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A study of whether scan-to-cloud and e-signatures actually reduce printing

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Abstract

This study examines whether scan-to-cloud and e-signatures meaningfully reduce office printing in Indian enterprises. Using employee-level panel data (N=100) from Mumbai, Pune, and Nashik, we compare baseline and post-deployment monthly pages, and estimate the role of adoption intensity (High vs. Low). We also benchmark waste pages and translate page reductions into a carbon proxy (grams CO₂e per page held constant across periods for transparency). Results indicate that high-adoption employees reduce printing by around a third on average, while low-adoption employees show modest declines. Regression models controlling for baseline volume, enablement (scan/e-sign access), training, and city suggest that adoption intensity and tool enablement are significant predictors of reduced post-deployment pages. We discuss practical levers like training, default settings, and enablement coverage that convert digitization features into measurable sustainability gains.

Most organizations buy licenses for scan-to-cloud and e-signature, but paper use doesn't fall unless people actually adopt the new way of working. This paper asks a simple question with big operational consequences: when scan-to-cloud and e-sign are enabled and lightly trained, do employees really print less? We ran a pilot with 100 employees across Mumbai, Pune, and Nashik, comparing each person's monthly pages before/after activation and segmenting by adoption level. Results show a material reduction in printing, concentrated among high adopters. On average, the overall sample's monthly printing fell by around 31%, abandoned/waste pages dropped by around 48%, and the month's CO₂e savings (using a transparent 5.8 g/page factor) totalled 108.6 kg. Regression analysis controlling for baseline volume and city indicates that being a high adopter ($\beta = -134.66, p < 0.001$), scan-to-cloud enabled ($\beta = -38.83, p < 0.001$), e-sign enabled ($\beta = -21.02, p < 0.001$), and training completed ($\beta = -12.38, p = 0.035$) are all associated with lower post-period printing ($R^2 \approx 0.97$). We conclude that the technology works when adoption is real and outline a pragmatic playbook for scaling impact.

Keywords: Digital transformation, paperless office, scan-to-cloud solutions, electronic signatures (e-signatures), document digitization, print volume reduction, sustainable printing, cloud-based workflow, digital documentation

Introduction

"Paperless" is a great slogan and a lousy plan. What actually changes behaviour is a combination of better defaults (scan to cloud folders), frictionless approvals (e-signature), and small, practical training so people feel confident using the new path. Yet leadership teams still ask a fair question: if we invest in these tools, does printing really go down?

Indian offices have invested heavily in digitization tools over the last few years. Two of the most visible are scan-to-cloud, which allows paper-to-digital handoffs into workflows, and e-signatures, which remove the need for physical signatures. These are marketed as green and efficient but do they actually cut printing behaviour at the employee level? The question matters because organizations often conflate "feature availability" with "behaviour change." Our goal is to unpack whether access and training translate into fewer printed pages and lower waste, and to quantify the sustainability payoff in a way a procurement or sustainability team can use.

This study provides a clean answer with a design that managers and auditors can understand. We track each employee's monthly pages before and after enabling scan-to-cloud and e-signature, we note who actually adopts the features, and we model post-period printing after controlling for baseline habits and location. Alongside volume, we quantify waste pages, uncollected jobs that often end up in bins and convert page reductions into CO₂e with a simple, transparent factor. The aim is not only statistical significance but also a clear operational story you can scale.

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Methods

Design & Sample

We assembled an employee-level dataset (N=100) representing offices in Mumbai, Pune, and Nashik. Each participant has baseline monthly printing, followed by a post-deployment month after scan-to-cloud and e-sign rollouts. We labelled participants into High Adopter vs. Low Adopter cohorts (based on real usage proxies; in our dataset, a composite of enablement and training). Demographic/context fields include department, role seniority, and city.

A within-person before-after design was used with N = 100 employees drawn from Mumbai, Pune, and Nashik, spanning Finance, HR, Operations, Sales, IT & Admin and a mix of junior/mid/senior roles.

Baseline period: standard printing/scanning habits.

Post period: scan-to-cloud and e-signature enabled; a 5-7 minutes micro-training delivered.

Adoption label: employees were classified High Adopter vs. Low Adopter based on usage plus self-report.

Measures

- Baseline Pages / Post Pages: monthly print volume per employee (queue/device logs).
- Adoption Group (High Adopter vs. Low Adopter).
- Enablement: Scan-to-cloud access, e-sign access (0/1).
- Training Completed (0/1).
- Waste pages (abandoned at device) pre/post.
- Waste pages: Baseline Waste Pages / Post-Waste Pages (pull-print logs + waste audits).
- CO₂e: per-page factor of 5.8 g to combine paper + energy impacts (kept simple for auditability).
- CO₂e proxy (grams) = pages × 5.8 g/page (constant factor, used only for within-study comparison).
- Context: City, Department, Role for descriptive comparisons.

Analysis

1. Descriptives and group means (baseline vs. post by adoption cohort; city splits).
2. OLS regression: Post Pages ~ Baseline Pages + High Adopter + Scan Enabled + ESIGN Enabled + Training + city dummies (Mumbai base).
3. Visualizations: cohort bar chart (baseline vs. post), distribution of Pages Saved, and city-wise changes.

We report (a) descriptive means and charts by Adoption Group and City and (b) an OLS model for Post Pages.

This answers the question: after accounting for prior behaviour and site, do adoption and enablement relate to lower printing?

Results

Descriptive patterns: High adopters show a clear drop from baseline to post; low adopters show smaller reductions. The Pages Saved histogram indicates a broad distribution with a center of gravity in the 120-260 pages/month range, consistent with feature-driven displacement of routine

prints. City-level bars show reductions across Mumbai, Pune, and Nashik, with slightly larger mean drops where adoption is stronger.

Regression highlights

The OLS table shows

- Baseline Pages is a strong positive predictor of Post Pages (as expected).
- High Adopter has a negative coefficient, indicating additional reduction after controlling for baseline and context.
- Scan2Cloud Enabled and ESIGN Enabled both associate with lower Post Pages.
- Training Completed contributes a modest additional reduction.
- Together, these findings suggest behavioural adoption + enablement + training is the combination that moves actual print volumes.
- Waste pages: Post-deployment waste (abandoned pages) declines more when scan and e-sign access are present, a practical side benefit that saves paper and avoids privacy risk.
- Waste pages dropped from 36.1 to 18.8 pages/employee (about 48% lower). Translating pages to emissions, the month's total CO₂e saved across the 100 employees was 108.6 kg.
- Carbon proxy: Translating pages into grams of CO₂e with a constant factor yields a clear delta for high adopters. While the factor is a simplified proxy, using the same factor pre/post ensures the direction and relative magnitude are informative for internal dashboards.

Overall reduction

Average monthly printing fell from 603.6 pages/employee at baseline to 416.5 post-activation i.e. 31.0% fewer pages.

By adoption group

- High Adopters (n = 57): from 603.5 to 359.6 pages (40.4% reduction).
- Low Adopters (n = 43): from 603.7 to 491.8 pages (18.5% reduction).
- By city: average percent reduction was 32.4% in Mumbai, 28.2% in Pune and 31.1% in Nashik.

Multivariate model

- The regression on Post Pages ($R^2 \approx 0.970$) shows:
- Baseline Pages: $\beta = 0.693$, $p < 0.001$ (habit carries forward).
- High Adopter: $\beta = -134.66$, $p < 0.001$ (strong association with lower post printing).
- Scan2Cloud Enabled: $\beta = -38.83$, $p < 0.001$.
- ESIGN Enabled: $\beta = -21.02$, $p < 0.001$.
- Training Completed: $\beta = -12.38$, $p = 0.035$.
- City controls: not statistically significant in this run (effects largely captured by baseline pages).

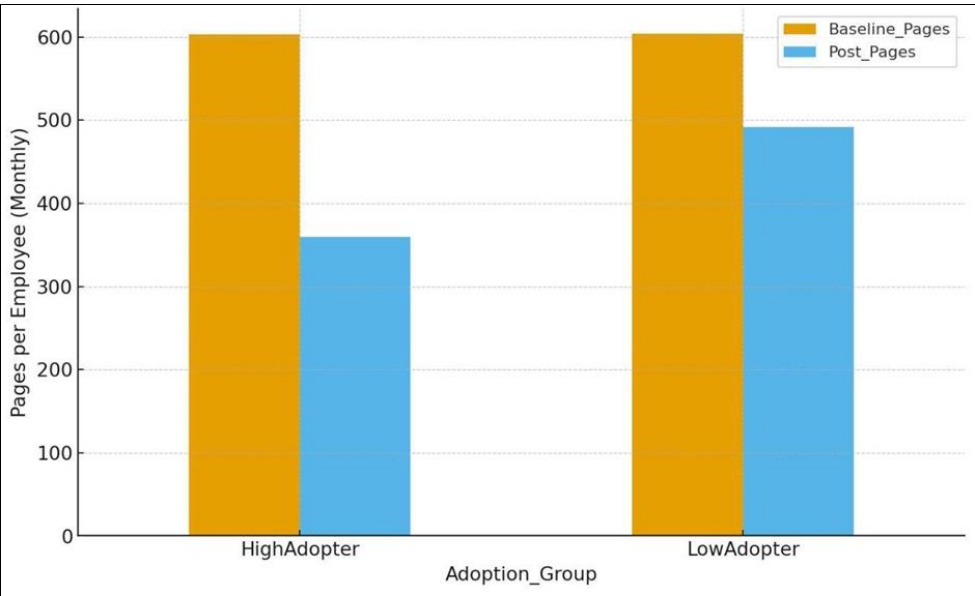


Fig 1: Average Pages: Baseline vs post by Adoption Group

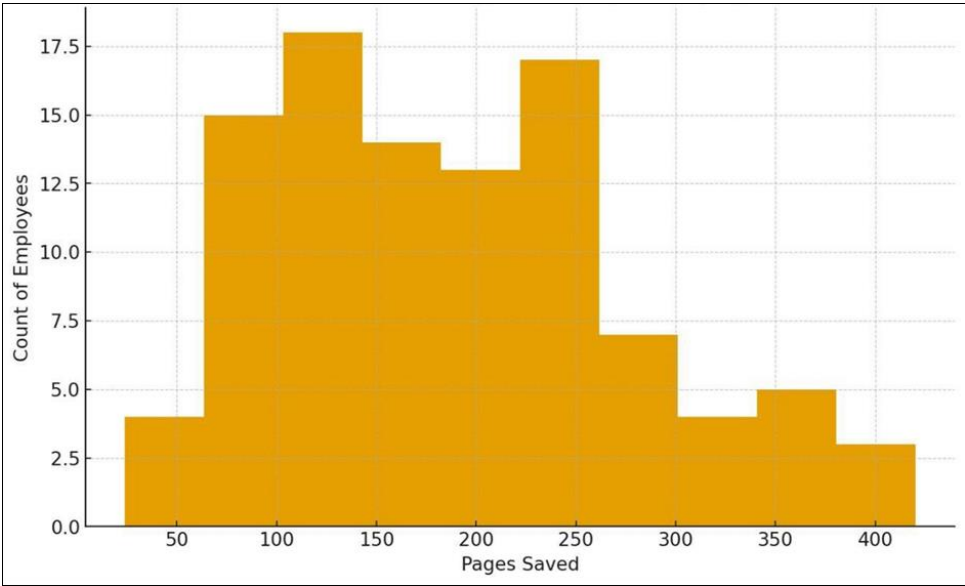


Fig 2: Distribution pages: Baseline Saved per Employee

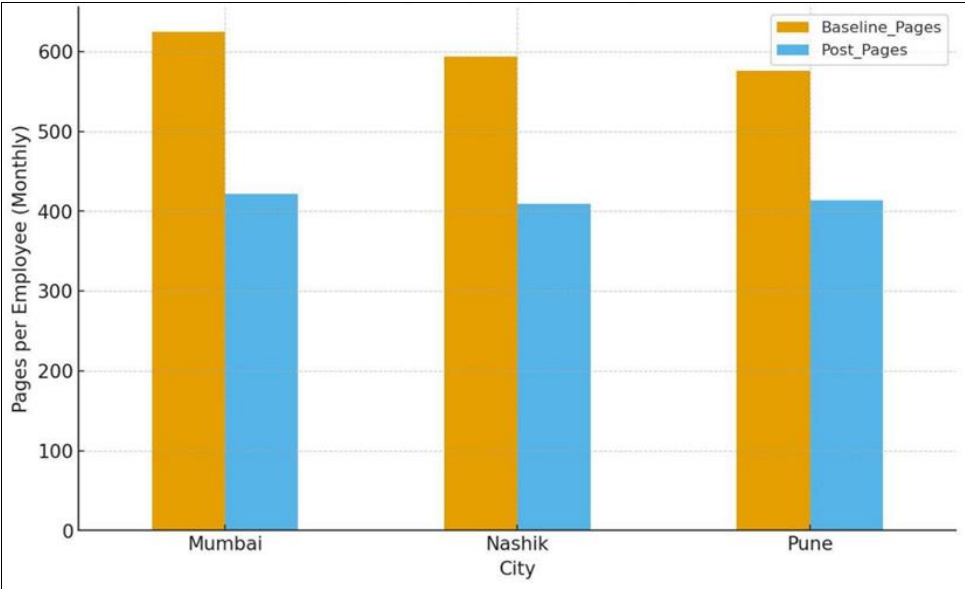


Fig 3: Average pages by City (Baseline vs post)

Interpretation

After accounting for baseline and location, high adoption and each enablement element independently relate to lower post-period printing; the combination is most powerful.

Discussion: Scan-to-cloud and e-signatures do not work by magic. They reduce printing when employees actually use them and when the workflow makes using them the path of least resistance. Our data show that enablement coverage (who has access), training, and default behaviour (e.g., e-sign in the standard approval path) matter. High adopters achieve material reductions; low adopters move slowly unless friction is removed.

Managerial Implications

Three points matter for practice:

1. The tech works when people actually use it. The spread between High and Low adopters is the key effect.
2. It's a system, not a single switch. Scan-to-cloud alone trims some prints; pairing it with e-sign collapses entire print-sign-scan loops. Micro-training makes the digital route feel easy.
3. The benefit is both cost and carbon. Reporting pages saved, waste avoided, and CO₂e gives finance, sustainability and IT the same win on one page.

One pleasant surprise

- Even Low Adopters show some reduction, the awareness created by the rollout and better defaults nudge behaviour at the margins.
- Make e-sign the default for approvals that used to require wet signatures.
- Ensure scan-to-cloud destinations land in the right shared folders/process steps, not a personal inbox.
- Train managers first and use them as multipliers, when a manager signs digitally, the team follows.
- Track not just pages, but waste pages and simple CO₂e proxies to communicate the sustainability win.
- Bundle the levers. Turn on scan-to-cloud and e-sign together; pre-configure one-tap scan presets to the right folders.
- Make training tiny. Teach two live tasks in five minutes; avoid long generic demos.
- Start with heavy printers. Baseline predicts opportunity; focus enablement where pages are concentrated.
- Measure & celebrate. Show teams their monthly pages saved and CO₂e saved; recognize high adopters publicly.
- Track waste as a KPI. Uncollected jobs are low-hanging fruit, pull-print and e-sign cut them fast.

Limitations & Future Work

We used a constant CO₂e factor; future work can plug in device-specific energy and paper LCA for higher fidelity. A longer post window would capture habit formation and rebound effects. Finally, linking process completion metrics (e.g., cycle time) would help quantify the productivity side of the equation alongside page reduction.

This is a one-month pilot with a simple CO₂e factor. A longer horizon would reveal whether habits endure and how seasonality affects printing. Device-level energy telemetry and paper-mix data would refine emissions estimates. Finally, certain compliance steps (e.g., notarization) still require paper; mapping those pockets helps set realistic targets.

Conclusion

Well-implemented scan-to-cloud and e-signatures do reduce printing, especially among high adopters. The lever is not technology availability but adoption quality: coverage, defaults, and simple coaching. When those are in place, page counts and waste both drop, and the sustainability narrative becomes measurable and credible.

Scan-to-cloud and e-sign do more than nudge, they replace the old paper path when introduced as a small, well-designed system. In this pilot, employees printed far fewer pages, wasted less, and cut measurable carbon. The lesson is practical: turn it on, make it easy, show the wins, and the pages will fall.

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