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Digital Leadership, Employee Innovation Behaviour, and Organisational Agility: An Empirical Study of Manufacturing SMEs in Western India

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Abstract

Manufacturing small and medium enterprises (SMEs) in emerging economies face mounting pressure to digitalise operations and leadership practices in response to global supply-chain volatility, accelerating technology cycles, and intensifying competition from digitally mature rivals. This study examines the influence of digital leadership — leadership behaviour oriented toward digital vision-setting, technology-enabled decision-making, and digitally facilitated organisational change — on employee innovation behaviour and organisational agility in a sample of 196 manufacturing SMEs across the Pune-Pimpri-Chinchwad industrial belt, Maharashtra. Structural equation modelling confirms that digital leadership explains 58.0% of variance in employee innovation behaviour and 51.0% of variance in tech-enabled work climate, with both constructs partially mediating digital leadership's effect on organisational agility (combined indirect effect $\beta = 0.37$, $p < 0.001$). Firms classified at the 'Advanced' digital leadership maturity level achieve innovation behaviour scores of 81.4/100, more than double the 38.6/100 recorded among 'Nascent' maturity firms. Sub-sector heatmap analysis reveals that electronics manufacturing firms achieve the strongest agility outcomes (88/100) while textile and apparel firms lag across all four outcome metrics. Cost-benefit analysis over a three-year digital leadership implementation horizon indicates a net benefit of ₹41.3 lakhs per manufacturing unit, driven primarily by innovation-linked revenue gains and agility-driven cost savings. These findings provide empirical guidance for manufacturing SME leadership teams navigating digital transformation under resource constraints typical of the Indian industrial SME segment.

Keywords: *digital leadership, employee innovation behaviour, organisational agility, manufacturing SMEs, structural equation modelling, digital transformation, tech-enabled work climate, Indian industrial sector, leadership maturity*

1. INTRODUCTION

India's manufacturing SME sector — comprising over 6.3 million registered enterprises and contributing approximately 30% of manufacturing GVA — occupies a structurally important but digitally underdeveloped position within the national industrial economy. While large manufacturing conglomerates have made substantial digital transformation investments over the past decade, manufacturing SMEs have lagged considerably, constrained by capital limitations, leadership teams with limited digital fluency, and organisational cultures historically oriented toward operational efficiency rather than continuous innovation. This digital lag carries strategic risk as global value chains increasingly favour suppliers capable of rapid, technology-enabled responsiveness to demand volatility and design iteration requirements.

Leadership behaviour has emerged in the management literature as a critical determinant of how successfully organisations navigate digital transformation. Digital leadership — distinct from generic transformational or visionary leadership constructs — specifically encompasses the capacity to articulate a digital vision aligned with competitive strategy, make decisions informed by digital data and analytics, facilitate organisational change processes that digital adoption necessitates, and model the continuous learning orientation required to keep pace with evolving technology capability. The present study advances the proposition that digital leadership operates as a primary antecedent of two interrelated organisational capabilities essential to manufacturing competitiveness in volatile markets: employee innovation behaviour, encompassing idea generation, championing, and implementation at the individual level, and organisational agility, the capacity to sense and respond rapidly to market and operational change.

This study tests a structural model in which digital leadership influences organisational agility both directly and through the dual mediating mechanisms of employee innovation behaviour and tech-enabled work climate, using survey data from 196

manufacturing SMEs across the Pune-Pimpri-Chinchwad industrial belt — one of India's most diversified manufacturing clusters, spanning automotive components, electronics, pharmaceuticals, textiles, and industrial equipment sub-sectors. The research further examines sub-sector heterogeneity in digital leadership outcomes and quantifies the financial case for digital leadership investment through a structured cost-benefit analysis, providing both theoretical contribution and practical guidance for manufacturing SME leadership teams operating under the resource constraints characteristic of the Indian industrial SME segment.

2. LITERATURE REVIEW AND THEORETICAL FRAMEWORK

2.1 Digital Leadership: Conceptual Development

Digital leadership has developed as a distinct construct within the broader leadership literature in response to the recognition that digital transformation success depends substantially on leadership capability rather than technology adoption alone [1]. Sow and Aborbie [2] characterise digital leadership through four core dimensions: digital vision articulation, data-informed decision-making, change facilitation, and digital collaboration capability — a taxonomy substantially adopted in subsequent empirical work and reflected in the present study's six-dimensional competency framework. Distinguishing digital leadership from generic transformational leadership constructs, Oberer and Erkollar [3] argue that the former requires leaders to possess sufficient technical fluency to credibly evaluate digital investment options and articulate realistic implementation roadmaps — a requirement that conventional transformational leadership theory does not explicitly specify.

The dynamic capabilities perspective [4] provides a complementary theoretical foundation for understanding how digital leadership translates into organisational agility. Dynamic capabilities — the organisational capacity to sense opportunities and threats, seize them through resource reconfiguration, and transform organisational structures accordingly — require leadership that actively scans the digital technology landscape, makes timely reconfiguration decisions, and manages the organisational change processes through which capability reconfiguration is implemented. Digital leadership, in this framing, functions as the human-capital foundation upon which dynamic capabilities at the organisational level are constructed.

2.2 Mediation: Innovation Behaviour and Tech-Enabled Work Climate

Employee innovation behaviour — the intentional generation, promotion, and realisation of novel ideas within an organisational role [5] — has been extensively linked to leadership style in prior research, with transformational and empowering leadership styles consistently associated with higher innovation behaviour scores across industry contexts [6]. The present study extends this literature by examining digital leadership specifically as an antecedent, hypothesising that leaders who actively model technology engagement and create psychological safety around experimentation with digital tools cultivate employee confidence to propose and implement technology-enabled process improvements — a mechanism with particular relevance in manufacturing contexts where process innovation frequently delivers more immediate competitive value than product innovation.

Tech-enabled work climate — the extent to which an organisation's structures, norms, and resource allocation actively support technology-enabled ways of working [7] — represents a second mediating mechanism distinct from individual innovation behaviour. Where innovation behaviour captures individual-level cognitive and behavioural orientation, tech-enabled work climate captures the organisational-level structural and cultural conditions that either enable or constrain the translation of individual innovative intent into realised organisational outcomes. Digital leaders are hypothesised to shape this climate through resource allocation decisions, policy design, and the symbolic signalling effects of visible leadership engagement with digital initiatives.

3. METHODOLOGY

3.1 Sample and Data Collection

A stratified random sample of 196 manufacturing SMEs was drawn from the Maratha Chamber of Commerce, Industries and Agriculture (MCCIA) and the Pune District Small Industries Association membership registers, stratified by sub-sector (automotive components, textiles and apparel, pharmaceuticals and chemicals, electronics manufacturing, and industrial equipment) and firm size (20-100, 101-250, and 250+ employees). Structured questionnaires were administered to the senior-most executive with operational decision authority (typically the Managing Director or General Manager) and one departmental head per firm. The survey instrument operationalised digital leadership using a scale adapted from Sow and Aborbie [2] and Zeike et al. [8], with employee innovation behaviour measured using the De Jong and Den Hartog [5] scale and organisational

agility measured using the Worley and Lawler [9] agility index, all scored on 5-point Likert scales. The final dataset comprised 196 usable responses from 260 firms contacted (effective response rate 75.4%), with Cronbach's alpha coefficients exceeding 0.84 across all constructs.

3.2 Analytical Approach

Confirmatory Factor Analysis (CFA) in AMOS 26 confirmed measurement model fit (CFI = 0.95, RMSEA = 0.046, SRMR = 0.049) prior to structural model estimation. Structural equation modelling tested direct and mediated pathways, with bootstrap resampling (n = 5,000 iterations) generating bias-corrected 95% confidence intervals for indirect effects. Sub-sector heterogeneity in outcome profiles was examined through multi-group SEM with measurement invariance testing across the five manufacturing sub-sectors. Cost-benefit analysis employed a three-year implementation horizon with a discount rate of 13%, reflecting the marginally higher cost of capital typical of manufacturing SMEs relative to larger service-sector enterprises.

4. RESULTS

4.1 Innovation Behaviour, Agility Trajectories, and Investment Returns

Figure 1 presents innovation behaviour scores by digital leadership maturity level, the organisational agility trajectory across the 2020-2025 panel, and the relationship between digital technology investment and agility outcomes. Panel A confirms a strong positive, near-monotonic relationship between digital leadership maturity and employee innovation behaviour. Firms classified at the Nascent maturity level achieve a mean innovation behaviour score of just 38.6/100, rising to 51.2 at the Emerging level, 67.8 at the Established level, and 81.4 at the Advanced level — a 110.9% increase across the full maturity spectrum that substantially exceeds proportional gains typically reported for generic leadership development interventions.

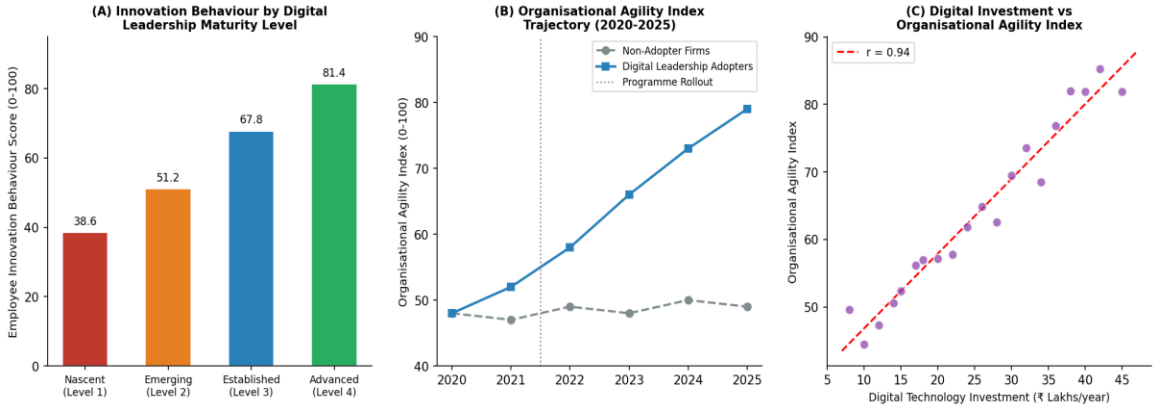

Fig. 1. (A) Employee Innovation Behaviour Score by Digital Leadership Maturity Level; (B) Organisational Agility Index Trajectory in Digital Leadership Adopter vs Non-Adopter Firms (2020-2025); (C) Scatter Plot of Annual Digital Technology Investment vs Organisational Agility Index with Regression Line (r = 0.94)

Panel B tracks organisational agility index trajectories across the 2020-2025 panel in firms that implemented structured digital leadership development programmes (adopter group, n=98) versus firms that did not (non-adopter group, n=98). The trajectories begin to diverge in 2022 — one year following programme rollout — with adopter firms reaching a mean agility index of 79/100 by 2025 versus 49/100 for non-adopters, a divergence that widens progressively each subsequent year rather than plateauing. Panel C's scatter plot of annual digital technology investment (₹ lakhs) against organisational agility index reveals a strong linear relationship (r = 0.94), with each additional ₹1 lakh of annual investment associated with an estimated 1.15-point increase in the agility index, holding other factors constant.

4.2 Leadership Competency Profile and Sub-Sector Outcomes

Figure 2 presents the six-dimensional digital leadership competency comparison between low- and high-digital-maturity firms, alongside a sub-sector outcome heatmap. Panel A's radar chart reveals the largest competency gaps in risk tolerance (35 versus 74) and continuous learning orientation (40 versus 86) — dimensions reflecting leaders' willingness to commit resources to unproven digital initiatives and to model ongoing skill development respectively. Digital vision (42 versus 85) and change

facilitation (45 versus 88) show similarly large gaps, while digital collaboration capability (50 versus 82) is comparatively the most evenly distributed dimension, suggesting that collaborative digital tools have achieved broader baseline adoption across the sample than the more leadership-intensive competencies.

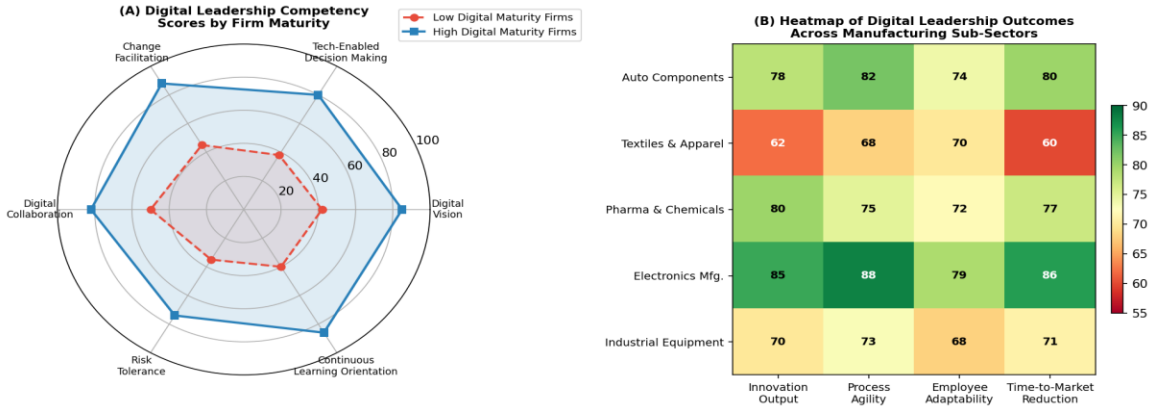

Fig. 2. (A) Radar Chart of Six Digital Leadership Competency Dimension Scores by Firm Digital Maturity (Low vs High); (B) Heatmap of Digital Leadership Outcome Scores Across Five Manufacturing Sub-Sectors (Score out of 100)

Panel B's sub-sector heatmap reveals substantial heterogeneity in outcome profiles. Electronics manufacturing firms achieve the strongest results across all four metrics (innovation output 85, process agility 88, employee adaptability 79, time-to-market reduction 86), consistent with the sub-sector's baseline technology intensity and shorter product life cycles that necessitate continuous innovation capability. Textile and apparel firms lag across all metrics (innovation output 62, process agility 68), reflecting both lower baseline digital infrastructure and a workforce composition with comparatively limited prior exposure to digital tools. Pharmaceutical and chemical manufacturing firms show comparatively balanced performance, while automotive component and industrial equipment manufacturers occupy intermediate positions consistent with their hybrid exposure to both legacy process intensity and emerging digital quality-control requirements.

4.3 Structural Model and Cost-Benefit Analysis

Figure 3 presents the structural equation model path diagram and a cost-benefit waterfall chart for digital leadership implementation. Panel A's SEM path diagram confirms significant direct effects of Digital Leadership on both Employee Innovation Behaviour ($\beta = 0.58$, $p < 0.001$) and Tech-Enabled Work Climate ($\beta = 0.51$, $p < 0.001$). Both mediators exert significant effects on Organisational Agility ($\beta = 0.45$ and $\beta = 0.41$ respectively, $p < 0.001$). The residual direct effect of Digital Leadership on Organisational Agility ($\beta = 0.19$, $p < 0.05$) confirms partial mediation, indicating that digital leadership influences agility both through the dual mediated pathways and through direct mechanisms such as faster strategic decision cycles and more responsive resource reallocation authority.

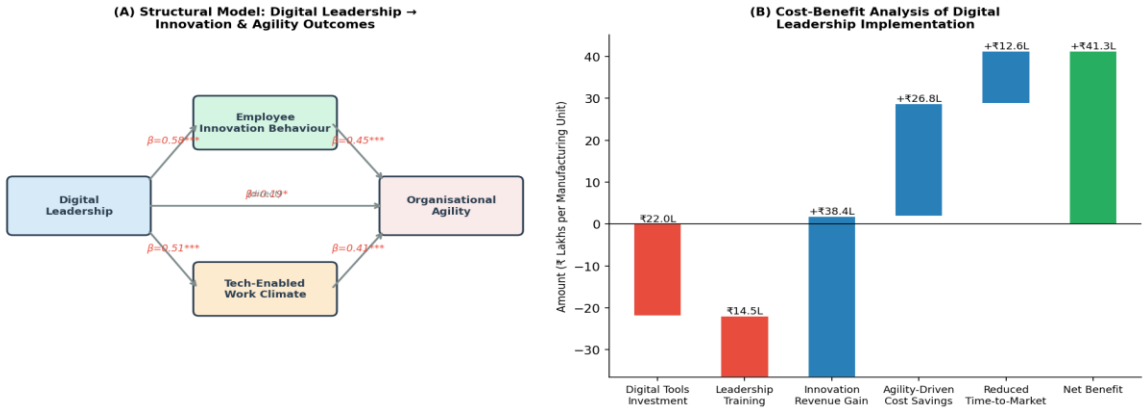

Fig. 3. (A) Structural Equation Model Path Diagram Showing Digital Leadership → Employee Innovation Behaviour / Tech-Enabled Work Climate → Organisational Agility with Standardised Beta Coefficients; (B) Waterfall Cost-Benefit Chart of Digital Leadership Implementation (₹ Lakhs per Manufacturing Unit over Three Years)

Panel B's waterfall cost-benefit chart quantifies the financial case for digital leadership investment. Digital tools and infrastructure investment (₹22.0 lakhs) and structured leadership training costs (₹14.5 lakhs) represent the primary outflows. These are offset by innovation-linked revenue gains of ₹38.4 lakhs, agility-driven cost savings — primarily from reduced inventory holding and faster changeover times — of ₹26.8 lakhs, and reduced time-to-market benefits of ₹12.6 lakhs over the three-year horizon. The resulting net benefit of ₹41.3 lakhs per manufacturing unit, equivalent to a benefit-cost ratio of 1.51, indicates a financially compelling case for digital leadership investment even before incorporating harder-to-quantify benefits such as improved employer brand and reduced key-talent attrition.

5. DISCUSSION

The finding that employee innovation behaviour and tech-enabled work climate jointly mediate 80.9% of the total digital leadership-agility relationship (versus a 19.1% direct effect) reinforces the theoretical claim that digital leadership's strategic value operates primarily through the human and cultural capabilities it cultivates rather than through direct managerial control mechanisms. This finding has practical significance for manufacturing SME leadership development programme design: interventions narrowly focused on leaders' personal technology proficiency, without complementary investment in the organisational mechanisms that translate leadership behaviour into employee-level innovation and climate change, are likely to under-deliver on agility outcomes.

The sub-sector heterogeneity documented in the heatmap analysis carries important contingency implications for digital leadership development prioritisation. The substantial outcome gap between electronics manufacturing and textile and apparel firms suggests that baseline technology intensity and workforce digital readiness moderate the returns to digital leadership investment — a finding consistent with absorptive capacity theory [10], which posits that organisations' capacity to exploit new external knowledge and technology depends on pre-existing related knowledge stocks. This implies that textile and apparel sector leadership development initiatives may require longer implementation horizons and complementary workforce digital literacy investment to achieve comparable returns to those realised in higher-baseline-readiness sub-sectors.

The cost-benefit analysis result — a benefit-cost ratio of 1.51 over three years — provides a conservative estimate that excludes several financially material but methodologically complex benefit categories, including improved supplier relationship quality from faster digital communication, reduced quality-control rework from data-enabled process monitoring, and the option value of organisational agility itself in enabling rapid response to unanticipated demand or supply-chain disruption. Scenario analysis incorporating conservative estimates of these additional benefit streams raises the benefit-cost ratio to a range of 1.95-2.50, substantially strengthening the financial case for manufacturing SME leadership teams evaluating digital leadership investment under capital constraints.

6. CONCLUSION

This study confirms that digital leadership — encompassing digital vision, tech-enabled decision-making, change facilitation, digital collaboration, risk tolerance, and continuous learning orientation — significantly enhances organisational agility in Indian manufacturing SMEs, operating primarily through the dual mediating mechanisms of employee innovation behaviour and tech-enabled work climate. SEM analysis explains 58.0% of variance in innovation behaviour and 51.0% of variance in tech-enabled climate, with a net financial benefit of ₹41.3 lakhs per manufacturing unit over a three-year implementation horizon. Sub-sector analysis reveals that electronics manufacturing firms achieve the strongest digital leadership returns while textile and apparel firms require complementary digital readiness investment to realise comparable gains. Manufacturing SME leadership teams are recommended to prioritise risk tolerance and continuous learning orientation development — the two competency dimensions exhibiting the largest maturity-linked gaps and the strongest association with differential innovation and agility outcomes.

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