Implementation of Lean Office and Industry 4.0 Technologies to Enhance Administrative Efficiency, Productivity, and Organizational Sustainability: A Case Study in a Public Valuation Office

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Abstract
This study explores how the integration of Lean Office principles and Industry 4.0 technologies specifically IoT, AI, and Big Data for enhances administrative efficiency, productivity, and sustainability in professional service firms. A mixed-methods approach was adopted through surveys and interviews with 44 respondents from a public valuation office in Sidoarjo, Indonesia. Quantitative data were analyzed using multiple regression ($R^2 = 0.908$), revealing that Lean Office ($\beta = 0.281$, $p = 0.016$) and Industry 4.0 ($\beta = 0.253$, $p = 0.020$) significantly improved productivity. 93.18% of respondents acknowledged a reduction in process time after implementation, while 95.45% reported increased productivity. Furthermore, 98% agreed that interdepartmental collaboration improved after digital transformation. These findings suggest that lean-digital integration in administrative settings fosters adaptive work culture, reduces waste, and contributes to organizational sustainability.

***Keywords*:** *Administrative Efficiency, Digital Transformation, Industry 4.0, Lean Office, Smart Office*.

Abstrak
Penelitian ini mengkaji bagaimana integrasi prinsip Lean Office dan teknologi Industri 4.0 terutama IoT, AI, dan Big Data untuk meningkatkan efisiensi, produktivitas, dan keberlanjutan dalam proses administratif organisasi jasa. Pendekatan mixed-method digunakan melalui survei dan wawancara terhadap 44 responden di Kantor Jasa Penilai Publik di Sidoarjo, Indonesia. Analisis regresi berganda ($R^2 = 0{,}908$) menunjukkan bahwa Lean Office ($\beta = 0{,}281$, $p = 0{,}016$) dan Industri 4.0 ($\beta = 0{,}253$, $p = 0{,}020$) secara signifikan meningkatkan produktivitas. Sebanyak 93,18% responden menyatakan terjadi penurunan waktu proses, sementara 95,45% menyatakan produktivitas meningkat. Selain itu, 98%

responden menyatakan kolaborasi antar divisi meningkat setelah transformasi digital. Temuan ini menunjukkan bahwa integrasi lean-digital di sektor administratif mendorong budaya kerja adaptif, mengurangi pemborosan, dan memperkuat keberlanjutan organisasi.

Keywords**:** *Efisiensi Administratif, Transformasi Digital, Industri 4.0, Lean Office, Smart Office*.

1. Introduction

In the era of digital disruption, administrative processes within professional service firms are under increasing pressure to transform. As organizations face growing demands for efficiency, sustainability, and responsiveness, administrative functions can no longer be treated as cost centers but as strategic assets in achieving competitive advantage [1]. The convergence of Lean Office practices and Industry 4.0 technologies has emerged as a promising framework to address these challenges [2], [3].

Lean Office, derived from Lean Manufacturing principles, is designed to eliminate non-value-added activities and streamline business workflows in non-manufacturing environments [4]. Tools such as Value Stream Mapping (VSM), 5S, and Kaizen facilitate continuous improvement and efficiency in administrative settings [5], [6]. However, in isolation, Lean practices face limitations in handling complex and dynamic information environments, which are increasingly prevalent in digital-era service operations.

Industry 4.0 offers a digital extension to Lean principles by integrating technologies such as the Internet of Things (IoT), Artificial Intelligence (AI), Robotic Process Automation (RPA), and Big Data Analytics [7], [8]. These technologies support real-time data processing, predictive decision-making, and cross-functional collaboration capabilities essential for developing smart, responsive, and sustainable office systems [3], [9], [10]. Notably, the synergy between Lean and digitalization has been shown to improve process agility and employee empowerment [11], [12].

Although prior studies have demonstrated the individual benefits of Lean Office and Industry 4.0, comprehensive empirical studies integrating both paradigms in administrative, especially in developing economies, remain scarce. Recent reviews [13], [14] underline the lack of robust case-based evidence on how digital-lean integration affects productivity, culture, and sustainability outcomes in office environments. Furthermore, limited research explores how adaptive work culture and employee collaboration evolve as part of smart office transformation [15], [16].

This gap is particularly critical in the Indonesian public and service sectors, where digital adoption is uneven, and process inefficiencies persist [17]. Most digital transformation initiatives fail to incorporate structured process redesign or lean thinking, leading to partial implementations that deliver suboptimal results [18].

Therefore, the core problem addressed in this research is: How can the integration of Lean Office principles and Industry 4.0 technologies jointly improve administrative efficiency, productivity, and organizational sustainability in a real-world public service organization?

To answer this problem, the research is guided by the following objectives: (1) To quantify the effect of Lean Office practices on administrative efficiency and productivity. (2) To quantify the effect of Industry 4.0 technologies on productivity and operational sustainability. (3) To examine empirically whether the joint implementation of Lean Office and Industry 4.0 produces a synergistic effect on administrative performance. (4) To contextualize quantitative findings through qualitative insights on work culture, collaboration, and sustainability practices.

This study contributes to the state of the art by providing empirical, measurable evidence on the effectiveness of lean-digital integration in non-manufacturing administrative settings an area underrepresented in literature, especially in the Global South. The findings are expected to guide both academics and practitioners in designing smarter, more resilient administrative systems.

2. Method

This study employed an explanatory sequential mixed-methods design, in which quantitative analysis was conducted first to test the statistical relationships between Lean Office, Industry 4.0, and administrative performance, followed by qualitative inquiry to explain and contextualize the quantitative results. The quantitative phase aimed to measure the magnitude and significance of the relationships using multiple regression analysis, while the qualitative phase was used to interpret behavioral, cultural, and organizational changes that could not be fully captured by numerical indicators alone.

The use of mixed methods was justified by the socio-technical nature of lean–digital transformation, where technological efficiency improvements are inseparable from human adaptation, learning behavior, and organizational culture. This approach enhances analytical rigor through triangulation and improves explanatory depth [19], [20]. The study was conducted over three months (November 2024-January 2025) in a public valuation located in Sidoarjo, Indonesia.

2.1 Research Design

A descriptive-exploratory design was adopted, using both quantitative and qualitative strategies. The quantitative component involved the distribution of a structured Likert-scale questionnaire to a census population of 44 employees. The qualitative component comprised in-depth interviews and direct observations to gain contextual insights into lean-digital implementation and its organizational effects. This triangulation allowed validation of results and captured the complexity of behavioral and technological interactions [19].

2.2 Variables and Operational Definitions

Based on the conceptual framework, the variables are classified as follows in Table 1.

Table 1. Operational Definition of Variables

No.	Variable	Type	Indicators
1	Lean Office (X1)	Independent	Value Stream Mapping (VSM), 5S Methodology (Seiri–Shitsuke), Kaizen (Continuous Improvement)
2	Industry 4.0 (X2)	Independent	Internet of Things (IoT) sensors, Artificial Intelligence (AI), and Digital workflow automation
3	Administrative Efficiency (Y1)	Dependent	Reduction in process time, elimination of redundant steps, and standardization of procedures
4	Productivity (Y2)	Dependent	Increased output per staff/hour, improved service quality, and workflow consistency
5	Operational Sustainability (Y3)	Dependent	Reduction in paper usage, energy efficiency, and increased interdepartmental collaboration

Source: Adapted from [21]–[23]

Operationalization of constructs followed prior validated models from [21]–[23]. All constructs were measured using a 5-point Likert scale (1 = strongly disagree, 5 = strongly agree).

2.3 Sampling Technique

This study used a total population sampling (also known as the census method), targeting all 44 employees from key departments, including administration, inspection, finance, and supervisory units. This method was chosen due to the manageable population size and the relevance of every unit to the administrative process chain.

2.4 Data Collection

Primary data were collected via - Questionnaires (quantitative): Covering 13 structured statements and 1 open-ended question, distributed physically and digitally, Semi-structured interviews (qualitative): Conducted with managers and senior officers, On-site observations: Documenting workflow, lean practices, and technology use in real-time.

Secondary data, including company reports, standard operating procedures, and internal performance evaluations, were used to (1) map the pre-implementation administrative workflow, (2) identify baseline inefficiencies, and (3) validate consistency between reported improvements and documented operational changes. These documents supported the interpretation of survey and interview results and ensured that perceived performance improvements were grounded in organizational records rather than subjective perception alone.

2.5 Data Analysis

Statistical tests were conducted to validate instruments and examine the effect of Lean Office and Industry 4.0 on administrative performance below (Table 2).

Table 2. Summary of Statistical Analysis Methods and Interpretations

No	Analysis Type	Method/Test Used	Statistical Result	Interpretation
1	Descriptive Statistics	Frequency & Percentage (SPSS)	Gender: Male 43%, Female 57% Age peak: 22 y.o. (31.8%)	The sample distribution shows a gender and age balance suitable for an office environment
2	Instrument Validity	Pearson Correlation (r > r-table, df = 42, α = 0.05)	All items: r = 0.619–0.779 r-table = 0.304	All indicators are valid ($p < 0.05$), suitable for a regression model
3	Instrument Reliability	Cronbach's Alpha	α = 0.822–0.839 on all constructs	Highly reliable (α > 0.7), consistency between questionnaire items confirmed
4	Normality Test	Kolmogorov–Smirnov (KS Test)	Asymp. Sig. = 0.200	Residuals are normally distributed ($p > 0.05$)
5	Model Fit (Simultaneous Effect)	ANOVA / F-Test	F = 6.663, Sig. = 0.003	The regression model is statistically significant at α = 0.05
6	Coefficient of Determination	R^2 (Model Summary)	R = 0.945, R^2 = 0.908	90.8% of productivity & efficiency explained by Lean Office & Industry 4.0
7	Partial Significance (Per Variable)	Multiple Linear Regression	β(Lean) = 0.281, p = 0.016 β(Industry 4.0) = 0.253, p = 0.020	Both independent variables significantly affect the dependent variable
8	Qualitative Thematic Analysis	[20]	Themes: 1) Resistance to change, 2) Learning culture, 3) Digital facilitation	Supports quantitative findings, enriches organizational insight with context

Source: SPSS Output (2025), Interview Transcripts, Field Observations

2.6 Research Flowchart

To ensure reproducibility, the workflow is summarized in Figure 1 below.

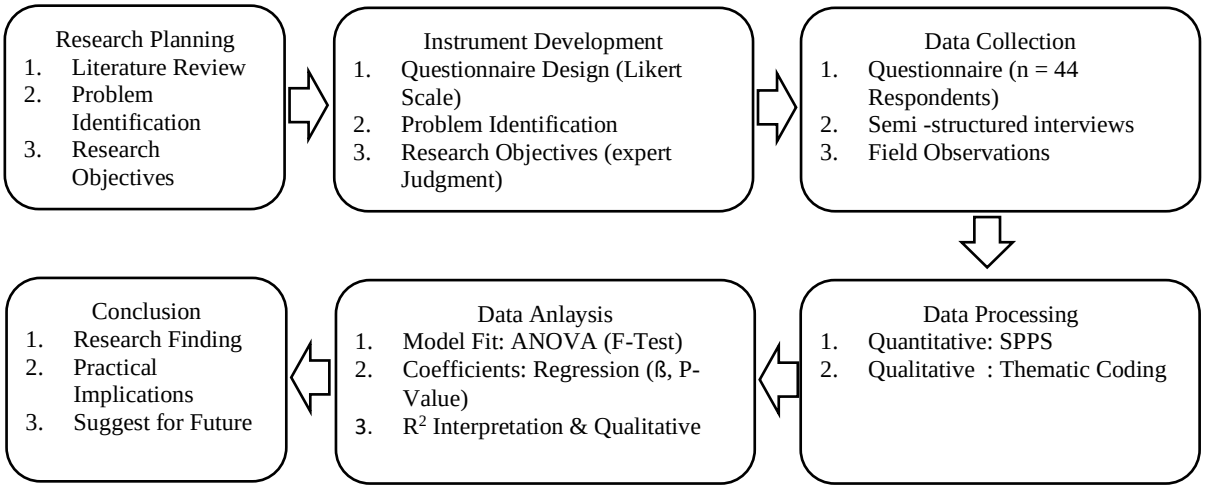


Figure 1. Research Design and Data Processing Flow

This flowchart illustrates the research process from planning to analysis. It integrates both quantitative (SPSS-based) and qualitative (thematic coding) methods, ensuring comprehensive

data triangulation. Each stage from instrument development to model validationis structured to support replicability, clarity, and alignment with mixed-method research standards

3. Results and Discussion

This study explored the impact of Lean Office and Industry 4.0 implementation on administrative efficiency, productivity, and sustainability within a public service organization using a mixed-method approach. The findings confirmed that the integration of these two paradigms has a significant and measurable influence on organizational performance. Quantitative analysis revealed strong statistical associations, while qualitative insights offered nuanced contextual explanations that reinforce the numerical results.

3.1 Model Accuracy and Predictive Power

Multiple linear regression results showed that the combination of Lean Office and Industry 4.0 technologies accounted for 90.8% of the variance in administrative performance outcomes ($R^2 = 0.908$). The F-test result of 6.663 ($p = 0.003$) confirmed the statistical significance of the model. This validates prior findings by [2], [23] regarding the synergistic effect of lean and digital transformation frameworks in service-based.

3.2 Influence of Lean Office on Efficiency

The Lean Office variable demonstrated a positive and significant effect on process efficiency ($\beta = 0.281$, $p = 0.016$). Through the use of tools like 5S, Value Stream Mapping (VSM), and Kaizen, organizations were able to reduce non-value-added activities and standardize workflows. Respondents agreed that such practices increased clarity and reduced redundancy. These results are consistent with [24]–[27], who emphasize that lean principles adapted for offices can shorten lead times and promote structured operations.

3.3 Contribution of Industry 4.0 to Productivity and Sustainability

Industry 4.0 technologies, including IoT, AI-based automation, and digital dashboards, also showed a significant positive impact on administrative performance ($\beta = 0.253$, $p = 0.020$). Employees reported noticeable improvements in speed, accuracy, and service quality. These outcomes echo the findings of [28]–[32], who highlight that Industry 4.0 tools enhance real-time visibility and decision support. Furthermore, interview participants noted reduced error rates and better data transparency, aligning with studies by [33]–[36].

3.4 Thematic Interpretation and Mixed-Method Integration

Qualitative analysis revealed three recurring themes:

(1) Cultural resistance and adaptation,
(2) Digital empowerment, and
(3) Sustainability awareness.

A respondent explained, “Now I spend less time on paperwork and more on actual service. It’s clearer, faster, and less stressful.” This supports the quantitative evidence on improved

productivity and reduced process cycle time. The integration between both data types is summarized below:

Table 3. Mixed-Method Integration of Key Findings

Quantitative Result	Supporting Theme	Qualitative Evidence
Lean Office improves process efficiency	Workflow simplification and clarity	"Now I know exactly which steps matter and which ones don't."
Industry 4.0 increases productivity	Digital empowerment	"The dashboard helps us track and fix things faster than before."
Efficiency leads to sustainability improvements	Environmental awareness	"We reduced so much paper; it feels good and responsible."
Collaboration enhanced through tech integration	Adaptive work culture	"The system forced us to work together more, across teams."

Source: SPSS regression output and thematic coding [20]

These themes confirm that, beyond numerical improvements, the integration of Lean and Industry 4.0 reshaped the organizational mindset and enabled a culture of continuous learning and eco-efficiency. The alignment of employee perception with system output enhances confidence in the intervention's effectiveness.

3.5 Comparison with Previous Studies and Research Gap Fulfillment

This study validates the assertions of [37]–[39], who observed that lean implementation in public service reduces processing time up to 82%. However, unlike previous studies that often focus on isolated implementation (either lean or digital), this research confirms that a combined application produces compounded benefits, particularly in developing economies such as Indonesia.

Moreover, this study contributes a new dimension by contextualizing lean digital synergy within administrative, non-manufacturing service environments, a gap rarely explored in existing Q1–Q3 literature [40]–[42]. This unique contribution makes the findings highly relevant for both practitioners and scholars aiming to implement structured transformation in similar public organizations.

4. Conclusion

This study concludes that the integration of Lean Office practices and Industry 4.0 technologies significantly enhances administrative efficiency, productivity, and operational sustainability in public service organizations. The multiple regression model ($R^2 = 0.908$) indicates that Lean Office and Industry 4.0 jointly explain 90.8% of the variance in administrative performance, confirming their strong and statistically significant contribution to efficiency, productivity, and sustainability outcomes.

Lean Office tools, particularly 5S and Value Stream Mapping, were found to be effective in reducing non-value-added activities and streamlining workflows. Meanwhile, Industry 4.0

technologies such as AI and IoT enable process automation, real-time monitoring, and improved cross-functional collaboration.

Through a mixed-method approach, qualitative insights confirmed the statistical results and revealed cultural shifts, digital empowerment, and increased environmental awareness. These findings underscore the importance of aligning technological transformation with organizational readiness and adaptive work culture.

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