demirguc-Kunt, 2006).

India's digital payment infrastructure has transformed the environment in which these firms operate. UPI processed 18,586.60 crore transactions worth Rs 260.56 lakh crore in FY2024–25, rising to 24,161.69 crore transactions worth Rs 314.23 lakh crore in FY2025–26, according to figures presented to Parliament (Outlook Money, 2026). Analysis by SBI Research found that person-to-merchant payments rose from 39% of UPI transaction volume in June 2020 to 64% in July 2025, and from about 13% to 29% of transaction value (IANS, 2025). This shift means that even small shops and service providers now generate continuous digital records of their sales. These records are potentially valuable to lenders. Combined with the Account Aggregator framework, which allows individuals and firms to share their financial data with regulated institutions on the basis of consent, they could enable lending based on observed cash flows rather than collateral.

This possibility has attracted interest from policymakers, banks and fintech firms, but the evidence base remains scattered across disciplines. This paper addresses three research questions: (RQ1) Why do MSMEs face constraints in accessing formal credit? (RQ2) How can digital payment adoption and the resulting data trails reduce these constraints? (RQ3) What enabling conditions and risks shape the translation of payment data into credit access in India? The paper contributes an integrative synthesis, a conceptual framework and implications for practice and policy.

II. LITERATURE REVIEW

2.1. Information Asymmetry and MSME Credit

The classic explanation for small-firm credit constraints is information asymmetry. Stiglitz and Weiss (1981) showed that when lenders cannot distinguish between safe and risky borrowers, raising interest rates attracts riskier borrowers, so lenders ration credit instead. Small firms are especially affected because they are informationally opaque. Berger and Udell (2006) argued that lenders overcome opacity through different lending technologies. Some rely on hard information, such as financial statements and credit scores, while relationship lending relies on soft information accumulated through repeated interaction. Cross-country evidence shows that access to finance is a significant growth constraint for small enterprises (Beck & Demirguc-Kunt, 2006). Digital payment data represent a new form of hard information that can be generated even by firms without formal accounts.

2.2. Digital Finance and Financial Inclusion

Digital financial services can extend inclusion by lowering transaction costs and reaching previously unserved populations (Ozili, 2018). In Kenya, access to the M-Pesa mobile money service increased household consumption and lifted an estimated 2% of households out of poverty, with larger effects for female-headed households (Suri & Jack, 2016). The Global Findex database has documented rapid growth in account ownership and digital payments across developing economies (Demirgüç-Kunt et al., 2022), and a government factsheet citing the 2025 Findex reports that account ownership in India has reached 89% (PIB, 2026). Account ownership, however, does not automatically translate into credit access, which depends on whether lenders can use the data generated by digital transactions.

2.3. Digital Footprints and Alternative Data in Lending

A growing literature shows that alternative data can improve credit assessment. Berg et al. (2020) found that simple digital footprints, such as the type of device and email provider used for an online purchase, predicted default as well as or better than traditional credit bureau scores, and complemented them. Frost et al. (2019) showed that large technology firms use data from their platforms to lend to small firms, often with lower reliance on collateral. These studies suggest that transaction data generated by digital payments could similarly help lenders assess small firms.

2.4. Technology Adoption

Whether MSMEs generate such data depends on their adoption of digital payments. Technology acceptance models emphasise perceived usefulness, ease of use, social influence and facilitating conditions (Venkatesh et al., 2003). Adoption also depends on network effects: a merchant benefits from accepting digital payments only when enough customers use them. Crouzet et al. (2023) showed that India's 2016 demonetisation, which caused a sudden shortage of cash, led to a persistent increase in the adoption of electronic payments, with adoption spreading through local networks of users. Chodorow-Reich et al. (2020) documented the significant short-run economic effects of the same cash shortage. Among Indian micro-enterprises, UPI adoption has been found to evolve through a continuing interplay of new affordances, such as interoperable QR codes, and new constraints, such as fraud risk (Kumar et al., 2025). Among unorganised retailers, awareness, cost, customer acceptance, entrepreneurial drive, perceived usefulness and personal innovativeness significantly influence the intention to use mobile payments (Ram & Selvabaskar, 2023).

III. METHODOLOGY

The study adopts an integrative literature review design. A purposive, non-exhaustive sampling strategy was used. Literature was identified through keyword searches combining "MSME", "small business", "SME finance" and "credit access" with "digital payments", "UPI", "fintech", "alternative data" and "financial inclusion", followed by citation tracking from key studies. Peer-reviewed articles in finance, economics and information systems were prioritised, supplemented by influential working papers where peer-reviewed evidence on recent Indian developments was not yet available. Official statistics and policy documents from the National Payments Corporation of India, the Reserve Bank of India, the Ministry of MSME and the World Bank were used to describe the institutional context. Sources were coded for the mechanisms, enabling conditions and risks linking digital payments to credit, and the results were synthesised into the framework presented in Section V. Working papers are identified as such, and their findings are treated as provisional.

IV. RESULTS

4.1. India's Digital Public Infrastructure for MSME Finance

The review identifies three layers of infrastructure relevant to MSME credit, summarised in Table 1. The first is the payment layer, led by UPI, which generates transaction data. The second is the data-sharing layer, centred on the Account Aggregator framework, which allows firms to share their financial information with lenders on the basis of consent. Established through the Reserve Bank of India's Master Direction of 2016 (Reserve Bank of India [RBI], 2016), the system had enabled more than 2,887 million accounts and fulfilled more than 493 million consents by mid-2026, with 17 operational account aggregators and over 1,000 lenders and other financial information users live (Sahamati, 2026). The third is the credit layer,

which includes initiatives designed to standardise and simplify digital lending. In August 2024, the Reserve Bank of India announced the Unified Lending Interface, which it described as part of a "new trinity" of JAM, UPI and ULI intended to transform lending (Business Standard, 2024).

Table 1. India's Digital Public Infrastructure Layers Relevant to MSME Credit

Layer	Key Components	Role in MSME Credit
Payment layer	Unified Payments Interface (UPI); QR-code merchant payments	Generates high-frequency records of sales and cash flows
Data-sharing layer	Account Aggregator framework (RBI); consent-based data sharing	Allows firms to share verified financial data with lenders
Credit layer	Unified Lending Interface (ULI); Open Credit Enablement Network (OCEN)	Standardises and reduces the cost of digital lending

Source: Author's synthesis based on the reviewed literature and official sources.

4.2. Evidence Linking Digital Payments to Credit

Emerging evidence from India supports a link between digital payments and credit. Using data on the universe of consumer loans, Alok et al. (2024) found that the launch of UPI increased financial deepening and allowed new borrowers to access formal credit. Banks mainly expanded lending to prime borrowers, while fintech lenders served all segments and were the only lenders to extend credit to new-to-credit customers, and the expansion was not accompanied by higher default rates. Ghosh et al. (2026) showed that borrowers' use of cashless payments improves their access to fintech credit and predicts a lower probability of default, with stronger effects for payment technologies that provide more precise information. They argue that payment choices act as a signal that borrowers are less likely to divert cash flows.

Evidence on business outcomes points in the same direction. In a working paper combining district-level UPI data with a large household panel, Dubey and Purnanandam (2023) found that households in districts with higher digital payment intensity experienced income gains and started more new businesses after UPI's introduction, with larger gains for self-employed households such as hawkers and traders. They attribute these effects mainly to relaxed borrowing constraints and lower transaction costs. Taken together, these studies suggest that digital payment data are already changing credit allocation in India, with fintech lenders playing a leading role.

4.3. Mechanisms

The literature points to three mechanisms through which digital payments improve credit access. First, an information mechanism: payment data provide verifiable, high-frequency evidence of sales and cash flow, reducing the information asymmetry identified by Stiglitz and Weiss (1981) and enabling a new lending technology based on transaction data (Berger & Udell, 2006). Second, a cost mechanism: digital data reduce the cost of underwriting and monitoring small loans, which makes small-ticket lending more viable. Third, a formalisation mechanism: once a firm's transactions are digital, it becomes easier to integrate it into tax, registration and credit systems, gradually increasing its visibility to the formal financial sector.

4.4. Barriers and Risks

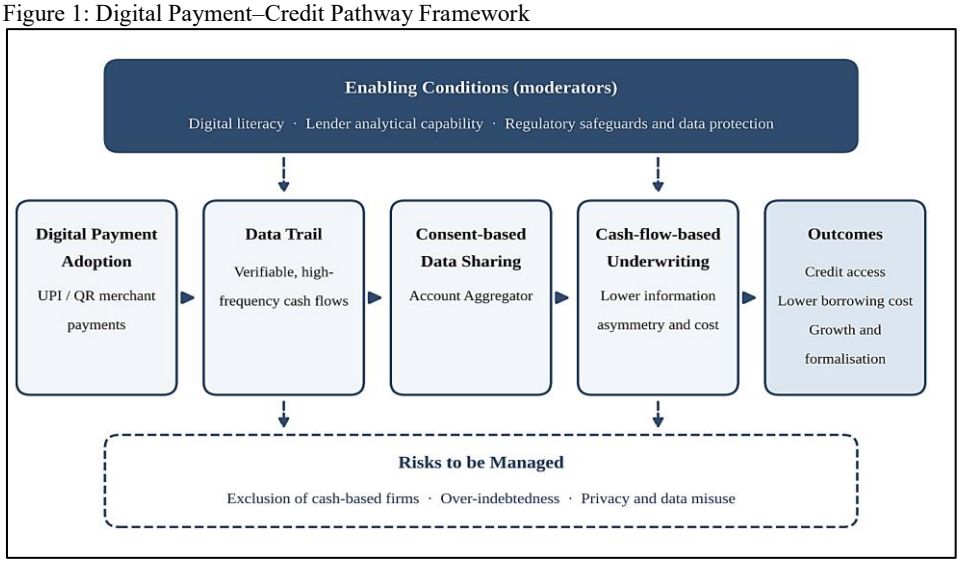
The review also identifies important barriers and risks. Many micro-enterprises still operate largely in cash, and the benefits of digital data do not reach firms that do not generate them. Digital literacy and trust remain uneven, especially among older owners and in rural areas. Not all lenders have the analytical capability to use transaction data. Easier access to credit can also lead to over-indebtedness if lending is not accompanied by sound underwriting. Finally, the use of payment data raises concerns about privacy and consent, which India's consent-based Account Aggregator architecture and data protection law seek to address.

V. DISCUSSION

5.1. The Digital Payment–Credit Pathway Framework

Synthesising these findings, this paper proposes the Digital Payment–Credit Pathway Framework, shown in Figure 1. The framework traces a sequence of four stages. Digital payment adoption by MSMEs generates a data trail of transactions. Through consent-based data sharing, this trail becomes available to lenders as verifiable cash-flow information. Lenders use this information for cash-flow-based underwriting, which leads to improved credit access, lower costs of borrowing and, ultimately, MSME growth and formalisation. The strength of this pathway is moderated by enabling conditions, namely digital literacy, lender analytical capability and regulatory safeguards, and it is accompanied by risks, namely exclusion of offline firms, over-indebtedness and misuse of data, which must be actively managed.

Figure 1: Digital Payment–Credit Pathway Framework



Source: Developed by the author based on the review.

Four propositions follow from the framework.

- Proposition 1: MSMEs with a longer and higher-volume history of digital merchant payments are more likely to obtain formal credit, and on better terms, than comparable firms that transact mainly in cash.
- Proposition 2: The positive effect of digital payment adoption on credit access is stronger when firms share data through consent-based infrastructure such as the Account Aggregator framework.
- Proposition 3: The credit benefits of digital payments are greatest for micro and newly formed firms, which are the most informationally opaque under traditional lending technologies.
- Proposition 4: Without sound underwriting and borrower protection, rapid expansion of payment-data-based lending increases the risk of over-indebtedness among micro-enterprises.

5.2. Implications for Practice and Policy

For MSME owners, the framework implies that accepting digital payments and keeping transactions in formal accounts are not only conveniences but also investments in creditworthiness. For banks and other lenders, payment data offer an opportunity to serve a large and underserved market profitably, but doing so requires investment in analytics, partnerships with fintech firms and products designed around cash-flow patterns. For policymakers, three priorities follow: extending digital literacy and payment acceptance among the smallest firms, encouraging lenders to use consent-based data sharing, and strengthening borrower protection and data governance so that the expansion of digital credit remains responsible.

5.3. Limitations and Directions for Future Research

This study is an integrative review, and part of the evidence on recent Indian developments comes from working papers that have not yet completed peer review. Official data on credit outcomes for MSMEs that adopt digital payments remain limited. Future research could use firm-level data linking payment histories to loan outcomes, compare outcomes across lender types, and examine the effects of the Account Aggregator framework and the Unified Lending Interface as they scale.

VI. CONCLUSION

India's digital payment revolution has created an opportunity to address one of the most persistent problems in small business finance: the information gap between lenders and MSMEs. This review shows that digital transaction data can reduce this gap and that emerging Indian evidence links the growth of digital payments to an expansion of credit. The proposed Digital Payment–Credit Pathway Framework explains how payment data become credit access and highlights the enabling conditions and risks involved. Realising the full potential of this pathway will require coordinated action by MSMEs, lenders and policymakers so that digital inclusion leads to responsible financial inclusion.

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Reskilling and Leadership for AI-Enabled Public Administration: An Integrative Review and a Workforce Capability Framework

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Abstract

Governments are adopting artificial intelligence (AI) to deliver services, process cases and inform policy, but the success of these initiatives depends less on the technology than on the capabilities of the public workforce that must use, oversee and explain it. Evidence on how AI reshapes tasks suggests that routine cognitive work is most exposed, while demand grows for analytical, interpersonal and ethical judgement. Yet research on public-sector AI has concentrated on technology adoption and governance, and far less on the reskilling and leadership needed to make adoption work. This paper addresses that gap through an integrative review of literature from public administration, labour economics, leadership and learning science, supplemented by policy sources. The review identifies three capability clusters that AI-enabled public administration requires: digital-technical capability, human-relational capability and adaptive leadership capability. It also finds that evidence-based learning designs, particularly spaced, retrieval-based microlearning embedded in work, offer a scalable route to building these capabilities across large civil services. Drawing on dynamic capabilities and transformational leadership theory, the paper proposes the AI-Ready Public Workforce Capability Framework, which links institutional enablers, capability clusters and learning architecture to public value outcomes. Four propositions and practical recommendations are offered for public managers and training institutions, with reference to India's Mission Karmayogi.

Keywords: - Public Administration, Artificial Intelligence, Reskilling, Public Sector leadership, Capacity Building

I. INTRODUCTION

Artificial intelligence is entering public administration at every level, from chatbots that answer citizen queries and models that prioritise inspections or detect fraud, to generative tools that draft correspondence and summarise case files (Wirtz et al., 2019; Zuiderwijk et al., 2021). Governments see in these technologies the promise of faster, more consistent and more responsive services at a time of fiscal pressure and rising citizen expectations. Yet experience with earlier waves of e-government shows that technology on its own rarely transforms public organisations. Transformation depends on whether the people who work in them can use new tools competently, redesign their work around them and exercise sound judgement about their outputs (Mergel et al., 2019).

This human dimension has become more pressing with the spread of generative AI. Research on the labour-market effects of AI indicates that the technology is skill-biased and task-displacing: employment in routine cognitive occupations declines while demand rises for complex problem-solving and interpersonal skills (Acemoglu & Restrepo, 2019; Aswani, 2026a). Many core public-sector tasks, such as processing applications, drafting standard documents and answering routine enquiries, are precisely the kind of cognitive work that large language models can perform or accelerate (Eloundou et al., 2024). At the same time, public servants carry responsibilities for fairness, legality and accountability that cannot be delegated to an algorithm (Bullock, 2019; Young et al., 2019). The public workforce must therefore develop new technical skills while strengthening the human and ethical capacities that AI cannot replace. The scale of the challenge is considerable: employers surveyed for the World Economic Forum expect 39% of workers' existing skill sets to be transformed or become outdated over 2025–2030, and estimate that 59 out of every 100 workers will need training by 2030 (World Economic Forum, 2025).

Despite this, research on AI in government has focused mainly on adoption drivers, applications and governance risks (Zuiderwijk et al., 2021; Medaglia et al., 2023). Studies of public-sector digital transformation consistently identify leadership and workforce capability as decisive enablers, but they rarely specify which capabilities are needed or how they can be developed at scale (Mikalef et al., 2022; Aswani, 2026b). This paper addresses three research questions: (RQ1) How does AI change the nature of work in public administration? (RQ2) What capabilities do public servants and public leaders need in AI-enabled administration? (RQ3) How can these capabilities be developed effectively across large public workforces? The paper contributes an integrative synthesis across disciplines, a workforce capability framework with testable propositions, and practical recommendations for public managers and civil service training institutions.

II. LITERATURE REVIEW

2.1. AI and the Changing Nature of Public Work

Public administration scholars have long examined how information technology alters administrative discretion. Bovens and Zouridis (2002) described a shift from street-level bureaucracies, in which front-line officials exercise judgement in face-to-face encounters, to system-level bureaucracies, in which decisions are increasingly embedded in software designed by system developers and legal experts. AI extends this trajectory. Bullock (2019) argues that AI is most likely to replace human discretion in tasks that are low in complexity and uncertainty, while tasks high in complexity and uncertainty will continue to require human judgement. Young et al. (2019) similarly frame AI as "artificial discretion", a tool whose value and risks depend on the type of task and the quality of human oversight.

Labour economics offers a complementary task-based perspective. Autor et al. (2003) showed that computerisation substitutes for routine tasks and complements non-routine analytical and interpersonal tasks. Acemoglu and Restrepo (2019) add that automation displaces labour from some tasks but can reinstate it through the creation of new tasks, so outcomes depend on how organisations redesign work. Recent evidence on generative AI points in the same direction. In a controlled experiment with professional writing tasks, ChatGPT reduced completion time and raised output quality, with the largest gains for less experienced workers (Noy & Zhang, 2023). In a large field study of customer-support agents, access to a generative AI assistant increased productivity, measured as issues resolved per hour, by 15% on average, and less experienced and lower-skilled workers improved both the speed and quality of their output (Brynjolfsson et al., 2025). These findings suggest that the impact of AI on public employees will depend heavily on whether organisations invest in redesigning roles and building skills.

2.2. Theoretical Perspectives

Two theoretical lenses guide this review. The dynamic capabilities perspective holds that organisations sustain performance in changing environments by sensing opportunities, seizing them and reconfiguring their resources (Teece et al., 1997). In the public sector, the workforce is the most important resource to be reconfigured, and the ability to reskill employees continuously is itself a dynamic capability. The transformational leadership perspective explains how leaders motivate followers to embrace change through idealised influence, inspirational motivation, intellectual stimulation and individualised consideration (Bass & Riggio, 2006). Emotional intelligence, understood as the ability to perceive, understand and manage emotions in oneself and others (Mayer & Salovey, 1997), is closely linked to this style of leadership. Among senior corporate leaders, relationship management and social awareness have been found to be the emotional intelligence dimensions most strongly associated with transformational leadership (Aswani, 2025a). Both lenses are relevant to AI adoption, which requires leaders who can reduce anxiety, build trust and guide employees through repeated cycles of change (Kotter, 1995).

2.3. Research Gaps

Three gaps emerge from the literature. First, studies of public-sector AI adoption treat workforce skills as one enabler among many, without specifying the capabilities required (Mikalef et al., 2022; Selten & Klievink, 2024). Second, research on leadership in digital transformation seldom connects leadership behaviours to the specific demands of AI, such as explaining algorithmic decisions to citizens or deciding when to override a model. Third, the learning-science evidence on how adults acquire and retain skills is rarely brought to bear on civil service training, which often relies on infrequent classroom programmes (OECD, 2017). This review integrates these strands.

III. METHODOLOGY

The study adopts an integrative literature review design, suited to synthesising evidence from different disciplines into a new conceptual framework. A purposive, non-exhaustive sampling strategy was used. Literature was identified through keyword searches combining "artificial intelligence", "generative AI" and "automation" with "public administration", "public sector", "civil service", "reskilling", "capacity building", "leadership" and "workplace learning", followed by backward and forward citation tracking from key reviews. Sources were drawn from four bodies of work: public administration and e-government, labour economics, leadership and organisational behaviour, and learning science. Peer-reviewed articles and scholarly books were prioritised and were supplemented by official policy documents. Sources were coded for the task changes, capability requirements, development approaches and institutional conditions they describe. The coded themes were then compared across disciplines to derive the framework presented in Section V.

IV. RESULTS

The review produced three main findings: AI shifts the composition of public work, AI-enabled administration requires three distinct capability clusters, and building these capabilities at scale depends on the design of learning and on institutional conditions. Table 1 summarises the capability clusters.

4.1. Shifting Task Composition

Across the literature, AI is associated with a shift in the composition of public work rather than the simple elimination of jobs. Routine information processing, such as data entry, document classification, standard correspondence and rule-based eligibility checks, is the most exposed to automation (Wirtz et al., 2019; Eloundou et al., 2024). Tasks involving complex judgement, negotiation, empathy and accountability remain human-centred, and new tasks emerge in supervising AI systems, validating outputs, managing data and explaining automated decisions to citizens (Bullock, 2019; Young et al., 2019). This shift implies that reskilling must address both new technical tasks and the expanded human role.

4.2. Capability Clusters for AI-Enabled Administration

The first cluster, digital-technical capability, includes AI and data literacy, the ability to use AI tools effectively and critically, and an understanding of the limitations of AI, such as bias and error. Public servants do not need to become data scientists, but they must be able to judge when an AI output is reliable and when it should be questioned (Medaglia et al., 2023). The second cluster, human-relational capability, covers ethical judgement, empathy, communication and collaboration. As AI absorbs routine tasks, the distinctive contribution of public servants increasingly lies in these areas, consistent with labour-market evidence that interpersonal skills are gaining value (Autor et al., 2003; Aswani, 2026a). The third cluster, adaptive leadership capability, concerns the ability of managers to set a vision for AI use, redesign work, manage change and maintain accountability. Here, emotional intelligence matters because leaders must address employees' fears about job security and build trust in new ways of working (Aswani, 2025a; Bass & Riggio, 2006).

Table 1. Capability Clusters for AI-Enabled Public Administration

Capability Cluster	Example Competencies	Development Approaches	Key Sources
Digital-technical	AI and data literacy, effective and critical use of AI tools, awareness of bias and error	Hands-on practice with real tools, short modules, guided experimentation	Wirtz et al. (2019); Medaglia et al. (2023)
Human-relational	Ethical judgement, empathy, communication, collaboration, explaining decisions to citizens	Case-based learning, simulations, peer learning	Autor et al. (2003); Aswani (2026a)
Adaptive leadership	Vision for AI use, work redesign, change management, emotional intelligence, accountability	Leadership programmes, coaching, action learning	Bass and Riggio (2006); Aswani (2025a)

Source: Author's synthesis based on the reviewed literature.

4.3. Learning Design for Capability Building at Scale

The learning-science literature indicates that how training is designed matters as much as what it covers. Spacing practice over time produces more durable learning than massed practice (Cepeda et al., 2006). Retrieval practice, in which learners actively recall information, improves long-term retention more than repeated study (Roediger & Karpicke, 2006). Microlearning applies these principles through short, focused units. A review of microlearning research found that sessions of roughly 5 to 15 minutes, combined with spaced repetition and active recall, can improve retention compared with longer sessions (Aswani, 2025b), and microlearning has attracted growing interest in workplace learning (Leong et al., 2021). For public workforces numbering in the hundreds of thousands or millions, such formats offer a scalable complement to classroom training. They are most effective when embedded in daily work and combined with practice, feedback and opportunities for social learning (Noe et al., 2014).

4.4. Institutional Enablers

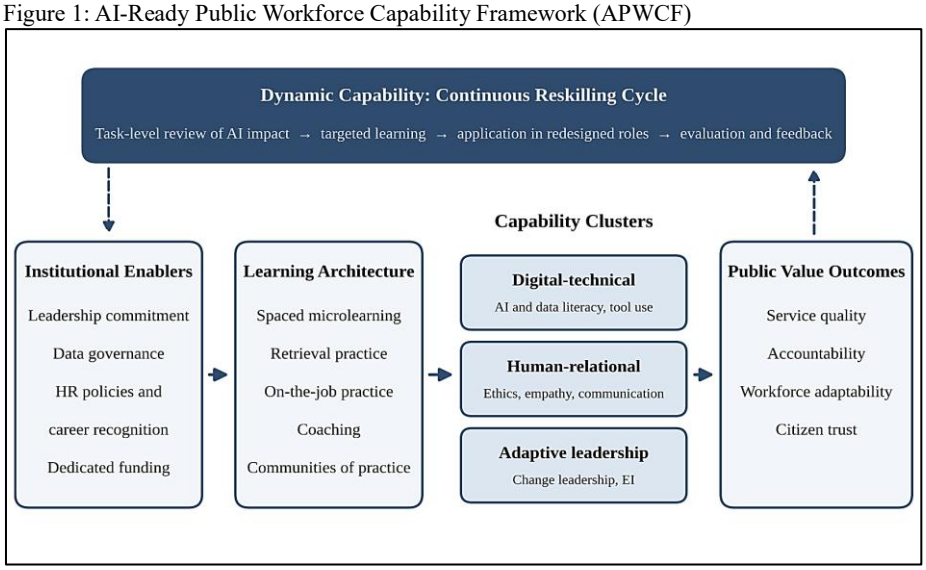
Capability building does not occur in isolation. Studies of public-sector digital transformation identify leadership commitment and data governance maturity as the most critical, and often the most underfunded, enablers (Aswani, 2026b). Research on European municipalities similarly finds that AI capability in government depends on complementary resources, including skills, data, technical infrastructure and organisational structures that connect AI specialists with operational units (Mikalef et al., 2022; Selten & Klievink, 2024). Human resource policies are also important: reskilling is more likely to succeed when it is linked to redesigned job roles, recognised in career progression and supported by protected learning time (OECD, 2017). India's Mission Karmayogi, the National Programme for Civil Services Capacity Building, illustrates this institutional approach. It combines a competency-based approach for civil servants with the iGOT Karmayogi online learning platform and a Capacity Building Commission that supports the approval of annual capacity-building plans (Prime Minister's Office, 2020).

V. DISCUSSION

5.1. The AI-Ready Public Workforce Capability Framework

Synthesising these findings, this paper proposes the AI-Ready Public Workforce Capability Framework (APWCF), shown in Figure 1. The framework has four components. Institutional enablers, namely leadership commitment, data governance, HR policies and dedicated funding, create the conditions for capability development. A learning architecture of spaced microlearning, on-the-job practice, coaching and communities of practice translates these conditions into learning. The three capability clusters identified in the results form the core of the framework. These capabilities in turn produce public value outcomes: better service quality, stronger accountability, greater workforce adaptability and higher citizen trust. Consistent with the dynamic capabilities perspective, the framework treats continuous reskilling as an ongoing organisational process rather than a one-off programme (Teece et al., 1997).

Figure 1: AI-Ready Public Workforce Capability Framework (APWCF)



Source: Developed by the author based on the review.

Four propositions follow from the framework.

- Proposition 1: The positive effect of AI adoption on public service performance is stronger when it is accompanied by systematic investment in all three capability clusters, rather than in digital-technical skills alone.
- Proposition 2: Leaders' emotional intelligence, particularly relationship management and social awareness, positively moderates employees' acceptance of AI-enabled changes to their work.
- Proposition 3: Reskilling programmes that use spaced, retrieval-based microlearning embedded in work produce more durable capability gains than programmes relying mainly on infrequent classroom training.
- Proposition 4: Leadership commitment and data governance maturity jointly determine whether workforce capability gains translate into public value outcomes.

5.2. Implications for Practice

For public managers and civil service training institutions, the framework suggests four priorities. First, organisations should conduct task-level reviews of how AI will affect specific roles, so that reskilling is targeted at real changes in work rather than at generic digital awareness. Second, training should develop the human-relational and leadership clusters alongside technical skills, with particular attention to ethical judgement and the explanation of automated decisions to citizens. Third, training institutions should adopt evidence-based learning designs, using short, spaced and practice-oriented modules delivered through platforms such as iGOT Karmayogi, and should measure retention and on-the-job application rather than course completion alone. Fourth, leadership development programmes for senior officials should include emotional intelligence and change management, because leaders shape how employees experience AI-driven change (Aswani, 2025a; Kotter, 1995).

5.3. Limitations and Directions for Future Research

This study is an integrative review and relies on published research, much of which comes from private-sector or high-income contexts. Evidence on generative AI in government is still emerging, and the framework and propositions are conceptual. Future research should test the propositions empirically, for example through evaluations of reskilling programmes in civil services, comparative studies across countries and levels of government, and longitudinal studies of how public servants' roles change after AI adoption.

VI. CONCLUSION

AI is changing the nature of public work by absorbing routine information processing and expanding the importance of judgement, empathy and accountability. This review shows that AI-enabled public administration requires three capability clusters, digital-technical, human-relational and adaptive leadership, and that these can be built at scale through evidence-based learning designs supported by strong institutional enablers. The proposed AI-Ready Public Workforce Capability Framework offers a basis for research and practice. Its central message is that governments seeking value from AI should invest in their people at least as deliberately as they invest in technology.

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Emotional Intelligence of Hospital Leaders, Nurse Burnout and Retention: An Integrative Review and a Conceptual Framework for Hospital Management

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Abstract

Hospitals worldwide face persistent shortages of nurses, and burnout is one of the main reasons nurses reduce their hours or leave the profession. While staffing levels and workload are well-established causes of burnout, a growing body of research points to the quality of leadership as a powerful and modifiable influence on nurses' wellbeing and intention to stay. This paper examines the role of leaders' emotional intelligence, the ability to perceive, understand and manage emotions in oneself and others, in shaping nurse burnout and retention. Using an integrative review of literature from hospital management, nursing, organisational psychology and leadership studies, the paper synthesises evidence on burnout, leadership styles and emotional intelligence in healthcare settings. The review finds that relational leadership styles are consistently associated with lower burnout and higher job satisfaction among nurses, and that emotional intelligence is a strong correlate of such styles. It also finds evidence that emotional intelligence can be developed through training. Drawing on the Job Demands–Resources model and conservation of resources theory, the paper proposes the Emotionally Intelligent Hospital Leadership Framework, in which leader emotional intelligence operates as a job resource that buffers the effects of high job demands on burnout and turnover intention. Four propositions and practical recommendations are offered for hospital administrators, with attention to the Indian context.

Keywords: - Hospital Management, Emotional Intelligence, Nurse Burnout, Leadership, Retention

I. INTRODUCTION

Nurses form the largest part of the health workforce, and their availability and wellbeing are central to the quality and safety of hospital care. According to the World Health Organization, the global nursing workforce grew from 27.9 million in 2018 to 29.8 million in 2023, yet a shortage of 5.8 million nurses remained in 2023 and is projected to persist at about 4.1 million by 2030 (World Health Organization [WHO], 2025). Shortages place additional pressure on the nurses who remain, increasing workloads and creating a cycle in which overwork leads to burnout and burnout leads to further departures. The link between staffing and wellbeing is well established: in a landmark study of hospitals in the United States, each additional patient per nurse was associated with higher patient mortality and with increases in nurse burnout and job dissatisfaction (Aiken et al., 2002).

Burnout among nurses is widespread. A meta-analysis of studies from around the world estimated an overall pooled prevalence of burnout symptoms among nurses of 11.23% (Woo et al., 2020), and rates are considerably higher in many settings and specialties. The World Health Organization classifies burn-out in the International Classification of Diseases (ICD-11) as an occupational phenomenon resulting from chronic workplace stress that has not been successfully managed (WHO, 2019). Because burnout originates in the workplace, it falls squarely within the responsibility of hospital management. Staffing and workload are important causes, but they are often constrained by budgets and labour-market conditions. Leadership, by contrast, is a factor that hospitals can influence relatively quickly, and research shows that the behaviour of immediate supervisors strongly affects how employees experience the demands of their work (Shanafelt et al., 2015; Cummings et al., 2018).

Emotional intelligence (EI) has attracted attention as a capability that may explain why some leaders are more effective than others in emotionally demanding environments. Among senior corporate leaders, relationship management and social

awareness have been found to be the EI dimensions most strongly associated with transformational leadership (Aswani, 2025a). Hospitals are particularly emotionally intense workplaces, in which nurses deal daily with suffering, death, time pressure and conflict. Yet the literature on EI in nursing has focused largely on nurses' own EI, and the mechanisms linking leaders' EI to nurse burnout and retention have not been integrated into a management framework (Smith et al., 2009; Akerjordet & Severinsson, 2008).

This paper addresses three research questions: (RQ1) What does the evidence show about the relationship between leadership and nurse burnout and retention? (RQ2) How is leaders' emotional intelligence related to effective leadership in healthcare? (RQ3) How can hospitals develop emotionally intelligent leadership to reduce burnout and improve retention? The paper contributes an integrative synthesis, a conceptual framework with testable propositions, and practical recommendations for hospital management.

II. LITERATURE REVIEW

2.1. Burnout in Healthcare

Burnout is commonly defined as a psychological syndrome arising from chronic interpersonal stressors at work, consisting of exhaustion, cynicism or depersonalisation, and reduced professional efficacy (Maslach et al., 2001). In nursing, burnout has been linked to lower quality of care, reduced patient satisfaction, absenteeism and turnover (Dall'Ora et al., 2020). Among physicians, burnout has similarly been associated with medical errors, reduced professionalism and intention to leave, and its drivers lie mainly in the work environment rather than in individual weakness (West et al., 2018). These findings indicate that burnout should be treated as an organisational problem requiring management action.

2.2. Theoretical Perspectives

Two theories explain how leadership can influence burnout. The Job Demands–Resources (JD-R) model proposes that every job has demands, such as workload and emotional pressure, which drain energy, and resources, such as support, autonomy and feedback, which help employees achieve goals and buffer the effects of demands (Bakker & Demerouti, 2007). High demands combined with low resources lead to burnout, while adequate resources foster engagement. Supportive leadership is one of the most important job resources. Conservation of resources theory adds that people strive to obtain and protect valued resources, and that stress occurs when resources are threatened or lost (Hobfoll, 1989). Leaders who replenish their staff's emotional and social resources can therefore prevent the spiral of resource loss that leads to burnout.

2.3. Emotional Intelligence and Leadership

Mayer and Salovey (1997) define EI as the ability to perceive, use, understand and manage emotions. Goleman (1998) popularised a broader model that includes self-awareness, self-regulation, motivation, empathy and social skills, and argued that these competencies are especially important for leadership. Empirical research supports a link between EI and leadership effectiveness. Wong and Law (2002) found that leaders' EI was related to followers' job satisfaction and extra-role behaviour. A meta-analysis by Harms and Credé (2010) found a significant positive relationship between EI and transformational leadership, and Joseph and Newman (2010) showed that EI predicts job performance, particularly in jobs with high emotional labour, a category that clearly includes nursing. In corporate settings, the relational dimensions of EI show the strongest association with transformational leadership, and the relationship is moderated by organisational culture and leadership experience (Aswani, 2025a).

2.4. Research Gaps

Reviews of EI in nursing have mainly examined nurses' own EI and its relationship with their performance and wellbeing (Smith et al., 2009). Reviews of nursing leadership have shown that relational leadership improves outcomes, but have not focused on EI as the underlying capability (Cummings et al., 2018). Few studies place leader EI within an established model of job stress such as the JD-R model, and evidence from low- and middle-income countries, including India, remains limited. This review addresses these gaps.

III. METHODOLOGY

The study adopts an integrative literature review design, appropriate for combining evidence from diverse study designs and disciplines into a conceptual framework. A purposive, non-exhaustive sampling strategy was used. Literature was identified through keyword searches combining "emotional intelligence", "leadership", "nurse manager" and "hospital" with "burnout", "turnover intention", "retention" and "job satisfaction", followed by backward and forward citation tracking from key reviews. Priority was given to systematic reviews, meta-analyses and influential empirical studies published in peer-reviewed journals, supplemented by foundational theoretical works and reports by the World Health Organization. Studies of both nurses and physicians were included where they illuminated the role of leadership in healthcare burnout. Sources were coded for the relationships they examined among leadership, EI, job demands, job resources, burnout and retention, and the resulting themes were synthesised into the framework presented in Section V.

IV. RESULTS

The review produced four main findings, summarised in Table 1 and discussed below.

Table 1. Summary of Key Findings from the Review

Finding	Summary of Evidence	Key Sources
Leadership style shapes nurse outcomes	Relational leadership linked to higher satisfaction and lower burnout; task-focused styles to poorer outcomes	Cummings et al. (2018); Wong et al. (2013); Shanafelt et al. (2015)
EI underpins relational leadership	EI correlates with transformational leadership and performance in emotionally demanding roles	Harms and Credé (2010); Joseph and Newman (2010); Aswani (2025a)
Leader EI acts as a job resource	Supportive leadership reduces demands and buffers their effect on burnout	Bakker and Demerouti (2007); Hobfoll (1989)
EI can be developed	Training produces moderate improvements in EI; brief spaced formats aid retention	Mattingly and Kraiger (2019); Aswani (2025b)

Source: Author's synthesis based on the reviewed literature.

4.1. Leadership Style Shapes Nurse Outcomes

The strongest evidence comes from systematic reviews of nursing leadership. Cummings et al. (2018) reviewed studies on leadership styles and outcomes for the nursing workforce and found that relational leadership styles, such as transformational leadership, were associated with higher nurse job satisfaction and better wellbeing, whereas task-focused styles were associated with poorer outcomes. A related review found that positive relational leadership was also linked to better patient outcomes, including higher patient satisfaction and lower mortality and adverse events (Wong et al., 2013). Similar effects appear among physicians: in a large study at an academic medical centre, each one-point increase in the leadership score of a physician's immediate supervisor was associated with lower burnout and higher satisfaction (Shanafelt et al., 2015).

4.2. Emotional Intelligence Underpins Relational Leadership

Relational leadership styles depend on capabilities that are central to EI: recognising staff distress, regulating one's own reactions under pressure, communicating with empathy and managing conflict constructively. Meta-analytic evidence links EI to transformational leadership (Harms & Credé, 2010) and to performance in emotionally demanding roles (Joseph & Newman, 2010). Reviews in nursing describe emotionally intelligent nurse leaders as better able to create supportive environments, build trust and handle the emotional dimensions of care (Akerjordet & Severinsson, 2008; Smith et al., 2009).

4.3. Leader EI as a Job Resource

When the findings are interpreted through the JD-R model, leader EI emerges as a job resource with two functions. First, it reduces demands by helping leaders anticipate workload problems, resolve conflicts and distribute work fairly. Second, it provides resources in the form of emotional support, recognition and voice, which buffer the effects of demands that cannot be reduced (Bakker & Demerouti, 2007). From a conservation of resources perspective, these behaviours help nurses recover emotional energy and prevent resource loss spirals (Hobfoll, 1989). The effects of leader EI are likely to be greatest where demands are highest, such as in understaffed wards and critical care units.

4.4. Emotional Intelligence can be Developed

An important practical finding is that EI is not a fixed trait. A meta-analysis of training studies concluded that EI can be improved through training, with moderate effects (Mattingly & Kraiger, 2019). This suggests that hospitals can treat EI as a leadership competency to be developed rather than only as a selection criterion. Because nurse managers and senior nurses have limited time for off-the-job training, short, spaced and practice-based formats may be particularly suitable, in line with evidence that brief microlearning sessions with spaced repetition and active recall improve retention (Aswani, 2025b).

4.5. Evidence from India

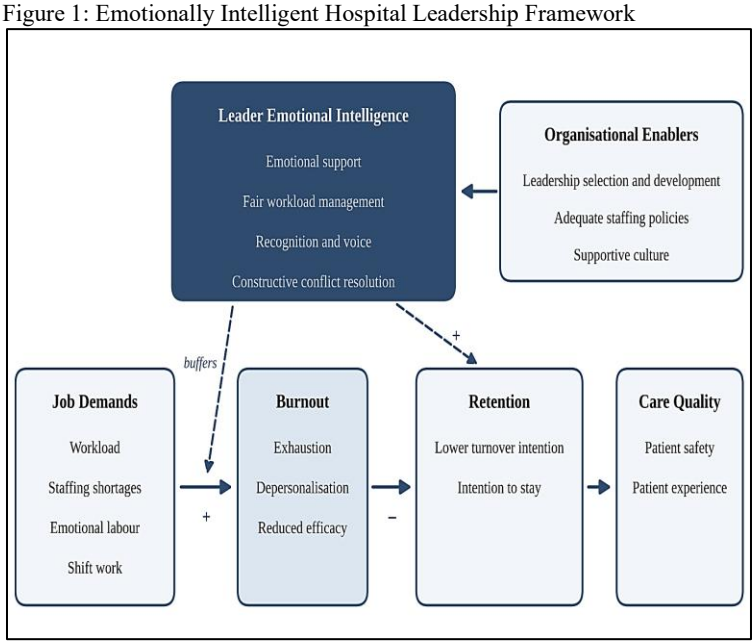
Evidence from India, although still limited, points to the same concerns. The Government of India reported 36.14 lakh nursing personnel in the country as of December 2022, giving an estimated nurse–population ratio of 1:476 under an assumption of 80% availability (Ministry of Health and Family Welfare [MoHFW], 2023). A cross-sectional study of 349 nursing professionals in public and private hospitals in Kerala, surveyed in 2024, found that 36.1% reported high burnout (Ambujam et al., 2026). These figures suggest that burnout is a significant concern for Indian hospitals and that leadership-based interventions deserve attention alongside workforce expansion. Research specifically examining the emotional intelligence of nurse managers in Indian hospitals remains scarce.

V. DISCUSSION

5.1. The Emotionally Intelligent Hospital Leadership Framework

Synthesising these findings, this paper proposes the Emotionally Intelligent Hospital Leadership Framework, shown in Figure 1. In the framework, job demands, including workload, staffing shortages, emotional labour and shift work, increase burnout, which in turn raises turnover intention and lowers quality of care. Leader EI, expressed through four relational behaviours, namely emotional support, fair workload management, recognition and voice, and constructive conflict resolution, acts as a job resource. It moderates the relationship between demands and burnout and has a direct positive effect on engagement and intention to stay. Organisational enablers, namely leadership selection and development, adequate staffing policies and a supportive organisational culture, determine whether leaders can exercise these capabilities.

Figure 1: Emotionally Intelligent Hospital Leadership Framework



Source: Developed by the author based on the review.

Four propositions follow from the framework.

- Proposition 1: Nurse managers' emotional intelligence is negatively associated with burnout among the nurses they supervise.
- Proposition 2: Leader emotional intelligence moderates the relationship between job demands and nurse burnout, such that the relationship is weaker when leader emotional intelligence is high.
- Proposition 3: The relationship between leader emotional intelligence and nurse retention is mediated by lower burnout and higher work engagement.
- Proposition 4: Structured emotional intelligence development programmes for nurse managers reduce burnout and turnover intention among their staff, with stronger effects in high-demand units.

5.2. Implications for Hospital Management

The framework suggests four priorities for hospital administrators. First, EI should be included in the competency frameworks used to select and promote nurse managers, alongside clinical expertise. Second, hospitals should invest in EI and relational leadership development for current managers, using evidence-based formats that combine short learning modules, practice, coaching and feedback. Third, leadership development is not a substitute for adequate staffing. Leaders can buffer demands, but persistently excessive workloads will overwhelm even the most emotionally intelligent manager (Aiken et al., 2002). Fourth, hospitals should routinely measure burnout and engagement and use the results to identify units where leadership support is most needed. In India, where nurse availability remains a policy concern and high burnout has been reported (MoHFW, 2023; Ambujam et al., 2026), these measures could offer a cost-effective way to improve retention while longer-term workforce expansion takes place.

5.3. Limitations and Directions for Future Research

As an integrative review, this study relies on published research, much of which is cross-sectional and comes from high-income countries. Causal relationships between leader EI and nurse outcomes therefore cannot be firmly established. Future research should test the propositions using multilevel designs that match leaders' EI with the outcomes of their teams, longitudinal studies and controlled evaluations of EI training for nurse managers, especially in Indian and other low- and middle-income hospital settings.

VI. CONCLUSION

Nurse burnout is a workplace problem with serious consequences for staff, patients and hospitals. This review shows that leadership is one of the most important and most modifiable influences on burnout and retention, and that emotional intelligence underpins the relational leadership styles associated with better outcomes. The proposed Emotionally Intelligent Hospital Leadership Framework positions leader EI as a job resource that buffers the effects of high demands. Because EI can be developed, hospitals have a practical lever to improve nurse wellbeing and retention. Investing in emotionally intelligent leadership, alongside adequate staffing, is therefore a strategic priority for hospital management.

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Sustainability as a Competitive Strategy in India's Paint Industry: Regulatory Drivers, Firm Practices and an Integrative Framework

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Abstract

India's paint industry is undergoing its most significant restructuring in decades. Large new entrants have added substantial capacity, incumbent margins are under pressure, and ownership of a leading multinational subsidiary has changed hands. At the same time, regulation on lead content and plastic packaging, together with growing environmental awareness, is raising the importance of sustainability. This paper examines how sustainability is becoming a dimension of competitive strategy in the sector. It combines an integrative review of literature on competitive strategy, the natural-resource-based view, institutional theory and green innovation with a document analysis of regulatory texts, company sustainability reports and industry analyses published between 2016 and 2025. The findings show that regulation has established a baseline of compliance, particularly the 90 parts per million limit on lead in household and decorative paints. However, evidence of non-compliant lead paints on the market points to an enforcement gap. Leading firms have gone beyond compliance through renewable energy, water stewardship, low-emission products and packaging responsibility, but the depth of these practices varies considerably across firms. Building on these findings, the paper proposes a Sustainability–Competitiveness Pathway Framework linking regulatory push, market pull and competitive pressure to green capabilities and to economic, environmental and social outcomes. Four propositions and implications for managers and policymakers are presented.

Keywords: - Paint Industry, Competitive Strategy, Sustainability, Green Innovation, India

I. INTRODUCTION

Paints and coatings are a familiar part of everyday life, yet the industry that produces them is closely linked to the wider economy. Demand is driven by housing, construction, automobiles and industrial manufacturing, so the sector tends to grow with urbanisation and rising incomes (Aswani, 2025). India's organised paint industry was estimated at about Rs 62,000 crore at the end of FY2023, with decorative paints accounting for about 70% of consumption and industrial paints for about 30% (Indian Chemical News, 2023). Per capita paint consumption in India has been reported at about 3.5 kg a year, compared with a global average of about 10 kg, which indicates considerable room for growth (The Week, 2025a).

For much of its history, the organised segment has been highly concentrated. The five largest firms, Asian Paints, Berger Paints, Kansai Nerolac, AkzoNobel India and Indigo Paints, have been estimated to hold about 90% of the organised market (Indian Chemical News, 2023), and Asian Paints alone has been reported to hold more than half of the market (Kelkar, 2025). This structure is now changing rapidly. The Aditya Birla Group launched Birla Opus in February 2024 with an announced investment of Rs 10,000 crore and planned capacity equivalent to a 40% addition to industry capacity (Grasim Industries, 2024). In 2025, JSW Paints agreed to acquire a controlling stake in AkzoNobel India (Kelkar, 2025). Competition has intensified, prices have been cut, and incumbent margins have come under pressure (The Machine Maker, 2024).

These competitive shifts coincide with rising environmental expectations. Paint manufacturing depends heavily on petrochemical inputs, generates hazardous waste, uses large volumes of water and packaging, and can release volatile organic compounds (VOCs) and heavy metals (CARE Ratings, 2019; Pieters & Mekonnen, 2024). India has regulated lead in household and decorative paints since 2017 and has introduced extended producer responsibility (EPR) for plastic packaging.

Whether sustainability can become a source of competitive advantage, rather than merely a compliance cost, is therefore a timely question for the sector.

Research on the Indian paint industry has focused mainly on market structure, consumer preference and distribution (Singhi et al., 2009; Gupta et al., 2020), while studies of lead in paint have come largely from environmental health (Kumar & Gottesfeld, 2008). Few studies connect these strands to strategic management theory. This paper addresses three research questions: (RQ1) How are competitive dynamics in India's paint industry changing? (RQ2) What regulatory and market forces are shaping sustainability in the sector, and how are leading firms responding? (RQ3) Under what conditions can sustainability become a source of competitive advantage for paint firms? The paper contributes an integrated analysis of the sector, a conceptual framework and practical implications for managers and policymakers.

II. LITERATURE REVIEW

2.1. Competitive Strategy and Resource-Based Perspectives

Porter (1985) argued that firms achieve competitive advantage through cost leadership or differentiation, sustained by the way they configure their value chain activities. The resource-based view complements this by locating advantage in resources that are valuable, rare, inimitable and non-substitutable (Barney, 1991). In the paint industry, such resources have traditionally included brand equity, extensive dealer networks, tinting systems and demand-forecasting capabilities. Asian Paints, for example, has long been noted for using its distribution and supply chain capabilities as a competitive weapon (Singhi et al., 2009). Hart (1995) extended the resource-based view into a natural-resource-based view, arguing that capabilities in pollution prevention, product stewardship and sustainable development can themselves become sources of competitive advantage.

2.2. Sustainability and Competitiveness

Porter and van der Linde (1995) challenged the assumption that environmental regulation necessarily harms competitiveness. They argued that well-designed regulation can stimulate innovations that reduce waste and costs, partially or fully offsetting the cost of compliance. Ambec and Lanoie (2008) reviewed the evidence and concluded that environmental performance can improve economic performance through both higher revenues, such as access to green market segments and product differentiation, and lower costs, such as savings in materials, energy and risk management. At the product level, green innovation has been associated with corporate competitive advantage (Chen et al., 2006), and firms integrate environmental sustainability into new products when driven by regulation, market opportunity and internal values (Dangelico & Pujari, 2010).

2.3. Institutional Pressures

Institutional theory explains why firms in the same field tend to adopt similar practices. DiMaggio and Powell (1983) identified three mechanisms: coercive pressures from regulation, normative pressures from professional standards and mimetic pressures arising from imitation under uncertainty. In the paint industry, lead regulation and EPR rules are coercive pressures, eco-labels and certifications act as normative pressures, and visible sustainability commitments by market leaders can trigger mimetic responses by competitors. Institutional theory also warns that firms may adopt practices symbolically, without changing their operations, which makes it important to examine reported performance rather than stated commitments alone.

2.4. Consumers and Green Purchasing

Demand-side conditions influence whether green strategies pay off. Studies of Indian consumers find that environmental concern, perceived product benefits and trust in green claims shape green purchasing behaviour (Jaiswal & Kant, 2018), and that young consumers' intentions to buy green products are influenced by attitudes, social norms and perceived control (Yadav & Pathak, 2016). However, intentions do not always translate into purchases, especially when green products carry a price premium. In the paint market, consumers often rely on painters and dealers for advice, so the influence of channel partners is also important (Gupta et al., 2020).

III. METHODOLOGY

The study combines an integrative literature review with a qualitative document analysis. The literature review drew on peer-reviewed research in strategic management, environmental management, institutional theory and consumer behaviour, together with environmental health studies on lead in paint. Sources were identified through keyword searches combining "paint industry", "coatings", "India", "competitive strategy", "green innovation", "lead paint" and "sustainability", followed by citation tracking.

The document analysis covered three types of secondary sources published between 2016 and 2025: regulatory texts, including the Regulation on Lead Contents in Household and Decorative Paints Rules, 2016 and the relevant Bureau of Indian Standards specification; company disclosures, namely sustainability and environmental, social and governance (ESG) reports of Asian Paints and Berger Paints and press releases of new entrants; and industry analyses by credit rating agencies and business news organisations. Asian Paints and Berger Paints were selected because they are among the largest firms in the sector and publish detailed sustainability data. The documents were coded for competitive developments, regulatory requirements and sustainability practices, and the results were interpreted through the theoretical perspectives reviewed above. Market estimates vary across sources because of differences in definitions and methods, so figures are reported with their sources and dates.

IV. RESULTS

4.1. Changing Competitive Dynamics

The analysis indicates that the competitive landscape changed more between 2019 and 2025 than in the preceding decades. Table 1 summarises the key developments. The entry of well-capitalised conglomerates has been the main driver. JSW Paints entered the market in 2019 with an initial investment of Rs 600 crore (Business Today, 2019). Birla Opus followed in 2024 with a much larger investment and by the fourth quarter of FY2025 its parent reported a revenue market share of more than 10% in the organised decorative paints market (Business Standard, 2025). The resulting capacity additions and price competition have weighed on incumbents. CareEdge Ratings projected that the operating margins of major players would settle at about 14% by FY2026, compared with a five-year average of 18% (The Machine Maker, 2024). In December 2025, JSW Paints completed its acquisition of a majority stake in AkzoNobel India, further consolidating the challenger segment (The Week, 2025b).

Table 1. Key Developments in India's Paint Industry, 2019–2025

Year	Development	Significance
2019	JSW Paints enters with an initial investment of Rs 600 crore	First major conglomerate entry in decades
2024	Birla Opus launched with an announced Rs 10,000 crore investment and capacity equal to a 40% addition to industry capacity	Large-scale capacity addition intensifies price competition
2024	CareEdge projects major players' operating margins at about 14% by FY2026, against a five-year average of 18%	Margin pressure on incumbents
2025	Birla Opus (with Birla White Putty) reported above 10% revenue share of organised decorative paints in Q4 FY2025	Rapid market share gain by new entrant
2025	JSW Paints completes acquisition of a majority stake in AkzoNobel India	Consolidation of the challenger segment

Source: Business Today (2019), Grasim ndustries (2024), The Machine Maker (2024), Business Standard (2025) and The Week (2025b).

The industry's cost structure adds to this pressure. Nearly half of the raw materials used by paint companies are crude oil derivatives, and titanium dioxide pigment accounts for about a quarter of paint content (CARE Ratings, 2019). Firms are therefore exposed to volatile commodity prices, which strengthens the economic case for efficiency in materials, energy and packaging.

4.2. Regulatory Drivers

Three sets of rules shape sustainability in the sector. First, the Regulation on Lead Contents in Household and Decorative Paints Rules, 2016, issued by the Ministry of Environment, Forest and Climate Change, prohibit the manufacture, trade, import and export of household and decorative paints containing lead in excess of 90 parts per million, and require labels stating that the lead content does not exceed this limit (Ministry of Environment, Forest and Climate Change [MoEFCC], 2016). Second, the Bureau of Indian Standards specification for plastic emulsion paints sets optional Ecomark requirements, including a VOC content of not more than 5% by mass and limits on heavy metals (Bureau of Indian Standards [BIS], 2004). Third, EPR obligations for plastic packaging require producers and brand owners to manage the plastic packaging they place on the market, and both Asian Paints and Berger Paints report EPR compliance activities (Asian Paints, 2025; Berger Paints, 2024).

Regulation has set a baseline, but compliance is uneven. A study by Toxics Link and IPEN found that 46 of 51 solvent-based paints for home use analysed in India, about 90%, were lead paints, with the highest concentration reaching 250,000 ppm (Toxics Link & IPEN, 2023). Earlier research had documented high lead levels in Indian enamel paints before the rules were introduced (Kumar & Gottesfeld, 2008). These findings suggest that coercive pressure alone has not eliminated harmful products, and that enforcement and consumer awareness remain significant gaps.

4.3. Firm Sustainability Practices

The two firms analysed have adopted practices that go well beyond lead compliance, though at different levels of depth. Table 2 compares selected indicators. Asian Paints reports that 57.6% of the electricity used in its decorative paint factories came from renewable sources in FY2024–25, that its water replenishment equalled 478% of its freshwater consumption, and that its specific Scope 1 and 2 greenhouse gas emissions had fallen by 69% from its FY2013–14 baseline. It also reports that all its products are free of lead and added heavy metals (Asian Paints, 2025). Berger Paints reports that renewable electricity met 20% of its total energy requirement in FY2023–24 and that it reduced water consumption by 35%, and it sets targets of zero VOC for all water-based paints and GreenPro certification for all decorative products (Berger Paints, 2024). Asian Paints' report also acknowledges that some of its 2025 targets were not met, for example on the number of EPR plastic collection points (Asian Paints, 2025). Such candid disclosure is a useful signal of substantive rather than symbolic adoption.

Table 2. Selected Sustainability Indicators of Two Leading Paint Firms

Indicator	Asian Paints (FY2024–25)	Berger Paints (FY2023–24)
Renewable energy	57.6% of electricity in decorative factories from renewables	Renewable electricity met 20% of total energy requirement
Water	Replenishment equal to 478% of freshwater consumption	Water consumption reduced by 35%

Emissions	Specific Scope 1+2 emissions down 69% from FY2013–14 baseline	Scope 1+2 emissions of 39,270 tCO2e reported
Products	All products free of lead and added heavy metals	Targets: zero VOC in all water-based paints; GreenPro for all decorative products
Packaging	100 EPR plastic collection points in 25 towns (2025 target not met)	Target: manage 100% of plastic waste as per EPR

Source: Asian Paints (2025) and Berger Paints (2024). Figures are self-reported and not directly comparable.

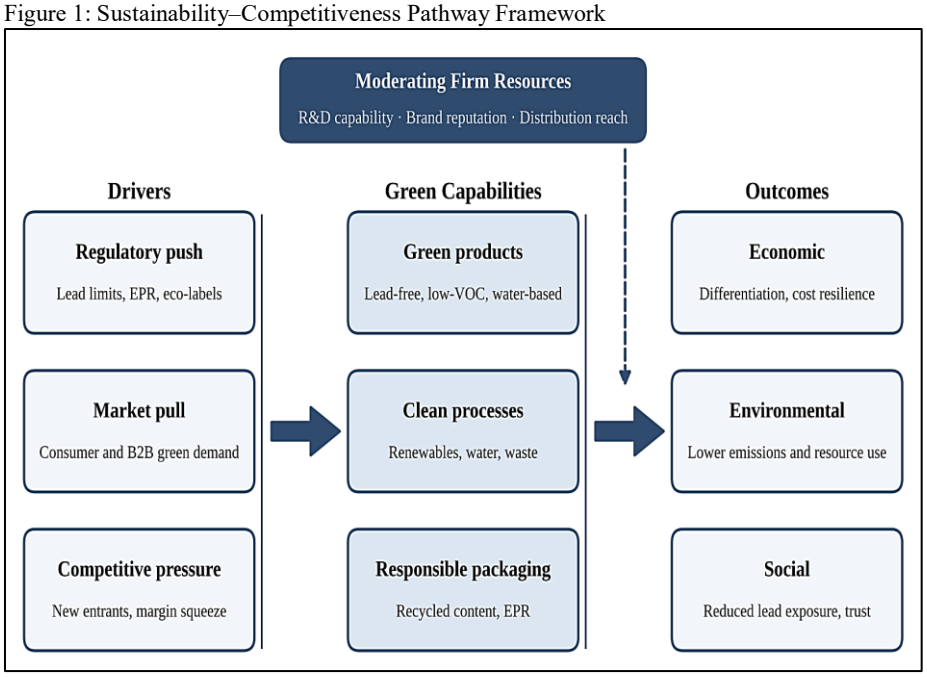
At the product level, the shift towards water-based formulations is central to reducing VOC emissions. Research on waterborne polymer dispersions shows that they have become commercially established across many coating applications, although achieving performance equal to solvent-based systems in demanding uses remains a technical challenge (Pieters & Mekonnen, 2024). Green product innovation thus requires investment in research and development, which favours firms with scale and technical capability.

V. DISCUSSION

5.1. The Sustainability–Competitiveness Pathway Framework

The findings support the view that sustainability in India's paint industry is moving from a compliance issue to a strategic one. Synthesising the results with the theoretical perspectives, this paper proposes the Sustainability–Competitiveness Pathway Framework, shown in Figure 1. The framework identifies three drivers. Regulatory push comprises coercive pressures such as lead limits and EPR obligations (DiMaggio & Powell, 1983). Market pull comprises consumer and institutional demand for safer and greener products (Jaiswal & Kant, 2018). Competitive pressure, intensified by new entrants, pushes firms to seek new sources of differentiation and cost efficiency (Porter, 1985). These drivers stimulate the development of green capabilities in three areas: green products (lead-free, low-VOC and water-based formulations), clean processes (renewable energy, water stewardship and waste reduction) and responsible packaging (recycled content and EPR collection). Consistent with the natural-resource-based view, these capabilities can produce economic outcomes such as differentiation and cost savings, environmental outcomes such as lower emissions and resource use, and social outcomes such as reduced exposure to lead (Hart, 1995; Ambec & Lanoie, 2008). Firm resources such as R&D capability, brand reputation and distribution reach moderate the strength of these pathways.

Figure 1: Sustainability–Competitiveness Pathway Framework



Source: Developed by the author based on the review.

Four propositions follow.

- Proposition 1: Intensified competition from new entrants increases incumbents' investment in sustainability-based differentiation, particularly in premium decorative segments.
- Proposition 2: Investments in clean processes, especially renewable energy and water efficiency, improve paint firms' cost resilience to commodity and energy price volatility.
- Proposition 3: The effectiveness of lead regulation in reducing exposure depends on enforcement and on the awareness of consumers, painters and dealers, rather than on the existence of the rules alone.
- Proposition 4: Firms that disclose sustainability performance transparently, including unmet targets, gain greater stakeholder trust than firms that report commitments without performance data.

5.2. Implications for Managers and Policymakers

For managers, the analysis suggests that sustainability should be integrated into core strategy rather than treated as a separate CSR activity. Incumbents facing price competition can use credible green attributes, such as certified low-VOC and lead-free products, to sustain differentiation, while efficiency in energy, water and materials can protect margins. New entrants, whose plants are recently built, have an opportunity to set high environmental benchmarks from the outset. Because painters and dealers strongly influence product choice, firms should also educate channel partners about the health and environmental benefits of safer products.

For policymakers, the persistence of lead paints despite the 2016 rules indicates a need for stronger market surveillance, regular product testing and public awareness campaigns. Policymakers could also consider mandatory VOC limits for decorative paints and wider adoption of credible eco-labels, which would reward firms that invest in green innovation and reduce the advantage of non-compliant producers.

5.3. Limitations and Directions for Future Research

This study relies on secondary sources, and company sustainability reports are self-reported and not always comparable. Market estimates also vary across sources. The document analysis focused on two large firms, so the findings may not reflect practices among smaller and unorganised manufacturers. Future research could use primary data from firms, dealers and consumers to test the propositions, examine the financial effects of green product strategies, and study how the new competitive landscape affects sustainability practices among smaller firms.

VI. CONCLUSION

India's paint industry is entering a new competitive era defined by large new entrants, consolidation and margin pressure. This study shows that sustainability is becoming part of how firms compete. Regulation has set a baseline, particularly on lead, but evidence of non-compliant products reveals an enforcement gap. Leading firms have gone well beyond compliance in energy, water, products and packaging, although practices vary across firms. The proposed Sustainability–Competitiveness Pathway Framework explains how regulatory push, market pull and competitive pressure can be converted into green capabilities that create economic, environmental and social value. For an industry whose products cover homes, schools and workplaces, aligning competitive strategy with sustainability is both a business opportunity and a public responsibility.

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Building Supply Chain Resilience in India's Pharmaceutical Industry: API Import Dependence and the Production Linked Incentive Response

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Abstract

India is a leading global supplier of generic medicines, yet its pharmaceutical industry depends heavily on imported active pharmaceutical ingredients (APIs), key starting materials and drug intermediates, most of them from China. The COVID-19 pandemic exposed this vulnerability: prices of essential APIs rose sharply in early 2020, and India restricted exports of 26 APIs and formulations. This paper uses a qualitative case study design to examine how this vulnerability arose, how it was revealed by the pandemic, and how Indian policy has responded. Drawing on official trade data, parliamentary replies, government reports and the supply chain resilience literature, the study analyses the Production Linked Incentive (PLI) scheme for bulk drugs, the PLI scheme for pharmaceuticals and the Bulk Drug Parks scheme. The analysis shows that China accounted for roughly two-thirds of India's bulk drug and intermediate imports by value between 2019–20 and 2022–23. The policy response has created new domestic capacity, and by early 2026 the government reported import substitution of about Rs 2,190 crore under the bulk drug scheme, which remains modest relative to total imports. The paper proposes a Pharmaceutical Supply Chain Resilience Framework and draws implications for managers and policymakers.

Keywords: - Supply Chain Resilience, Pharmaceutical Industry, Active Pharmaceutical Ingredients, Production Linked Incentive, India

I. INTRODUCTION

India occupies a central position in global medicine supply. According to the Government of India, the country ranks third in the world in pharmaceutical production by volume and eleventh by value, supplies around 20% of global generic medicines and provides about 60% of the vaccine supplies procured by UNICEF. Pharmaceutical exports reached USD 30.5 billion in 2024–25 (Press Information Bureau [PIB], 2026). This success, however, rests on a supply chain with an important structural weakness. Over recent decades, much of the production of active pharmaceutical ingredients (APIs), key starting materials (KSMs) and drug intermediates on which Indian formulation manufacturers depend shifted to China, where scale and cost advantages made imports cheaper than domestic production (Cherian et al., 2021).

The COVID-19 pandemic exposed the risks of this concentration. As Chinese production was disrupted in early 2020, the chairman of a leading Indian pharmaceutical company reported that the price of paracetamol had risen by 40% and that of the antibiotic azithromycin by 70% in India (Medical Dialogues, 2020). On 3 March 2020, the Directorate General of Foreign Trade restricted the export of 26 APIs and formulations, including paracetamol, metronidazole and vitamins B1 and B12, to protect domestic availability (The Tribune, 2020). These events turned a long-standing industrial concern into a question of health security, and the Government of India responded with a set of industrial policy measures aimed at building domestic capacity.

The pandemic also prompted a wider re-examination of global supply chains, with researchers and practitioners questioning whether efficiency-driven, geographically concentrated sourcing leaves firms and countries too exposed (Gereffi, 2020; Shih, 2020). This paper examines the Indian pharmaceutical case through the lens of supply chain resilience. It addresses three research questions: (RQ1) How did India's pharmaceutical supply chain become dependent on imported APIs and

intermediates? (RQ2) How did the COVID-19 disruption reveal this vulnerability? (RQ3) How has policy responded, and what does the early evidence suggest about its effectiveness in building resilience?

II. LITERATURE REVIEW

2.1. Supply Chain Resilience

Supply chain resilience refers to the ability of a supply chain to prepare for unexpected events, respond to disruptions and recover by maintaining continuity of operations (Ponomarov & Holcomb, 2009). Christopher and Peck (2004) argued that resilience can be designed into supply chains through re-engineering, collaboration, agility and a risk management culture. Sheffi and Rice (2005) emphasised redundancy and flexibility as the two main ways to build resilience, noting that flexibility is often more valuable than simply holding extra inventory. Pettit et al. (2010) developed a framework that links resilience to the balance between a firm's vulnerabilities and its capabilities, warning that both too little and too much investment in capabilities can be costly. Systematic reviews have identified flexibility, redundancy, collaboration, visibility and agility as the most frequently discussed resilience elements (Hohenstein et al., 2015; Tukamuhabwa et al., 2015), and dynamic capability theory has been used to conceptualise and measure resilience as a set of organisational capabilities (Chowdhury & Quaddus, 2017).

2.2. Pandemics and Global Value Chains

The COVID-19 pandemic generated a large body of research on supply chain disruption. Ivanov (2020) used simulation to show that the timing of facility closures and openings at different stages of a supply chain can be more important for its performance than the duration of the disruption itself. Ivanov and Dolgui (2020) extended resilience thinking towards the viability of intertwined supply networks, emphasising survival under long-term disruptions. In the international business literature, Gereffi (2020) analysed the shortages of medical supplies during the pandemic and argued that they reflected both the structure of global value chains and policy choices. Miroudot (2020) cautioned against simplistic calls for reshoring, arguing that resilience depends more on risk management and diversification than on bringing all production home.

2.3. API Dependence in India

Studies of the Indian pharmaceutical industry have documented the growth of API import dependence and its risks. Cherian et al. (2021) traced how India came to depend heavily on imports of raw materials for essential medicines and proposed short-, medium- and long-term policy, fiscal and technological measures to build self-reliance. Using a general equilibrium model of the generic drug market, Lodh and Dey (2023) suggested that despite self-reliance policies, India's dependence on China could increase if it seeks to maintain its global position in generics, highlighting the cost trade-offs involved. Guerin et al. (2020) emphasised the global importance of Indian generics and the vulnerability created by their reliance on Chinese bulk drugs. Few studies, however, have evaluated the post-2020 policy response using recent official data.

III. METHODOLOGY

The study adopts a qualitative single-case study design, which is appropriate for investigating a contemporary phenomenon in depth within its real-life context, particularly when the boundaries between the phenomenon and its context are not clearly evident (Yin, 2018). The case is India's pharmaceutical supply chain for APIs, KSMs and drug intermediates, examined over the period from 2019–20 to early 2026.

The study relies on documentary evidence from multiple sources to support triangulation. These include a written reply to the Lok Sabha containing official import data compiled from the Directorate General of Commercial Intelligence and Statistics (Lok Sabha, 2023); government reports on the pharmaceutical sector and the PLI schemes (PIB, 2025, 2026); a ministerial statement to Parliament reported by the public broadcaster (All India Radio, 2026); and contemporaneous news reports of the 2020 disruption. The evidence was organised chronologically and analysed using the supply chain resilience concepts reviewed above, following a pattern-matching logic in which observed events were compared with theoretical expectations (Yin, 2018). Import shares in Table 1 were calculated by the author from the official figures.

IV. RESULTS

4.1. The Structure of Import Dependence

Official data show the scale and concentration of India's import dependence. Table 1 presents India's imports of bulk drugs and drug intermediates and the portion sourced from China. Total imports rose from Rs 24,172 crore in 2019–20 to Rs 35,249 crore in 2021–22. Throughout the period, China accounted for roughly two-thirds of imports by value and between about 61% and 66% by quantity. It is important to interpret these figures correctly. They show China's share of India's imports, not its share of India's total consumption of APIs, since the Department of Pharmaceuticals does not maintain data on domestic API production (Lok Sabha, 2023). Nonetheless, the concentration of imports in a single source country represents a significant vulnerability in resilience terms, as it limits the redundancy and flexibility that Sheffi and Rice (2005) identify as central to resilience.

Table 1. India's Imports of Bulk Drugs and Drug Intermediates and the Share Sourced from China

Year	Total Imports (Rs crore)	Imports from China (Rs crore)	China Share by Value	China Share by Quantity
2019–20	24,172	16,443	68.0%	60.6%
2020–21	28,529	19,403	68.0%	65.7%
2021–22	35,249	23,273	66.0%	66.0%
2022–23 (Apr–Nov)	27,209	18,973	69.7%	66.1%

Source: Lok Sabha (2023), based on DGCIS data. Shares calculated by the author from the reported values and quantities.

4.2. The 2020 Disruption

The events of early 2020 illustrate how this vulnerability translated into disruption. Supply interruptions from China led to sharp price increases for essential APIs (Medical Dialogues, 2020), and India's export restrictions on 26 APIs and formulations showed that the government regarded domestic availability as at risk (The Tribune, 2020). In resilience terms, the industry's lean, cost-optimised sourcing had prioritised efficiency over redundancy, and the absence of alternative sources limited its ability to respond quickly (Christopher & Peck, 2004; Pettit et al., 2010). At the same time, the crisis demonstrated the global significance of Indian supply: restrictions on Indian exports had implications for medicine availability in many other countries (Guerin et al., 2020).

4.3. The Policy Response

The government's response combined three instruments, summarised in Table 2. The PLI scheme for bulk drugs, launched on 20 March 2020 with an outlay of Rs 6,940 crore for 2020–21 to 2029–30, offers financial incentives for domestic manufacturing of 41 identified bulk drugs (PIB, 2025). By September 2025, the scheme had created capacity of 55,100 metric tonnes per year for 26 critical APIs and KSMs, with investment of Rs 4,763.34 crore and cumulative sales of Rs 2,313.16 crore (PIB, 2026). In March 2026, the Union Health Minister informed Parliament that 48 projects for 33 products had been approved, investment had reached Rs 4,814 crore, and imports of about Rs 2,190 crore had been avoided (All India Radio, 2026).

The PLI scheme for pharmaceuticals, approved in February 2021 with an outlay of Rs 15,000 crore, supports the domestic production of higher-value pharmaceutical products. By September 2025, investment under this scheme had reached Rs 40,890 crore, far exceeding the committed Rs 17,275 crore, with cumulative sales of Rs 3,16,797 crore, of which Rs 2,03,730 crore were exports (PIB, 2026). The government also reported that more than 190 APIs and drug intermediates were being manufactured in India for the first time (All India Radio, 2026). The third instrument, the Bulk Drug Parks scheme, provides financial assistance for common infrastructure in three parks in Andhra Pradesh, Gujarat and Himachal Pradesh, which were reported to be at various stages of development in early 2026 (PIB, 2026).

Table 2. Key Policy Instruments to Strengthen Domestic Pharmaceutical Supply

Instrument	Design	Reported Status
PLI scheme for bulk drugs (2020)	Rs 6,940 crore; 2020–21 to 2029–30; 41 identified bulk drugs	48 projects for 33 products; investment Rs 4,814 crore; imports avoided about Rs 2,190 crore (March 2026)
PLI scheme for pharmaceuticals (2021)	Rs 15,000 crore; higher-value pharmaceutical products; 55 selected companies	Investment Rs 40,890 crore; sales Rs 3,16,797 crore including exports of Rs 2,03,730 crore (September 2025)
Bulk Drug Parks scheme	Rs 3,000 crore; common infrastructure in three parks (Andhra Pradesh, Gujarat, Himachal Pradesh)	At various stages of development (early 2026)

Source: PIB (2025, 2026) and All India Radio (2026).

4.4. Assessing the Response

The early evidence suggests that the policy response has begun to build resilience, but on a limited scale so far. New capacity in previously imported products, such as penicillin and clavulanic acid, represents a meaningful increase in redundancy for specific critical molecules (All India Radio, 2026). However, the cumulative imports avoided under the bulk drug scheme, about Rs 2,190 crore by early 2026, are small compared with annual bulk drug and intermediate imports, which exceeded Rs 35,000 crore in 2021–22 (Lok Sabha, 2023). The response has therefore improved resilience for selected molecules rather than transforming overall dependence. This outcome is consistent with the literature's warning that reshoring is costly and slow, and that diversification and risk management may be as important as domestic production (Miroudot, 2020; Lodh & Dey, 2023).

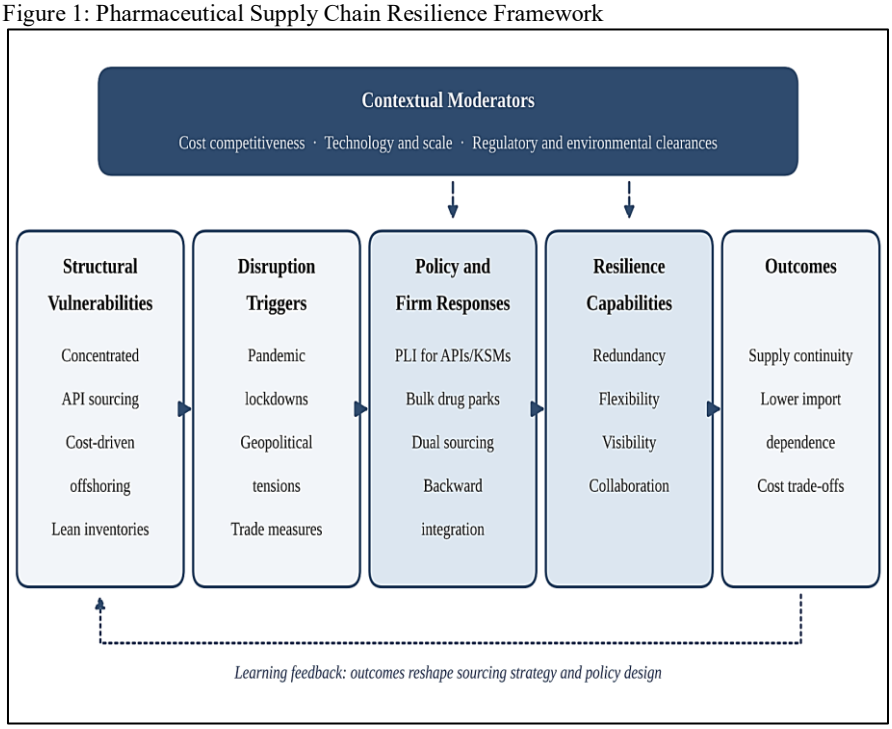
V. DISCUSSION

5.1. The Pharmaceutical Supply Chain Resilience Framework

Based on the case analysis, this paper proposes the Pharmaceutical Supply Chain Resilience Framework, shown in Figure 1. The framework begins with structural vulnerabilities, namely concentrated API sourcing, cost-driven offshoring and lean inventories. Disruption triggers, such as pandemic lockdowns, geopolitical tensions and trade measures, convert these vulnerabilities into supply shortfalls. Policy and firm responses, including production incentives, bulk drug parks, dual sourcing and backward integration, build resilience capabilities, namely redundancy, flexibility, visibility and collaboration (Christopher & Peck, 2004; Sheffi & Rice, 2005). These capabilities produce outcomes in the form of supply continuity and reduced import dependence, but also involve cost trade-offs. Contextual moderators, such as cost competitiveness, technology

and scale, and regulatory and environmental clearances, shape how effectively responses translate into capabilities. A learning feedback loop links outcomes back to sourcing strategies and policy design.

Figure 1: Pharmaceutical Supply Chain Resilience Framework



Source: Developed by the author based on the case analysis.

Four propositions follow from the framework.

- Proposition 1: Concentration of API sourcing in a single country increases the severity of supply disruptions for formulation manufacturers, regardless of their own production capabilities.
- Proposition 2: Production incentives build resilience most effectively when targeted at molecules with high import concentration and high therapeutic importance.
- Proposition 3: Firms that combine domestic sourcing with diversified international suppliers achieve greater resilience at lower cost than firms that pursue complete backward integration.
- Proposition 4: The effectiveness of production incentives depends on complementary infrastructure, such as shared effluent treatment and testing facilities, that reduces the cost disadvantage of domestic production.

5.2. Implications for Managers and Policymakers

For pharmaceutical managers, the case shows that supply chain decisions based solely on cost can create hidden risks. Firms should map their supply chains beyond the first tier to identify single-source dependencies in KSMs and intermediates, maintain strategic buffers for critical inputs, and develop qualified alternative suppliers. Where economically viable, backward integration into critical molecules can reduce exposure. For policymakers, the evidence suggests three priorities: sustaining incentive schemes long enough for new plants to reach competitive scale, accelerating the completion of bulk drug parks to provide shared infrastructure, and improving data collection on domestic API production so that progress on self-reliance can be measured accurately rather than inferred from import data alone.

5.3. Limitations and Directions for Future Research

This study relies on secondary documentary evidence, much of which is produced by government agencies, and some reported figures differ slightly between releases. It examines a single national case, which limits generalisability. Future research could use firm-level data to assess how individual companies have adjusted their sourcing strategies, evaluate the cost competitiveness of PLI-supported plants once incentives end, and compare India's approach with those of other countries seeking to diversify pharmaceutical supply chains.

VI. CONCLUSION

India's pharmaceutical industry illustrates the tension between efficiency and resilience in global supply chains. Decades of cost-driven sourcing produced a highly competitive generics industry that was nonetheless vulnerable to disruption in a single upstream supplier country. The COVID-19 pandemic made this vulnerability visible and prompted a significant policy response. Early evidence shows that the PLI schemes and related measures have created new domestic capacity and reduced dependence for selected critical molecules, but overall import dependence remains substantial. Building lasting resilience will require sustained policy support, investment in shared infrastructure and better data, combined with firm-level strategies of diversification and supply chain visibility.

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