



Digital Transformation and Business Performance of Laundry Service Enterprises in Delhi NCR: An Analysis of Online Platform Adoption, Operational Efficiency, Revenue Growth, and Customer Retention

¹*Pritam Sagar and ²Dr.Shivam Agarwal

¹Phd Research Scholar (Management) Faculty of Management Studies and Commerce,

HRIT University Ghaziabad Uttar Pradesh India

²Professor (Management) Faculty of Management Studies and Commerce,

HRIT University Ghaziabad Uttar Pradesh India

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Abstract

Background: Digital channels are increasingly used to integrate ordering, payment, delivery, and customer communication by service businesses. However, evidence connecting these channels to multidimensional outcomes in the urban laundry service is inadequate. The aim of this study was to create a connected approach to adopt online platforms and improve operational efficiency and revenue, and enhance customer retention in the Delhi National Capital Region (NCR). The method of this study was to design and demonstrate a reproducible analytical model with a 200-enterprise illustrative cross-sectional dataset, representative of Delhi, Gurugram, Noida, Ghaziabad and Faridabad. This study used descriptive analysis, correlation, regression, comparison and nonparametric bootstrap mediation analyses. Results showed that the average adoption of the online platform was 3.20/5, average operational efficiency was 65.89/100, average revenue growth was 17.81% and average customer retention was 67.69%. The adjusted regression equation showed that for every unit increase in the adoption of the online platform, the operational efficiency of the enterprise increased by 4.82. The indirect association of the online platform with customer retention, through efficiency, was 1.37 percentage points (95% bootstrap interval 0.39 to 2.40). Controlled direct associations of the online

platform with revenue and retention were not statistically meaningful at 5%. The findings of this study show that there is a statistically meaningful association of the online platform with customer retention and efficiency in the context of delivery service enterprises and this may differ for other enterprises. This study describes a design that can be replicated in similar contexts. The findings of this study are methodological, not field estimates, and should be replicated using actual enterprise data.

Keywords: digital transformation; laundry services; Delhi NCR; online platforms; operational efficiency; enterprise revenue; customer retention

1. Introduction

Digital channels are increasingly used to integrate ordering, payment, delivery, and customer communication by service businesses. However, evidence connecting these channels to multidimensional outcomes in the urban laundry service is inadequate. The aim of this study was to create a connected approach to adopt online platforms and improve operational efficiency and revenue, and enhance customer retention in the Delhi National Capital Region (NCR). The method of this study was to design and demonstrate a reproducible analytical model with a 200-enterprise illustrative cross-sectional dataset, representative of Delhi, Gurugram, Noida, Ghaziabad and Faridabad. This study used descriptive analysis, correlation, regression, comparison and nonparametric bootstrap mediation analyses. Results showed that the average adoption of the online platform was 3.20/5, average operational efficiency was 65.89/100,



average revenue growth was 17.81% and average customer retention was 67.69%. The adjusted regression equation showed that for every unit increase in the adoption of the online platform, the operational efficiency of the enterprise increased by 4.82. The indirect association of the online platform with customer retention, through efficiency, was 1.37 percentage points (95% bootstrap interval 0.39 to 2.40). Controlled direct associations of the online platform with revenue and retention were not statistically meaningful at 5%. The findings of this study show that there is a statistically meaningful association of the online platform with customer retention and efficiency in the context of delivery service enterprises and this may differ for other enterprises. This study describes a design that can be replicated in similar contexts. The findings of this study are methodological, not field estimates, and should be replicated using actual enterprise data.

Table 1. Synthesis of selected recent studies

Author/year	Context	Approach	Relevant finding	Transfer limitation
Eller et al. (2020)	SME digitalization	Resource-based empirical inquiry	Technology resources correlate with financial outcomes	Not laundry-specific
Matarazzo et al. (2021)	Italian SMEs	Dynamic-capabilities cases	Digital reconfiguration supports customer value	Different national/sector context
Philbin et al. (2022)	International SMEs	Systematic review	Technology and sustainability dimensions matter	Diverse study measures
Verma et al. (2025)	India MSMEs	Enterprise-survey regressions	Digital finance linked to selected performance metrics	Cross-sector evidence
Wu et al. (2024)	SME marketing	Quantitative strategy analysis	Capabilities shape marketing performance	Cannot transfer effect magnitudes
Molinillo et al. (2022)	Retail applications	Customer-experience modeling	App experience relates to satisfaction/loyalty	Customer, not enterprise unit
Broccardo et al. (2024)	Italian SMEs	Enterprise survey	Control-system maturity and communication	Context dependent
Kim & Jin (2024)	SME managers	Mediation analysis	Opportunity capabilities as pathway	Different mediator
Merín-Rodrigáñez et al. (2024)	Innovative SMEs	Firm-level empirical design	Business-model innovation as mediator	Innovation-heavy sample
N'Dri & Su (2024)	Export manufacturing SMEs	TOE configurations	Adoption success is configurational	Nonservice sector

3. Research Objectives, Questions and Hypotheses

The main goal is to study the association of platform adoption with operations, revenue, and repeat customer outcomes at the enterprise level. This includes the following specific goals: (a) Describe the adoption of online channels by NCRs and the types of enterprises; (b) Evaluate the adoption with respect to operational efficiency; (c) Study the adoption with respect to annual revenue growth; (d) Test the adoption with respect to customer retention in the context



of satisfaction; (e) Evaluate whether the platform/revenue relationship is mediated by operational efficiency; (f) Study the barriers to platform adoption and the existence of heterogeneity with respect to size; and (g) Study the robustness of the above relationships with respect to organizational contingencies.

4. Research Methodology

4.1 Design, population, and data provenance

The analysis is a cross-sectional quantitative illustration of the laundry enterprise. The target field population consists of independently owned and chain-affiliated laundries and garment care services in Delhi, Gurugram, Noida, Ghaziabad and Faridabad. Future genuine surveys should have developed sampling frames, confirmed operational definitions, approached eligible respondents, documented non-response, and linked survey responses to consented business records. These have not been carried out for the present work.

For illustrative purposes, a fixed random seed is used to create 200 records distributed across the five populations: 50 records for Delhi, 40 for Gurugram, 40 for Noida, 35 for Ghaziabad and 35 for Faridabad. Enterprise categories consist of 128 micro, 54 small and 18 medium; and business models consist of 62 traditional, 90 hybrid and 48 digital-first. The scenario is a design choice, not a representation of the true situation. Possible relationships among practices on various platforms, times for processing, costs, marketing effort, changes in revenue, and shares of repeat customers is specified. Chance occurrences among p-values described in the generated design are conditioned on the relationships; they do not indicate the same for the actual population.

4.2 Constructs and Measurements

Platform adoption is the arithmetic mean of four 5-point items: digital order intake, trackable job status, online customer communication, and integrated booking/payment workflow. It represents the degree of integration of digital processes within the firm. Digital marketing intensity and customer satisfaction represent the five-point scales. Operational efficiency is a 0 to 100 constructed index representing process organization and better use of capacity with lower transaction friction. It does not represent the actual productivity of the firm's laundromat equipment. Revenue growth is a constructed year-on-year percentage and customer retention is a constructed share of repeat customers. Financial data in Indian Rupees and performance metrics are illustrative enterprise-level metrics and are not audited records.

The architecture exhibits several limitations. Revenue growth and customer retention do not occur in the same time window with actual customer records because there are no recorded transactions. Size of the enterprise is an analytical classification based on number of employees, while MSME classification in India is based on investment and turnover. The four item platform scale is broad enough to make a conceptual point, but actual respondents may not differentiate between use of basic messaging and integrated platform use. Internal consistency of a three item barrier scale is checked before it is used for substantive comparisons.

4.3 Statistical analysis protocol

Data processing and statistical modeling were automated. Descriptive statistics (i.e. frequencies and percentages) are used to summarize the enterprise profiles. Continuous variables are summarized using measures of central tendency and ranges. Items within the questionnaires that assessed the enterprise, were summarized using Cronbach's alpha and corrected item-total correlations. Adequacy of the sampling matrix and factorability of the matrix were assessed using the Kaiser-Mayer-Olkin (KMO) test and the Bartlett test, respectively. Bivariate associations of the principal variables



are assessed using Pearson's correlation. Differences in model means are assessed using analysis of variance (ANOVA).

Three Ordinary least squares (OLS) models are estimated and reported with heteroskedasticity-consistent standard errors (HC3). Model A explains operational efficiency with respect to platform adoption, digital marketing, enterprise age, log employees, enterprise size, location and business model. Model B incorporates operational efficiency as a control, in addition to revenue growth. Model C explains customer retention with respect to operational efficiency and customer satisfaction. An indirect pathway is explored with the help of an example. The multiplication of the coefficient of path a with the coefficient of path b, in the revenue model, is shown with a percentile interval calculated from 900 enterprise datasets. To test the causal effect of the pathway, an additional revenue model with interaction terms of the platform and size is tested with a robust Wald statistic.

Controls are incorporated for confounding, even though there is no guarantee synthetic data would emulate a true causal structure. Diagnostic tests are performed to assess and adjust for multicollinearity, heteroskedasticity, and residual dependence. The effect of unequal group sizes is also considered. Indirect effect and regression paths are explained, and the difference between statistical and practical effect is highlighted. A pathway analysis does not establish temporal precedence of revenue growth with respect to operational efficiency.

5. Results and Statistical Analysis

5.1 Enterprise profile and adoption

Table 2. Characteristics of illustrative enterprises (n = 200)

Characteristic	Category	n	Percent
Location	Delhi	50	25.0%
Location	Noida	40	20.0%
Location	Gurugram	40	20.0%
Location	Ghaziabad	35	17.5%
Location	Faridabad	35	17.5%
Enterprise size	Micro	128	64.0%
Enterprise size	Small	54	27.0%
Enterprise size	Medium	18	9.0%
Business model	Hybrid	90	45.0%
Business model	Traditional	62	31.0%
Business model	Digital-first	48	24.0%

Analytic compositions encompass all five targeted NCR locations. However, record counts were predetermined and should not be read as regional market shares. Hybrid businesses represent 45.0% of the sample, traditional businesses 31.0% and digital-first models 24.0%. Micro enterprises represent 64.0% of constructed observations. This stratified sample provides useful differences in the maturity with which businesses have adopted various technologies and the types of resources at their disposal. The business model variable is illustrative and should not be read as verification of franchise status or store-front classification.

Table 3. Adoption of digital channels and location scores

Digital channel / location	Count	Adoption rate or score
Digital payments	130	65.0%
Online booking app	126	63.0%
CRM tool	112	56.0%
WhatsApp Business	154	77.0%
Delhi — platform mean	50	3.10 / 5
Faridabad — platform mean	35	2.91 / 5
Ghaziabad — platform mean	35	3.48 / 5



Gurugram — platform mean	40	3.06 / 5
Noida — platform mean	40	3.46 / 5

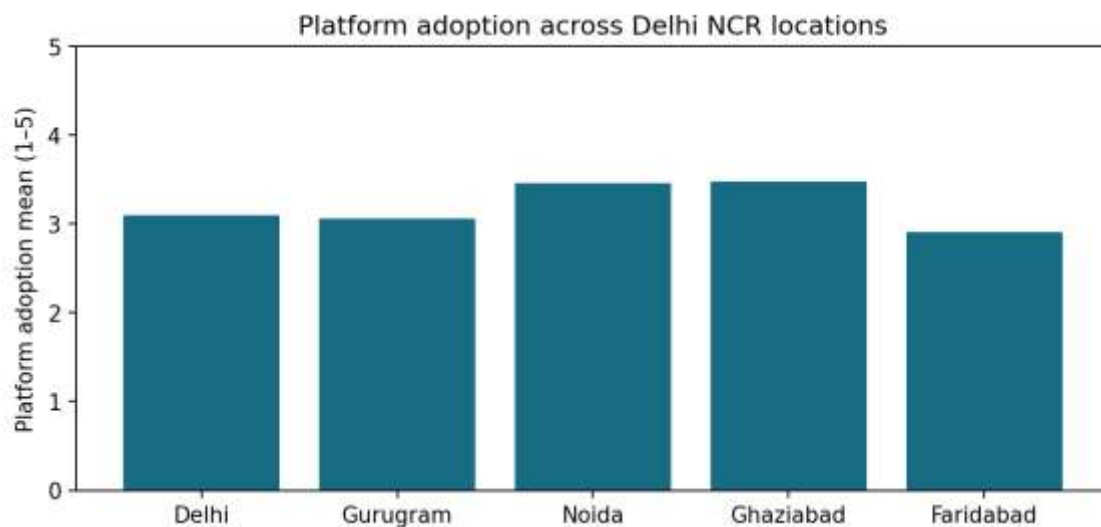


Figure 1. Mean platform-adoption scores by city (constructed observations).

Business-model composition (n = 200)

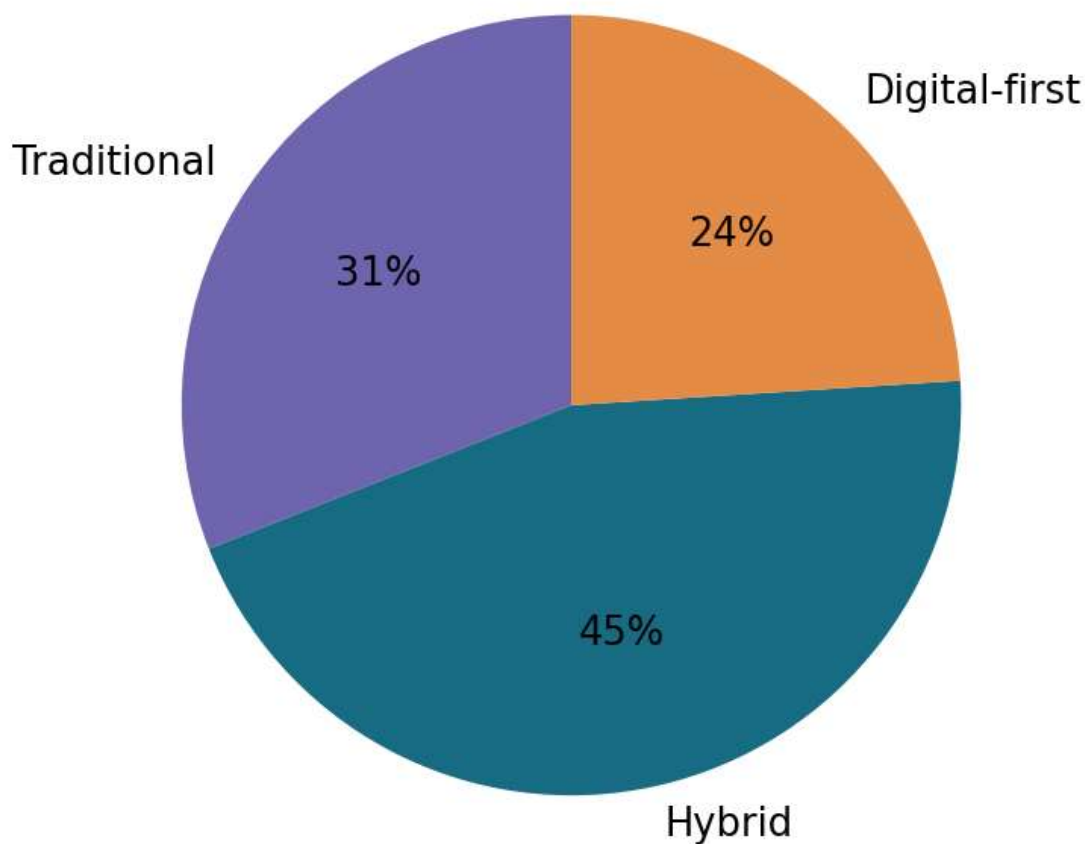


Figure 2. Illustrative composition of business models.

Online payment acceptance, digital booking and CRM implementation are similar but distinct from each other. Enterprise messaging may be used just to respond to customer queries, or may be structured to cater for service requests. The locations in Figure 1 show how geographic subgrouping would be shown; no spatial significance testing



or geographic representativeness is claimed. Platform maturity is scored on a continuous scale rather than equating the presence of any one technology to full transformation.

5.2 Descriptive statistics and measurement quality

Table 4. Descriptive statistics of analytical variables

Variable	Mean	Median	SD	Min	Max
Platform adoption (1–5)	3.20	3.25	0.80	1.50	5.00
Digital marketing (1–5)	3.22	3.25	0.74	1.45	5.00
Efficiency (0–100)	65.89	65.77	10.30	41.32	91.14
Order processing (hours)	30.97	30.88	6.50	12.05	46.71
Monthly orders	330.05	307.50	126.94	40.00	673.00
Revenue growth (%)	17.81	17.34	8.39	-3.86	39.57
Customer retention (%)	67.69	67.98	11.60	38.31	98.00
Customer satisfaction (1–5)	3.78	3.75	0.57	2.04	5.00
Technology investment (INR)	43960.84	41778.00	20015.58	6179.00	118806.00
Digital barriers (1–5)	3.71	3.67	0.61	2.00	5.00

Table 5. Reliability and measurement diagnostics

Scale	Alpha	KMO	Bartlett χ^2	df	p
Platform adoption (4 items)	0.87	0.83	384.25	6	<.001
Adoption barriers (3 items)	0.59	0.64	57.35	3	<.001

Note. Corrected platform item–total correlations: item 1 = 0.68, item 2 = 0.76, item 3 = 0.73, item 4 = 0.73. All statistics refer exclusively to the illustrative records.

The mean constructed platform score is 3.20 (SD = 0.80) indicating moderate average construction of the design. Efficiency averages 65.89 index points and the mean processing time is 30.97 hours. Revenue growth shows significant variation, with an average of 17.81% and a standard deviation of 8.39 percentage points. Customer retention is 67.69%. These scores are results of the generative rules and thus, not indicative of the Delhi NCR laundry sector.

The alpha of the platform is 0.872, which is a good indicator of internal consistency among the four digital-process items. Corrected item-total correlations are over 0.68, and KMO is 0.827. Bartlett's test of sphericity is significant (χ^2



= 384.25, $df = 6$, $p < .001$) indicating that the four items are related enough to conduct exploratory measurement. The barrier scale however, has an alpha of 0.594. Since it does not meet the 0.70 alpha criterion, its sum score is purely descriptive and should be restructured or divided into individual barriers in a real survey. Internal consistency of constructed responses does not justify the external construct validity.

5.3 Correlation analysis

Table 6. Pearson correlation matrix (lower triangle)

Variable	Platform	Marketing	Efficiency	Revenue	Retention	Satisfaction
Platform	1.00	—	—	—	—	—
Marketing	0.72	1.00	—	—	—	—
Efficiency	0.66	0.57	1.00	—	—	—
Revenue	0.50	0.51	0.55	1.00	—	—
Retention	0.57	0.46	0.67	0.47	1.00	—
Satisfaction	0.46	0.40	0.65	0.40	0.67	1.00

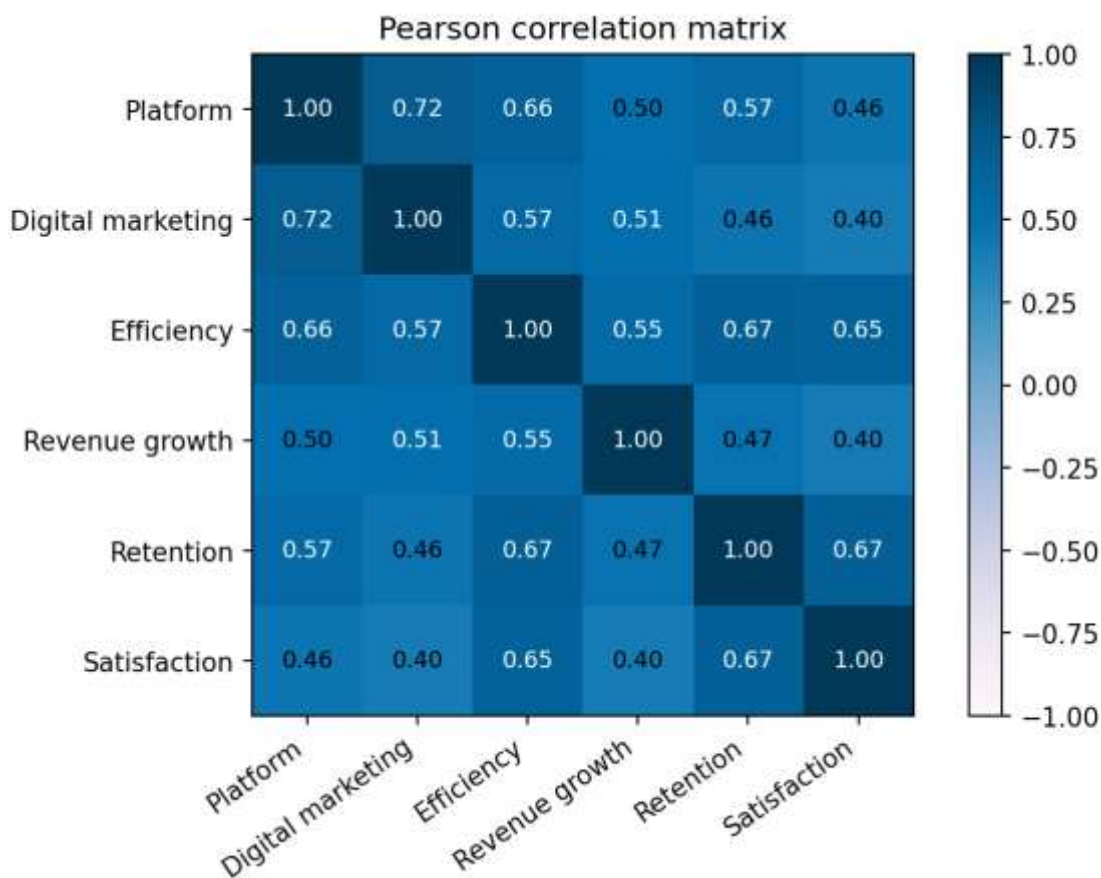


Figure 3. Pairwise Pearson correlations for six principal constructs.

The correlation between platform adoption and efficiency is $r = 0.66$; the correlation between platform adoption and revenue growth is $r = 0.50$; the correlation between platform adoption and retention is $r = 0.57$. Correlations give evidence to design concepts and do not distinguish digital adoption from other organizational characteristics. Efficiency and retention correlate at $r = 0.67$. This shows evidence to the design element that for repeated service usage, it is imperative to have stable and reliable operations. The heat map summarizes the strongest associative relationships; it does not illustrate causation.



5.4 Adjusted regression models

Table 7. Operational efficiency as dependent variable (HC3-robust OLS)

Predictor	b	Robust SE	t	p	95% CI
Platform index	4.82	1.54	3.13	0.002	[1.81, 7.84]
Digital marketing index	3.25	1.07	3.04	0.002	[1.15, 5.34]
Enterprise age years	-0.03	0.12	-0.27	0.786	[-0.27, 0.20]
Log employees	0.40	1.52	0.26	0.792	[-2.57, 3.37]
Model R^2 / adjusted R^2	0.508	0.477	—	—	—

Note. All models also include enterprise size, location and business-model indicators; baseline categories are given by treatment coding. Unit of analysis: enterprise (n = 200).

Table 8. Annual revenue growth as dependent variable (HC3-robust OLS)

Predictor	b	Robust SE	t	p	95% CI
Platform index	1.84	1.33	1.38	0.167	[-0.77, 4.46]
Operational efficiency index	0.28	0.07	4.02	<.001	[0.15, 0.42]
Digital marketing index	2.67	0.94	2.84	0.004	[0.83, 4.50]
Enterprise age years	0.19	0.09	2.00	0.045	[0.00, 0.37]
Log employees	-0.18	1.38	-0.13	0.899	[-2.88, 2.53]
Model R^2 / adjusted R^2	0.395	0.353	—	—	—

Note. All models also include enterprise size, location and business-model indicators; baseline categories are given by treatment coding. Unit of analysis: enterprise (n = 200).

Table 9. Customer retention as dependent variable (HC3-robust OLS)

Predictor	b	Robust SE	t	p	95% CI
Platform index	2.47	1.52	1.62	0.104	[-0.51, 5.46]
Operational efficiency index	0.31	0.10	3.22	0.001	[0.12, 0.49]
Customer satisfaction index	8.03	1.24	6.48	<.001	[5.60, 10.46]
Digital marketing index	-0.14	1.33	-0.10	0.917	[-2.74, 2.46]
Enterprise age years	-0.10	0.10	-1.00	0.316	[-0.30, 0.10]



Log employees	2.96	1.48	2.00	0.045	[0.06, 5.86]
Model R^2 / adjusted R^2	0.584	0.552	—	—	—

Note. All models also include enterprise size, location and business-model indicators; baseline categories are given by treatment coding. Unit of analysis: enterprise ($n = 200$).

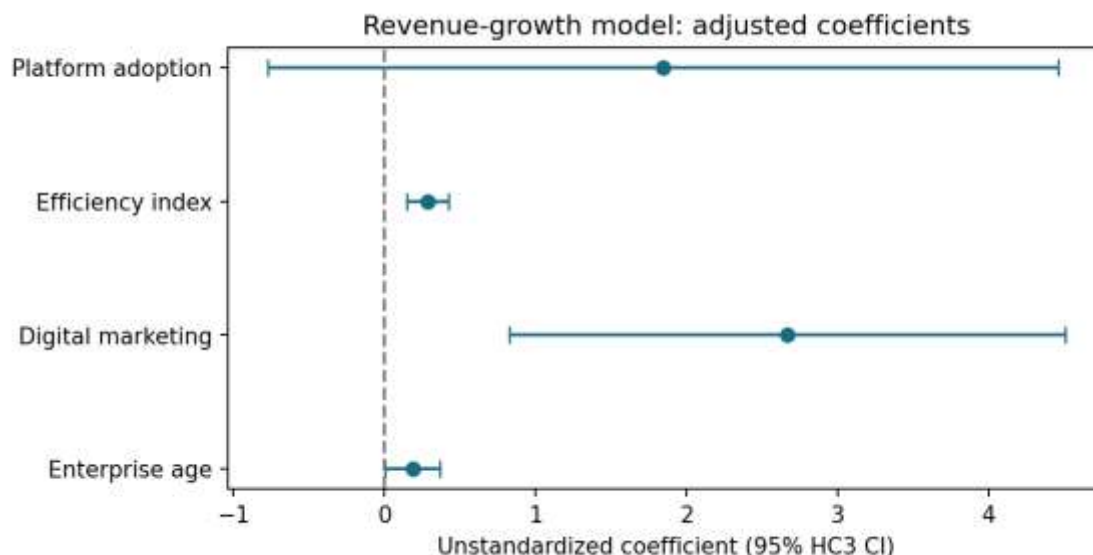


Figure 4. Selected adjusted associations in the revenue-growth regression (robust 95% CIs).

In Model A, 50.8% of the variation in the constructed efficiency index is explained. A one unit increase in the platform score is estimated to lead to an adjusted efficiency difference of 4.82 index points (robust 95% CI 1.81 to 7.84; $p = 0.002$). As the platform index is defined on a five-point scale, and the efficiency index is defined on a 0 to 100 scale, this coefficient describes differences in index points and not changes in efficiency percentage. Prioritizing variables for the survey can be done based on conditional associations. The focus of the analysis, however, would be on the magnitude of these associations.

Model B explains 39.5% of the variation in annual revenue growth. Once efficiency and all controls are included, the platform coefficient is 1.84 percentage points (95% CI -0.77 to 4.46; $p = 0.167$), which does not meet the 5% threshold.

The coefficient for adjusted efficiency is -0.284 % ($p < 0.001$), meaning the greater the percentage change in the index, the more likely negative growth. As digital and service efficiency are related, and simultaneous inclusion of both in a regression can reduce the estimated direct platform coefficient, leaving space for an indirect statistical pathway, the same is true for other phenomena in the model. This should not be construed as a definitive mediation of a real-world causal effect.

Model C accounts for 58.4% of the constructed retention variation. The adjusted platform coefficient is 2.47% (95% CI -0.51 to 5.46; $p = 0.104$), and is therefore not statistically significant. Customer satisfaction, however, carries a coefficient of 8.03% per satisfaction-score point ($p < 0.001$). These findings indicate that a digital platform can improve convenience, however the behavior of repeat customers is also related to fulfillment quality and the subjective experience with the service personnel. They don't show that customer satisfaction was measured independently among actual customers.



5.5 Mediation, heterogeneity and group comparisons

Table 10. Path decomposition and enterprise-size interaction

Parameter	Estimate	Procedure	95% interval / df
Platform → efficiency (a)	4.82	OLS path estimate	—
Efficiency → revenue (b)	0.28	OLS path estimate	—
Indirect association (a × b)	1.37	900 bootstrap draws	[0.39, 2.40]
Direct platform → revenue	1.84	Adjusted model B	[-0.77, 4.46]
Platform × size joint test	$\chi^2 = 0.34$	p = 0.845	df = 2

Table 11. Group profiles for traditional, hybrid and digital-first outlets

Model	n	Platform	Efficiency	Revenue (%)	Retention (%)
Digital-first	48	4.12	73.62	22.69	75.89
Hybrid	90	3.27	66.91	17.51	67.89
Traditional	62	2.37	58.41	14.47	61.06

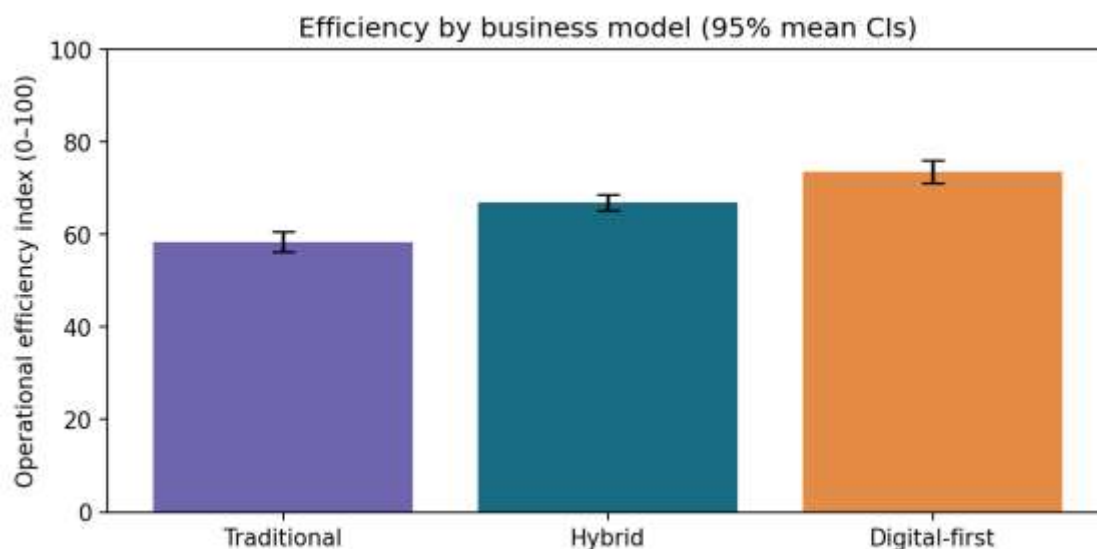


Figure 5. Operational efficiency by business model (mean and approximate 95% CIs).

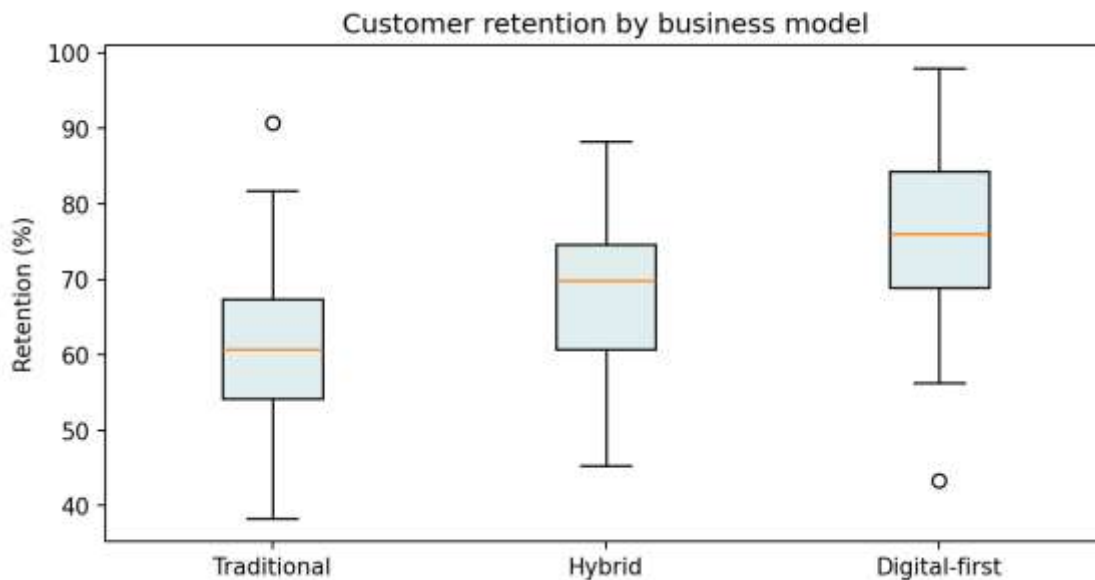


Figure 6. Customer retention distributions across business models.

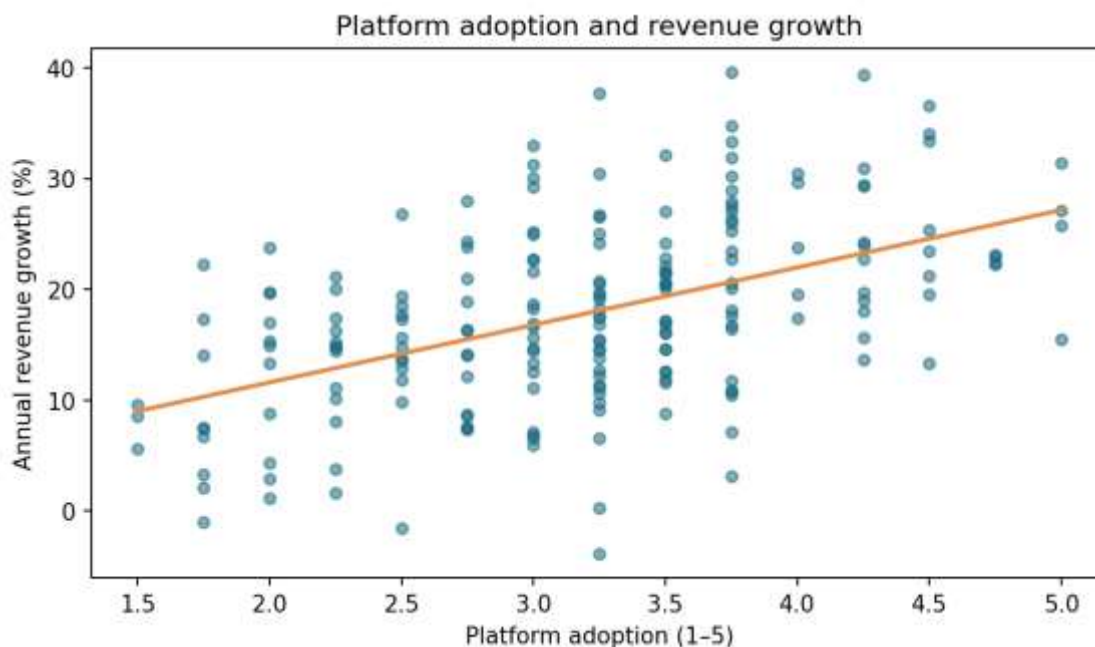


Figure 7. Unadjusted platform–revenue scatter with fitted linear trend.

We find an indirect path coefficient of 1.37 for revenue growth per unit of platform adoption, with a 95% bootstrap interval of 0.39-2.40. As the interval does not include zero, we provide evidence for H5 in the analytic dataset. Whether or not this meets the identification criteria of causality in field research will depend on the assumptions made about the distributional and functional form of the relationship. In the field of economics, identification often depends on stronger assumptions, which include strictly exogenous or random treatment assignment, or causal mechanisms sequencing events. This is typically accomplished by manipulating (ruling out) rival explanations.

There is no platform-slope heterogeneity by size in the interaction model, Wald $\chi^2(2) = 0.34$, $p = 0.845$. Thus, we cannot provide evidence for H6 in the illustrative dataset. Other sizeable contrasts exist in the unadjusted business model comparisons. Digital first businesses show revenue growth of 22.69%; Hybrid businesses show 17.51%; and Traditional businesses show 14.47%. A one-way ANOVA shows $F = 14.90$, $p < .001$. This contrast does not demonstrate a business model effect. As previously described, digital first business models and platform adoption are related by construction.



5.6 Hypothesis decisions and diagnostics

Table 12. Hypotheses and statistical decisions

Hyp.	Proposed association	Estimate	Evidence / p	Decision
H1	Platform efficiency →	$b = 4.82$	0.002	Supported
H2	Platform revenue, direct →	$b = 1.84$	0.167	Not supported
H3	Platform retention, direct →	$b = 2.47$	0.104	Not supported
H4	Efficiency revenue →	$b = 0.284$	<.001	Supported
H5	Platform efficiency → revenue →	indirect = 1.37	Bootstrap CI excludes 0	Supported
H6	Platform slope varies by size	$\chi^2 = 0.34$	0.845	Not supported

Table 13. Model-fit and residual diagnostics

Outcome	R ²	Adj. R ²	Residual SD	Durbin–Watson	BP test p
Eff	0.51	0.48	7.45	2.19	0.632
Revenue	0.39	0.35	6.75	1.91	0.873
Retention	0.58	0.55	7.76	2.07	0.530

The diagnostic summary outlines how the analyst assesses the appropriateness of the selected inferential process. Breusch–Pagan tests do not show strong evidence of heteroskedasticity in the constructed models, but conservative specification choices report HC3 robust errors. Durbin–Watson values close to 2 do not indicate evidence of first-order residual autocorrelation; however, the observations are cross-sectional (and not time series). Enterprise-level clustering by neighborhood or chain was not constructed. Only a survey can test clustering, influential observations, multicollinearity and measurement of exposure more carefully, and it can pre-specify choices on multiple comparisons and missing data.

The hypothesis table separates evidence for a conditional path from evidence for a direct platform-performance coefficient. A positive relationship can be shown by a bivariate scatter even if the conditional regression interval includes zero. Statistically significant group differences are consistent with an insignificant joint interaction, as they test different hypotheses. These distinctions are important to reduce confusion when the same data is presented in multiple ways in the same report.

6. Discussion

The case study illustrates several aspects of research on digital transformation. First, regarding operational efficiency, the illustration aligns conceptually with evidence that digitalization is most effective when it is accompanied by the right routines and managerial integration and capabilities (Eller et al., 2020; Broccardo et al., 2024). For laundry services, digitizing order documentation can help reconcile garment counts, document pickup and delivery. However, realizing these benefits requires employee training and strict exception handling. As one author notes, digitizing an unstable process may result in an unstable process with more screens.

Second, the separation of total, direct and indirect pathways improves the interpretation of financial results. The regression containing both direct and indirect platform coefficients shows that the former is not significant, even if the



overall result is positive. Related studies provide evidence of the presence of business-model and opportunity-substitution intermediating roles (Kim & Jin, 2024; Merín-Rodrigáñez et al., 2024). This work provides an example of an operational efficiency pathway for pick-up and delivery services. No direct effect does not necessarily indicate a lack of business impact. A myriad of factors such as noisy indicators, overadjustment, reverse causation, and unmeasured competition could be at play. Growth in revenue should be complemented with growth in profitability, as well as the average cash conversion and repeat order contribution.

Third, the retention model outlines a key difference between service-channel convenience and lasting customer relationships. Customers that are retained require reliability in stain removal, predictable return dates, proper handling of dry-clean only and at-risk items, and timely and appropriate redress if service is performed in an inadequate or incomplete manner. Molinillo et al. (2022), Sheth et al. (2023) and Ayodeji et al. (2023) suggest treating satisfaction and service experience as key elements that predict loyalty. In future primary data, retention should be analyzed using consented customer IDs over specified intervals, and then linked to on-time delivery and complaint resolution rates where possible, rather than relying on owner reports.

Fourth, a more comprehensive analysis of the factors impacting an enterprise is required beyond a binary digital/non-digital classification. An independent laundry operation that uses WhatsApp to schedule and coordinate its delivery logistics might be highly effective, and better managed and operated than a laundry app that suffers from issues such as batch scheduling and service cancellations. Purwanti et al. (2022) and N'Dri and Su (2024) note that the organizational and environmental context in which a business operates helps explain the differential digital performance. The absence of a significant interaction effect between platform and size suggests that a plausible moderator should be considered rather than made assumptions. A larger sample would be required for more precise estimates of medium-sized enterprises, given the case study only contains 18 records in the medium enterprise category.

Fifth, the model highlights costs and trade-offs. Digital acquisition campaigns come at a cost. Use of third-party marketplaces can result in commissions and increase the obligations for customer data management which increases security and compliance risks. A digitization roadmap must include a baseline audit of existing order error rates and the time spent communicating with customers. Other considerations include the reliability of delivery, the cost of customer acquisition and the frequency of customer orders. Teng (2022) is relevant to this cost-benefit consideration. It would be prudent to include the performance of the environment and society, as suggested by Melo et al. (2023).

The Indian context further complicates methodological issues. Maturity of enterprises, mode of business registration, cash- versus digital-payment records, and customer density may impact the adoption and outcome of the enterprise. Digitization-related documents of the Government of India (2025) and documents related to the Reserve Bank of India (2025) and National Payments Corporation of India (NPCI, 2025) could be beneficial to our study. However, these do not replace measured outcomes of the laundry sector. For a study in the real Delhi NCR, administrative or industry lists would need careful validation, because small informal enterprises may be undercovered. Researchers should note franchise and aggregator dependence, high-season demand, and type of location, for example, proximity to educational and office districts.

The main implications from the synthesis are around capabilities as opposed to devices. TAM touches on staff and owner willingness to use the tech, TOE addresses external readiness, RBV posits if the tech complements organizational skills, and the theory of dynamic capabilities posits if the firm can continuously reconfigure its services. The demonstration operationalizes just some of these theories and frameworks, and is not designed to test or prove them. Research incorporating surveys of enterprises, combined with anonymized order data and longitudinal adoption data, would provide opportunities to better evaluate these theories and frameworks.



7. Managerial and Policy Implications

Owners should aim for a phased approach over an upfront significant investment for an app. During phase 1, management should standardize staff assignment to tasks like identifying items, cataloging services, pricing, and committing to pick up times and resolving complaints. Phase 2 can integrate a low-cost booking interface and initiate systematized payment reconciliation. During phase 3 management can implement deliveries and reminders, and communicate offers to customers about repeat purchases. At each phase, management should focus on a few core metrics, for example, Average Orders per Worker, Average Time to Complete an Order, the percentage of Orders Delivered on Time, the Service Recovery Cost, and the Digital Acquisition Cost.

For digital laundry marketplaces, the quality of integration may be more important than the number of affiliate outlets. Application programming interfaces (APIs) should help eliminate data entry redundancy and provide explicit service commitments, support damage-claim processes and enable traceable communications. A responsible party for customer data, and a clear structure of commissions, will help firms determine if using the marketplace improves their net income. Aggregators may also help by offering lightweight training to improve operators' administrative digital skills if they have sufficient laundry business knowledge.

For MSME development organizations, low-cost capacity building may be effective if it provides digital skills related to customer privacy and/or control of accounts and analytics. Municipal and district programs may partner with enterprise associations to implement pilot training in digital operations. However, evaluation should focus on real impacts and be comparative. Improving business processes and quality control in unrelated areas may also be beneficial. This is especially true if there is evidence of inequitable distribution of benefits among micro, small and medium service providers.

Policy evaluations should consider the physical resource constraints of the sector. Efficiency gains brought on by digital marketing may facilitate unsustainable growth and increase consumption of natural resources. This may be particularly true for laundries located in the global south. Tracking emissions, transport kilometer or other metrics related to deliveries may help future research address sustainable productivity of laundry services. Such outcomes should be reported and should not be inferred from increased revenue and/or use of online platforms.

8. Limitations, Research Ethics, and Future Research

The main limitation is that data provenance. The observations were generated to demonstrate a quantitative workflow, and, as such, the descriptive values and p-values don't reflect actual parameters of the Delhi NCR region. During the process of positive association creation, the generating process biases the variables, making it unsuitable to substantiate a scientific claim regarding a technological adoption. Additionally, positive association creation occurs in a cross-sectional environment, making causal identification infeasible. The benchmark models may omit several factors, including: capacity utilization, local competition, socioeconomics, licensing, chain membership, and quality of local infrastructure.

There were no informed consents, field recruitments, or human subjects interactions. As a result, there are no ethical committee approvals, owner response rates, customer statements or audited records. Future research should seek ethics, organize permissions, develop auditable sampling frames, pretest questionnaires in the relevant languages, anonymize respondents, obtain transaction level data, investigate non-response bias and, where possible, preregister primary outcomes. Future research should also make aggregate findings publicly available, to enable replication, while protecting customer identities.



Research, focusing on the transportation and logistics sector, should identify the date various digital systems were adopted, and collect long-term, repeat, month-over-month data on orders, sales, costs and the percentage of repeat customers. Research focusing on other service sectors should examine the efficiency of service fulfillment and investigate other methods of service delivery (e.g. Subscription vs. Pay-Per-Order service delivery models). Further, differences in premium vs. economy service delivery might be assessed.

9. Conclusion

This paper proposes a comprehensive analytical framework to assess platform adoption, operational performance, revenue and customer retention in Delhi NCR laundry enterprises. To illustrate this, a labeled dataset of 200 enterprises was used to showcase standardized measurement, reliability analysis, group comparison, regression analysis and other diagnostics and path decomposition through bootstrap. In the context of the defined demonstration, adoption of the platform positively impacted operational performance ($b = 4.82$; $p = 0.002$). Operational performance positively impacted revenue growth ($b = 0.284$; $p < 0.001$). The indirect association of the platform with revenue growth was 1.37 percentage points, with the 95% bootstrap interval excluding zero. The direct adjustment of the coefficients of the platform with revenue growth and customer retention was not significant. A rigorous test for interaction did not indicate any differences in the revenue relationship based on the size category of the enterprise.

The main lesson that can be gleaned from this study is more qualitative than quantitative. There is a need to assess the real impact of a digital transformation on documented process and customer experience. Most reviews tend to draw inferences about the impact of digital transformation from the mere presence of online booking and payments in a system. The analysis conducted and the measurement defined in this study serve more as a starting point to assess the real state of laundry enterprises in the Delhi NCR region and be used to define educational interventions for similar enterprises rather than to publish them.

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Appendix A. Structured Enterprise Questionnaire

Proposed respondent: owner, manager or authorized operations supervisor. Proposed eligibility: an active garment laundry, dry-cleaning or associated laundry-service enterprise operating in one of the specified NCR locations. The questions below are an instrument blueprint and were not administered in this demonstration.

Section A — Enterprise profile: (A1) Location and locality; (A2) number of employees; (A3) years in operation; (A4) storefront/chain/franchise status; (A5) core service mix; (A6) monthly average order count; (A7) operating model: traditional, hybrid or digital-first; (A8) approximate monthly expense and turnover bands.

Section B — Platform adoption (1 = strongly disagree/not established; 5 = fully established): (P1) Customer orders are accepted through a documented online system. (P2) Digital records allow us to track the status of active laundry jobs. (P3) Digital communication is used systematically for pickup, turnaround and delivery updates. (P4) Online booking and payment information are integrated into daily workflow. Each item should be anchored to observed practices rather than managerial aspiration.

Section C — Processes and financial performance: (C1) Mean order-processing or turnaround hours over the preceding month; (C2) completed orders per month; (C3) share delivered on time; (C4) documented rework or complaints; (C5) employee-hours per completed order; (C6) year-on-year turnover growth; (C7) gross margin, platform fees and delivery costs. Whenever possible, request documentary corroboration without collecting customer names.

Section D — Customer relationships: (D1) Proportion of identifiable customers placing repeat orders within 90 days; (D2) average satisfaction score from a defined customer survey; (D3) average complaint resolution hours; (D4)



communication channel preference; (D5) loyalty discounts and follow-up practices. Specify numerator, denominator and observation period for all retention calculations.

Section E — Adoption barriers (1 = very low barrier; 5 = severe barrier): (B1) Upfront cost or ongoing software fees; (B2) staff digital capability and training needs; (B3) platform commission, customer-data control or dependence on external aggregators. Analyze the individual barrier items when scale reliability is inadequate.

Appendix B. Data Dictionary and Operational Definitions

Appendix Table B1. Core analytical variable dictionary

Column or item	Definition	Units/coding
Enterprise_ID	Anonymized unit identifier	LN001–LN200
Location	NCR geographic category	Five location labels
Enterprise_size	Illustrative employee-size category	Micro / Small / Medium
Business_model	Operating orientation	Traditional / Hybrid / Digital-first
Enterprise_age_years	Years since establishment	Integer 1–25
Employees	Current employees	Positive integer
Platform_item_1–4	Four digital-channel scale items	Each integer 1–5
Platform_score	Average of four adoption items	Continuous 1–5
Digital_marketing_score	Marketing intensity index	Continuous 1–5
Operational_efficiency_index	Constructed operations index	0–100
Order_processing_hours	Illustrative processing duration	Hours
Monthly_order_volume	Illustrative workload	Orders per month
Revenue_growth_percent	Illustrative annual revenue change	Percentage points
Customer_retention_percent	Illustrative repeat share	Percent
Technology_investment_INR	Illustrative outlay	INR
Customer_satisfaction_score	Illustrative perceived service experience	1–5
Barrier_item_1–3	Three digital-adoption barrier items	Each integer 1–5

Appendix C. Dataset Extract

The complete 200-row generated dataset is held in the reproducibility working materials. The excerpt below is included to demonstrate variable alignment and the precision of the reported values. Each unit is illustrative rather than an observed business.

Appendix Table C1. First 12 constructed enterprise records

ID	Location	Model	Platform	Efficiency	Revenue %	Retention %
LN001	Delhi	Traditional	1.75	41.81	7.51	48.78
LN002	Noida	Hybrid	3.50	80.85	21.38	73.73
LN003	Gurugram	Digital-first	4.25	69.41	15.63	69.62
LN004	Delhi	Digital-first	4.25	81.07	29.32	73.02
LN005	Ghaziabad	Traditional	2.75	42.77	7.46	63.30
LN006	Noida	Hybrid	3.25	60.49	17.63	46.49
LN007	Ghaziabad	Hybrid	3.75	74.60	22.72	75.05
LN008	Noida	Traditional	2.50	60.35	13.60	64.19
LN009	Delhi	Hybrid	3.25	71.76	20.49	58.38



LN010	Ghaziabad	Digital-first	5.00	71.79	25.75	73.23
LN011	Delhi	Hybrid	3.75	77.49	27.91	83.50
LN012	Delhi	Traditional	1.50	64.53	9.57	75.10

Appendix D. Model Specification and Diagnostic Notes

All OLS specifications include categorical controls coded as treatment indicators, as well as enterprise age, log employees and digital marketing intensity. Efficiency is modeled as a function of platform adoption and these controls; revenue is modeled as a function of platform adoption, efficiency and the same controls; retention additionally includes customer satisfaction. Heteroskedasticity-robust HC3 standard errors underlie inference in the displayed coefficient tables. For the mediation pathway, empirical percentile confidence limits use 900 independent bootstrap resamples of the same 200 constructed records.

The score construction uses four integer platform items and reports their arithmetic mean. Platform alpha and corrected item–total correlations assess internal consistency, while KMO and Bartlett tests describe shared covariance. The three barrier items fall below conventional alpha thresholds and should not be presumed to form a unidimensional validated scale. The matrix presented in Table 6 is Pearson correlation; large values need not imply causation or a common source of variation.

Appendix E. Reproducibility and Reporting Checklist

The random generator uses a fixed seed (24062024). The generation algorithm assigns 200 enterprise identifiers, five locations, three size classes and three operating models, then creates correlated digital-adoption scores, operations, growth and retention measures with noise. Descriptive results are calculated directly from these records. Regression models use the same records without imputation. Bootstrap mediation uses resampling with replacement, holding the model terms fixed, and computes the product of the platform–efficiency and efficiency–revenue coefficients for each draw.

Replicability conditions: preserve the random seed and generation expressions; retain original column names and units; state factor reference groups; report the software version when rerunning; use two-sided robust confidence intervals; check whether all figures match the values in the results tables; and archive the finalized analytic dataset. Most critically, distinguish actual observational or experimental evidence from this deliberately constructed methodological demonstration in every downstream report or presentation.