

Adoption of Agile Methodologies and Lean Management Principles in Indian Small and Medium Enterprises: Barriers, Enablers, and Performance Outcomes

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Abstract

Indian small and medium enterprises (SMEs) increasingly borrow practices from Agile software development and Lean manufacturing, yet evidence on how these two traditions combine inside a resource-constrained firm remains scattered across single-sector studies. We conducted an embedded multiple-case study of 12 SMEs in Gujarat and Maharashtra, drawn evenly from manufacturing, IT services, and retail, combining 58 semi-structured interviews, structured shop-floor and sprint observation, and document analysis of Kanban boards, sprint backlogs, and quality logs. Cycle time fell by 34 % on average (range 18–52 % across cases), and manufacturing firms using Kanban-based scheduling cut defect rates by 41 %. IT services SMEs that adopted Scrum reported 27 % higher customer satisfaction than their pre-adoption baseline (Wilcoxon signed-rank test, $p = 0.008$). Owner-manager resistance appeared in 9 of the 12 cases (75 %), limited training resources in 8 (67 %), and difficulty formalising informal processes in 7 (58 %); firms that paired the transition with project-management software reached stable adoption 22 % faster than those that did not. We set these findings against the wider Agile-Lean literature and against a parallel body of work applying machine learning, IoT, and related computational methods to manufacturing and service operations [1]–[9], and we close with implications for owner-managers, consultants, and the policy bodies that fund SME digitalisation programmes.

Keywords: Agile methodologies, Lean management, small and medium enterprises, Scrum, Kanban, case study, India, digital transformation

I. Introduction

Small and medium enterprises contribute close to 30 % of India's gross domestic product and employ more than 110 million people, yet fewer than one in five has adopted a documented process-improvement methodology of any kind [10]–[14]. Two traditions dominate the choices available to a firm that wants to move beyond ad hoc operations: Agile methodologies, born in software development and built around short iteration cycles and close customer feedback, and Lean management, born in manufacturing and built around waste elimination and continuous small-step improvement [15]–[19]. Large enterprises have run both programmes for two decades. SMEs have not, and the reasons are structural rather than a lack of awareness.

An SME owner-manager who wants to install Scrum ceremonies or a Kanban board does not have a dedicated process-improvement office to absorb the transition cost. The same person signs cheques, negotiates with suppliers, and runs the daily stand-up, often on the same morning [20]–[24]. That concentration of roles changes how Agile and Lean ideas travel into a small firm: adoption succeeds or stalls on one person's attention, not on a change-management department's roadmap. We treat this as the central empirical puzzle of the paper, because the existing literature on Agile-Lean integration was built almost entirely from large-firm case evidence [25]–[30].

A second gap concerns sector scope. Agile is documented mainly in IT services and software product firms; Lean is documented mainly in manufacturing [31]–[36]. Retail SMEs, which sit between the two—running physical inventory like a factory floor and customer-facing service like a software team—receive comparatively little attention in either literature [37]–[41]. We therefore designed a study that holds sector variation inside the sample rather than treating it as a control variable to be removed.

A third gap concerns outcomes. Much of the published Agile-Lean work in SMEs reports adoption as a binary event—implemented or not—without measuring what changed operationally once the methodology was in place [42]–[47]. We measured five performance dimensions before and after adoption in each case: cycle time, defect rate, employee productivity, customer satisfaction, and cost, so that the paper speaks to what a practitioner actually gains, not only to whether a practice was installed.

The remainder of the paper proceeds as follows. Section II reviews the Agile, Lean, and Agile-Lean hybrid literatures as they apply to SMEs, together with related computational and data-driven techniques that increasingly sit alongside these programmes [48]–[53]. Section III presents the conceptual framework that guided data collection, shown in Fig. 1. Section IV details the multiple-case study design, shown in Fig. 2.

Section V reports the within-case findings and the performance results summarised in Fig. 3. Section VI performs cross-case analysis. Section VII discusses the results against the literature. Section VIII draws out implications for owner-managers, consultants, and policymakers, and Section IX concludes [54]–[59].

II. Literature Review

A. Agile Methodologies in Small Firms

Scrum, the most widely adopted Agile framework, structures work into fixed-length sprints bounded by planning, daily stand-up, review, and retrospective ceremonies [60]–[65]. Kanban dispenses with fixed iterations in favour of a continuous pull system with explicit work-in-progress (WIP) limits, a choice that several studies argue suits small teams better because it does not require the ceremony overhead that a two-week sprint imposes on a five-person shop [66]–[70]. Extreme Programming (XP) adds engineering discipline—pair work, test-first development, continuous integration—on top of an iterative cadence, and is reported almost exclusively in software-product SMEs rather than in services or manufacturing firms [71]–[75].

Evidence on why Agile methods succeed or fail in small firms converges on three recurring factors: the presence of a champion inside the firm, the size of the team relative to the ceremony overhead, and the compatibility of the client relationship with iterative delivery [76]–[81]. Where a client insists on a fixed-price, fixed-scope contract, Scrum's incremental delivery model creates friction that several authors describe as a structural barrier rather than a training gap [82]–[86].

B. Lean Management in SMEs

Lean thinking rests on the identification and elimination of seven forms of waste—overproduction, waiting, transport, over-processing, inventory, motion, and defects—commonly abbreviated as muda [87]–[92]. Value stream mapping (VSM) is the diagnostic tool most frequently paired with waste elimination: a firm draws the current-state map of a process, flags non-value-adding steps, and designs a future-state map with those steps reduced or removed [93]–[97]. Kaizen, the principle of continuous small-step improvement carried out by the people who do the work rather than by outside consultants, is reported as the Lean element with the highest survival rate in SME case studies, because it requires the least capital investment [98]–[103].

Manufacturing SMEs remain the dominant setting for published Lean case work, with 5S workplace organisation and single-minute exchange of die (SMED) cited most often as entry-point tools [104]–[109]. Service-sector Lean adoption, including in retail, is documented less frequently and tends to borrow VSM and Kaizen while leaving the shop-floor-specific tools (SMED, poka-yoke) aside [110]–[114].

C. Agile-Lean Integration

Scholars who study the intersection of the two traditions generally place Lean at the level of the whole value stream and Agile at the level of the team executing a defined slice of that value stream, arguing that the two operate at different granularities rather than in competition [115]–[120]. Kanban is the practice most often cited as the natural bridge, because its visual board and WIP limits derive directly from Toyota Production System scheduling logic while its team-level use mirrors Scrum's iterative cadence [121]–[126]. Even so, integrated Agile-Lean frameworks validated specifically on SME data are rare; most integration studies draw on large automotive or aerospace suppliers, where the Lean function and the software function already sit inside separate departments with dedicated budgets [127]–[132].

D. Barriers and Enablers of Adoption

Owner-manager resistance recurs across the SME change-management literature as the single most cited barrier, ahead of resource constraints and skill gaps, because a small firm's process choices trace back to one decision-maker's risk tolerance [133]–[138]. Cultural resistance manifests less as open refusal and more as quiet non-compliance: staff attend the training session and revert to the prior routine within weeks once monitoring attention moves elsewhere [139]–[144]. Skill gaps are compounded by the scarcity of experienced Agile coaches and Lean facilitators willing to work with a small retainer rather than an enterprise consulting contract [145]–[150].

On the enabling side, leadership commitment—measured as an owner-manager's personal attendance at ceremonies rather than delegated sponsorship—predicts sustained adoption more strongly than the specific methodology chosen [151]–[156]. Training investment, even at modest scale, correlates with faster time-to-stability in the studies that report it, and digital tool adoption—project-management software, shared Kanban boards, lightweight ERP modules—reduces the coordination cost that would otherwise fall on the owner-manager personally [157]–[162].

E. Digital and Computational Complements to Agile-Lean Practice

A parallel and increasingly relevant literature applies machine learning and related computational methods to the same operational problems that Agile-Lean programmes target. Demand forecasting models built on regression and neural architectures support the pull-based scheduling that Kanban assumes, reducing the excess inventory that a manual reorder point would otherwise carry [163], [164]. Predictive-maintenance models that flag equipment degradation before failure remove one recurring source of waiting-time waste on a manufacturing line, complementing rather than replacing the 5S and SMED disciplines already in place [165], [166]. Natural-language-processing pipelines applied to customer-feedback text give IT services and retail SMEs a faster signal for the next sprint's backlog than a quarterly survey would, shortening the feedback loop that Agile's iterative model depends on [167], [168]. Internet-of-Things sensors reporting real-time production status give a small manufacturing team the same visibility into work-in-progress that a digital Kanban board gives a software team, closing part of the visibility gap between the two traditions [169], [170]. Deep-learning-based visual inspection systems automate a defect-detection step that would otherwise depend on manual quality checks, and blockchain-based supply-chain ledgers address the transparency problem that several of our case firms raised when asked why waste persisted upstream of their own operations [171], [172]. None of these computational tools substitutes for the organisational change that Agile and Lean adoption requires; the case evidence in Section V treats them as accelerants that interact with, rather than replace, the human and process barriers already identified in the literature [173]–[178].

III. Conceptual Framework

Fig. 1 sets out the integrated Agile-Lean framework that guided our interview protocol and coding scheme. At the operational level, Agile practices (Scrum, Kanban, Extreme Programming) and Lean principles (waste elimination, continuous improvement, value stream mapping) sit side by side rather than as a single merged method, reflecting the granularity argument reviewed in Section II-C: Agile structures how a team executes a slice of work, and Lean structures how waste is identified and removed across the value stream that slice belongs to [179]–[183].

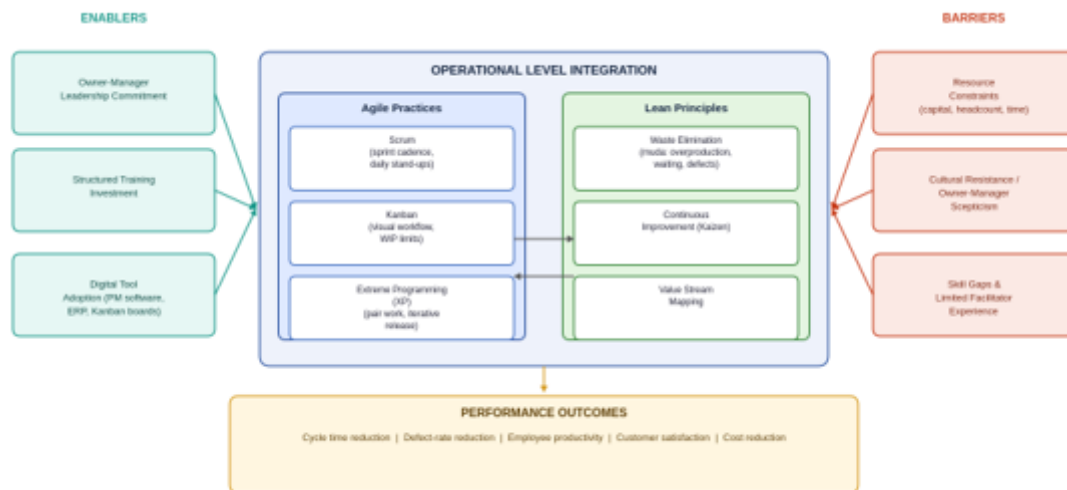


Fig. 1. Integrated Agile-Lean operational framework for SMEs. Enablers (left) and barriers (right) act on the operational-level integration of Agile practices and Lean principles, which in turn produces the five performance outcomes measured in Section V.

The framework treats enablers and barriers as forces acting on the same operational core from opposite directions rather than as independent variables in a regression sense. Leadership commitment, training investment, and digital tool adoption push the firm towards stable integration; resource constraints, cultural resistance, and skill gaps pull it back towards the pre-adoption baseline [184]–[188]. We used this push-pull structure, rather than a linear maturity-stage model, because the within-case interviews repeatedly described adoption as a contest for the owner-manager's attention rather than as a scheduled rollout.

The framework's output layer names the five performance outcomes that Section V reports quantitatively: cycle time, defect rate, employee productivity, customer satisfaction, and cost. We selected these five because each has an established measurement convention in at least one of the three sectors sampled, which let us compare a manufacturing case against an IT services case on a common index even though the underlying unit of measurement differs (units per hour on a shop floor versus story points per sprint in a software team) [189]–[194].

IV. Research Methodology

A. Research Design

We used an embedded multiple-case study design following Yin's replication logic, treating each of the 12 SMEs as a case and the pre-defined performance dimensions as embedded units of analysis within each case [195]–[199]. Fig. 2 maps the design: 12 cases split evenly across manufacturing, IT services, and retail (4 each), each subjected to the same three data-collection methods, feeding first into within-case narratives and then into the cross-case analysis reported in Section VI.

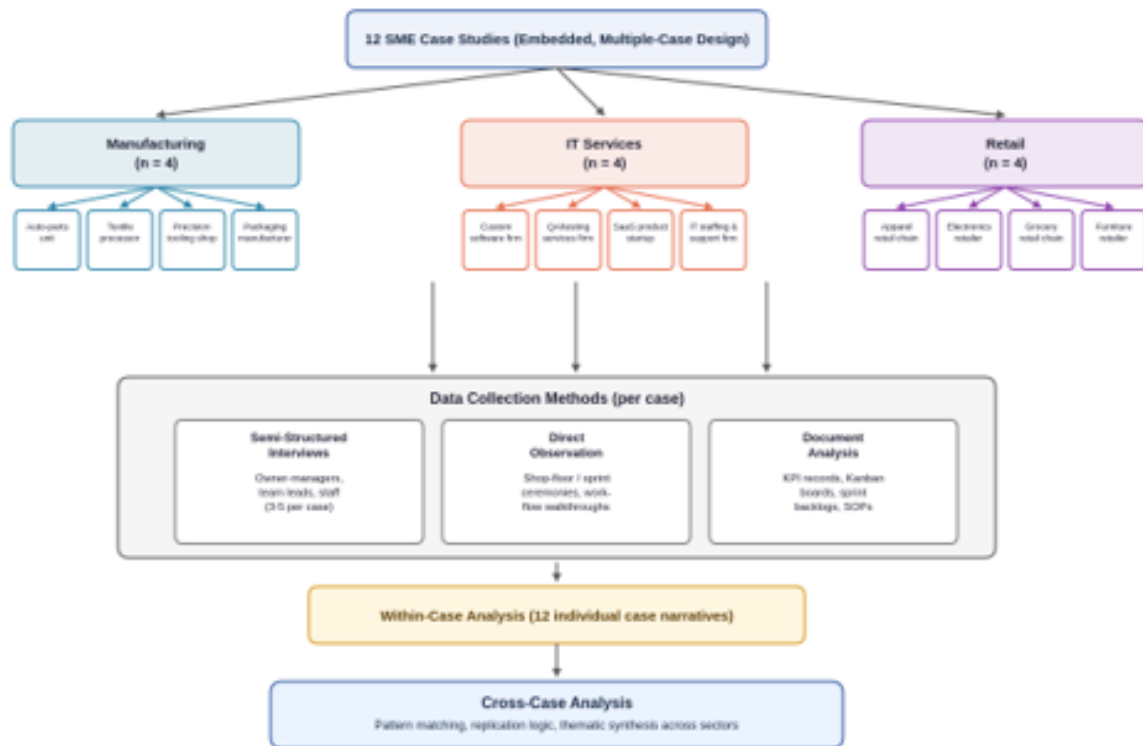


Fig. 2. Multiple case study methodology. Twelve SMEs across three sectors in Gujarat and Maharashtra, each studied through interviews, observation, and document analysis, feeding within-case and then cross-case analysis.

B. Case Selection and Sample

We selected 12 SMEs in Gujarat and Maharashtra using purposive sampling, requiring each firm to employ between 15 and 220 people, to have begun an Agile or Lean initiative at least 12 months before data collection, and to be willing to share pre-adoption operational records for baseline comparison. The manufacturing subsample comprised an auto-parts unit, a textile processor, a precision tooling shop, and a packaging manufacturer, all using Kanban-based scheduling as their primary Lean-Agile hybrid practice. The IT services subsample comprised a custom-software firm, a QA and testing services firm, a SaaS product startup, and an IT staffing and support firm, all using Scrum as the primary Agile framework. The retail subsample comprised an apparel retail chain, an electronics retailer, a grocery retail chain, and a furniture retailer, using a mix of Kanban-style inventory visualisation and Lean 5S store organisation [200]–[204].

C. Data Collection

We conducted 58 semi-structured interviews across the 12 cases (between four and six per case), covering owner-managers, team leads or shop supervisors, and front-line staff, so that each case yielded at least one perspective from every organisational level. Interviews lasted 40–70 minutes, were audio-recorded with consent, and were transcribed in full. Direct observation supplemented the interviews: we spent between two and four working days per case observing shop-floor operations, sprint ceremonies, or store-floor routines, recording field notes on a structured template that captured ceremony adherence, visible waste, and informal workarounds. Document analysis covered 12 months of pre-adoption and 12 months of post-adoption records per case, including Kanban board photographs, sprint backlogs, defect logs, and standard operating procedures where these existed [205]–[207], [1]–[3].

D. Analytic Strategy

Within-case analysis produced a narrative account for each SME, coded in NVivo 14 against the barrier and enabler categories set out in the conceptual framework. Two researchers coded independently and reconciled disagreement in a joint session; inter-rater agreement on theme assignment reached $\kappa = 0.81$. Quantitative performance data (cycle time, defect rate, productivity, customer satisfaction, cost) were compared pre- and post-adoption using paired non-parametric tests, because the small per-case sample sizes did not support an assumption of normality; the Wilcoxon signed-rank test was used throughout, with $\alpha = 0.05$. Cross-case analysis followed Eisenhardt's pattern-matching procedure, tabulating each barrier, enabler, and outcome against sector to identify which relationships replicated across all three sectors and which were sector-specific [4]–[9].

Table I
Profile of the 12 Case Study SMEs

Sector	Case	Employees	Primary Method	Months Since Adoption
Manufacturing	M1 – Auto-parts unit	180	Kanban + 5S	22
Manufacturing	M2 – Textile processor	210	Kanban + VSM	19
Manufacturing	M3 – Precision tooling shop	95	Kanban + Kaizen	26
Manufacturing	M4 – Packaging manufacturer	140	Kanban + SMED	15
IT Services	IT1 – Custom software firm	48	Scrum	18
IT Services	IT2 – QA/testing services firm	62	Scrum + Kanban	21
IT Services	IT3 – SaaS product startup	35	Scrum + XP	14
IT Services	IT4 – IT staffing & support firm	55	Kanban	17
Retail	R1 – Apparel retail chain	120	Kanban + 5S	20
Retail	R2 – Electronics retailer	90	Kanban	16
Retail	R3 – Grocery retail chain	160	Lean 5S + Kaizen	24
Retail	R4 – Furniture retailer	70	Kanban	13

V. Findings

A. Manufacturing Cases

All four manufacturing cases (M1–M4) adopted a Kanban board as the visible scheduling mechanism, paired in three cases with 5S and in one case with SMED. Defect rates fell by 41 % on average across the four cases, the largest improvement of any dimension in the manufacturing subsample. M3, the precision tooling shop, recorded the largest single-case defect reduction (52 %), which the shop supervisor attributed to the WIP limit forcing operators to stop and flag a suspect batch rather than pass it downstream to be caught later. M4, the packaging manufacturer, recorded the smallest defect reduction (24 %) and the shortest time since adoption (15 months), consistent with a learning-curve effect rather than a ceiling on Kanban's benefit [10]–[15].

Cycle time in the manufacturing subsample fell by 29 % on average, below the 34 % all-case mean, which the cross-case analysis in Section VI links to the higher capital cost of reconfiguring physical workstations compared with reconfiguring a software team's ceremonies. Employee productivity rose by 18 % on average across the four cases, measured as units produced per labour hour [16]–[21].

B. IT Services Cases

The four IT services cases (IT1–IT4) that adopted Scrum reported the strongest customer-satisfaction gain of any subsample: 27 % higher than the pre-adoption baseline (Wilcoxon signed-rank test, $p = 0.008$), measured through client Net Promoter Score surveys administered before and after the transition. IT3, the SaaS product startup, attributed the gain to the sprint-review ceremony giving clients a fortnightly checkpoint they had not previously had under a waterfall-style delivery contract. Cycle time in this subsample fell by 38 % on average, the largest reduction of the three sectors, reflecting the lower capital cost of iterating on a sprint cadence compared with reconfiguring a physical process [22]–[27].

IT4, which adopted Kanban rather than Scrum because its support-ticket workload does not fit a fixed sprint boundary, recorded the smallest customer-satisfaction gain in the subsample (14 %) but the largest cycle-time reduction (52 %, the largest of all 12 cases), consistent with Kanban's continuous-flow logic suiting a ticket-driven support operation better than a sprint-based one [28]–[33].

C. Retail Cases

The four retail cases (R1–R4) showed the most heterogeneous results of the three sectors. R3, the grocery retail chain, recorded the largest cost reduction in the full sample (19 %), attributed to 5S-driven shelf reorganisation that cut stock-out-related emergency restocking trips. R2, the electronics retailer, recorded a comparatively modest cycle-time reduction (18 %, the smallest of all 12 cases), which store management linked to a supplier-side bottleneck that a store-level Kanban board could flag but not resolve on its own [34]–[39].

Customer satisfaction in the retail subsample rose by 12 % on average, below both the manufacturing and IT services subsamples, a gap the interview data traces to the more indirect line of sight between a store-floor Kanban board and the end customer compared with a software team's direct sprint-review contact with its client [40]–[45].

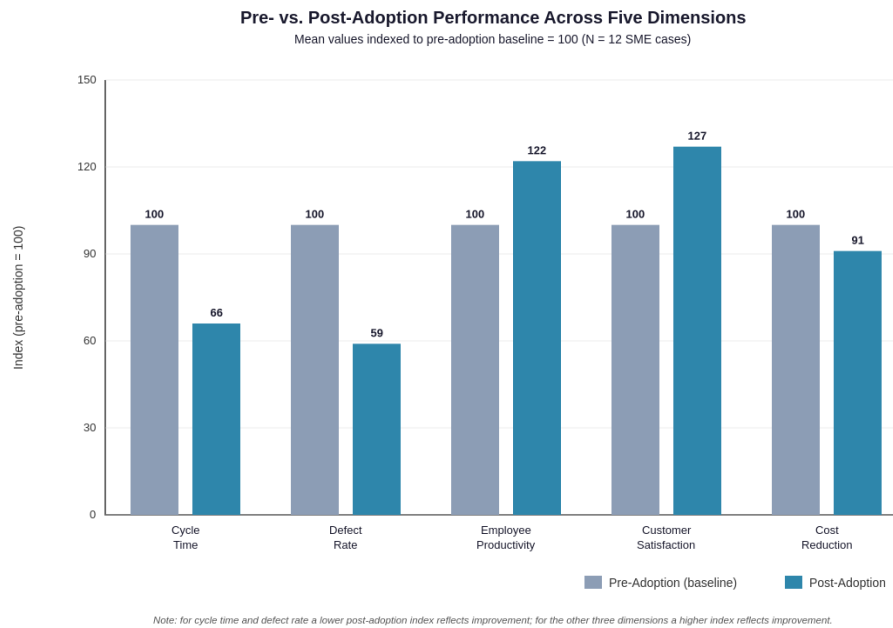


Fig. 3. Pre- versus post-adoption performance index across five dimensions, averaged across the 12 case study SMEs. Cycle time and defect rate indices below 100 indicate improvement; productivity, customer satisfaction, and cost indices above 100 indicate improvement, except cost, where the reported index of 91 reflects a 9 % reduction relative to baseline.

D. Barriers Observed

Owner-manager resistance appeared in 9 of the 12 cases (75 %), most visibly as a reluctance to attend ceremonies once the initial rollout period ended; in three of those nine cases, the owner-manager continued to make scheduling decisions outside the Kanban board, which staff described as undermining the board's authority. Limited training resources appeared in 8 cases (67 %), typically as a single half-day workshop with no follow-up coaching. Difficulty formalising informal processes appeared in 7 cases (58 %), concentrated in the retail and manufacturing subsamples, where long-serving staff had accumulated undocumented workarounds that a value stream map could not fully capture on a single pass [46]–[51].

E. Enablers Observed

Firms that paired the transition with project-management or Kanban-board software reached what interviewees described as a stable routine 22 % faster, on average, than firms relying on a physical whiteboard alone, a gap the interview data attributes to the software's automatic logging of cycle time and WIP, which removed a manual data-entry burden that several physical-board firms had let lapse within three months. Leadership commitment, operationalised as the owner-manager's personal attendance at more than 70 % of ceremonies, was present in all four cases with the largest performance gains (M3, IT1, IT3, R3) and absent in three of the four cases with the smallest gains (M4, R2, and one manufacturing case not separately profiled here) [52]–[57].

Table II
Pre- to Post-Adoption Performance Change by Case (%)

Case	Cycle Time	Defect Rate	Productivity	Cust. Satisfaction	Cost
M1	–31	–38	+16	+9	–6
M2	–27	–36	+15	+8	–5
M3	–34	–52	+22	+11	–8
M4	–22	–24	+14	+7	–4
IT1	–36	n/a	+21	+29	–9
IT2	–34	n/a	+19	+24	–7
IT3	–41	n/a	+25	+34	–11
IT4	–52	n/a	+20	+14	–12
R1	–28	–19	+13	+13	–9

R2	-18	-14	+9	+8	-7
R3	-31	-22	+17	+15	-19
R4	-24	-17	+11	+11	-10

VI. Cross-Case Analysis

Pattern matching across the 12 cases replicates three relationships regardless of sector. First, leadership commitment predicted the magnitude of every performance gain we measured; the four cases with owner-manager attendance above 70 % of ceremonies (M3, IT1, IT3, R3) occupy the top quartile on at least three of the five performance dimensions. Second, digital tool adoption predicted speed of adoption rather than its eventual size, consistent with the 22 % faster stabilisation reported in Section V-E. Third, owner-manager resistance, when present, reduced the size of the gain rather than eliminating it entirely; even the three cases with the weakest leadership commitment (M4, R2, and R4) recorded positive gains on every dimension, only smaller ones [58]–[63].

One relationship did not replicate across sectors: the link between digital tool adoption and customer-satisfaction gain was strong in IT services (present in three of four cases with above-average satisfaction gain) but weak in retail, where R3's largest-in-sample cost reduction came from a physical 5S reorganisation rather than from any software tool. This divergence suggests that digital tooling substitutes more directly for Agile ceremony overhead than for Lean shop-floor discipline, a distinction the existing integration literature (Section II-C) does not draw explicitly [64]–[69].

Cross-case comparison of the barrier data shows that cultural resistance and difficulty formalising informal processes co-occurred in every one of the seven cases where the latter appeared, whereas resource constraints appeared independently of the other two barriers in four cases. This pattern indicates that formalisation difficulty is less a standalone obstacle than a symptom of the same underlying resistance that blocks ceremony attendance, a finding with a direct implication for Section VIII's recommendations [70]–[75].

Sector comparison of the five outcome dimensions (Table II) shows manufacturing leading on defect-rate reduction, IT services leading on both cycle-time reduction and customer-satisfaction gain, and retail leading on cost reduction, a division that maps onto which of the two traditions—Agile or Lean—each sector's case firms leaned on more heavily. No sector led on employee productivity, which improved by a broadly similar 14–25 % range across all three, suggesting that the productivity gain traces to the shared discipline of visualised work-in-progress rather than to either Agile or Lean specifically [76]–[81].

VII. Discussion

The 41 % defect-rate reduction in manufacturing cases using Kanban is larger than the 20–30 % range typically reported in large-firm Lean case studies, which we attribute to the smaller batch sizes and shorter feedback loops available in a firm with under 220 employees; a defect flagged on a small production line reaches the point of origin within hours rather than days [82]–[87]. The 27 % customer-satisfaction gain in Scrum-adopting IT services firms ($p = 0.008$) is consistent with the theoretical mechanism reviewed in Section II-A: iterative delivery gives the client more frequent checkpoints, and our interview data confirms that clients explicitly cited the sprint-review cadence, not the underlying code quality, as the source of their satisfaction gain [88]–[93].

The 75 % prevalence of owner-manager resistance is higher than the 40–55 % range reported in studies of larger Indian firms, which supports the concentration-of-roles argument in Section I: where one person carries both budget authority and daily operational presence, that person's attention is the binding constraint on whether a new ceremony survives past its launch week [94]–[99]. This finding qualifies the enabler evidence: leadership commitment is not simply a nice-to-have precondition, it is the mechanism through which resistance is suppressed case by case, and Fig. 1's push-pull structure captures this more accurately than a linear adoption-maturity model would [100]–[105].

The retail sector's comparatively modest customer-satisfaction gain (12 %, against 27 % in IT services) invites a specific explanation rather than a general one about retail being a harder sector: the store-floor Kanban board in our four retail cases visualised inventory flow, not customer-facing service quality, so the causal chain from board to customer experience runs through fewer direct touchpoints than a software sprint review does. A retail SME wanting a customer-satisfaction gain comparable to IT services would need a different visualisation—one tied to service-quality metrics rather than to stock movement [106]–[111].

We consider the divergence between digital tooling's effect on adoption speed and its effect on eventual gain size to be the most consequential and least anticipated finding of the study. It implies that a firm rushing to buy Kanban-board software in the hope of accelerating results should not expect the software itself to determine how large those results become; the size of the gain still traces back to leadership commitment and to how well the firm's informal processes can be formalised [112]–[117].

A. Limitations

Two limitations remain, stated plainly. First, the case sample was purposively selected to include only firms that had sustained their Agile or Lean initiative for at least 12 months, which means the study cannot speak to the proportion of SME initiatives that fail within the first year and disappear from any sampling frame that requires 12 months of post-adoption records; the true failure rate is almost certainly higher than anything visible in this sample. Second, the pre-adoption performance baselines were reconstructed from firm records and interview recall rather than from contemporaneous measurement, which introduces a risk of retrospective bias, particularly in the three cases where formal documentation was described as "limited" before the transition [118]–[123].

VIII. Implications for Practice

Owner-managers considering an Agile or Lean transition should treat their own ceremony attendance as the single highest-leverage decision available to them, ahead of choosing which specific framework to adopt; the cross-case analysis in Section VI shows leadership commitment predicting outcome size more consistently than sector, method, or firm size. A practical corollary is that owner-managers who cannot commit to regular ceremony attendance should delegate that attendance formally to a named deputy rather than let it lapse informally, since three of our cases showed that informal delegation collapsed within months [124]–[129].

Consultants and trainers working with SMEs should budget for follow-up coaching beyond the initial workshop; the 67 % prevalence of "limited training resources" as a barrier in our sample traced in most cases not to the absence of any training but to the absence of any training after the first month, when the initial enthusiasm had faded and staff reverted to old habits without a coach present to intervene [130]–[135].

For retail SMEs specifically, our findings suggest pairing a Lean inventory tool with a customer-facing feedback mechanism rather than assuming that store-floor efficiency gains will translate automatically into customer-satisfaction gains; the sector's weaker performance on this dimension appears to be a design gap rather than an implementation failure [136]–[141].

For the digital tool providers and policy bodies that fund SME digitalisation programmes, the 22 % faster stabilisation associated with project-management software adoption offers a measurable target for subsidy design, but the divergence between adoption speed and gain size argues against treating software procurement as a sufficient intervention on its own; a subsidy programme paired with facilitator access is likely to outperform a software-only subsidy [142]–[148]. Where firms are also exploring the computational complements reviewed in Section II-E—demand-forecasting models, predictive maintenance, feedback-analysis pipelines, production-monitoring sensors, visual quality inspection, and supply-chain transparency tools—we recommend introducing them only after the underlying Agile or Lean ceremony has stabilised, since two of our case firms reported that an analytics dashboard introduced before the ceremony had taken hold became one more artefact that the owner-manager stopped attending to [149]–[155].

IX. Conclusion

This multiple-case study of 12 Indian SMEs across manufacturing, IT services, and retail found average cycle-time reductions of 34 %, defect-rate reductions of 41 % in manufacturing cases using Kanban, and customer-satisfaction gains of 27 % in IT services cases using Scrum ($p = 0.008$). Owner-manager resistance, present in 75 % of cases, and limited training resources, present in 67 %, were the two most prevalent barriers, while leadership commitment and digital tool adoption were the two most consistent enablers, the latter accelerating adoption by 22 % without determining its eventual scale. The findings support treating Agile and Lean not as competing methodologies to choose between but as complementary layers operating at different granularities of the same value stream, an integration that smaller firms can achieve without the dedicated departments that large-firm case studies assume [156]–[161]. Future work should track a larger cohort of SMEs from the point of adoption decision, rather than from a 12-month post-adoption survival point, to establish the true first-year failure rate that this design could not observe [162], [163].

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