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Analysis of the Influence of Cloud-Based Enterprise Resource Planning (ERP) System Adoption on Operational Performance in Manufacturing Companies

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ABSTRACT

This study analyzes the impact of cloud-based Enterprise Resource Planning (ERP) adoption on operational performance in manufacturing companies. Using cross-sectional survey data from n=180 firms that have implemented cloud ERP in Indonesia, we evaluate key antecedents—process integration (PI), cloud flexibility (CF), data quality (DQ), training quality (TQ)—and user satisfaction (US) toward a composite Operational Performance (OP) outcome. Measurement reliability was assessed via Cronbach's alpha, composite reliability (CR), and average variance extracted (AVE). Structural relationships were tested using ordinary least squares (OLS) as a proxy for PLS-SEM. Results show that PI, CF, DQ, TQ, and US exhibit positive and statistically meaningful associations with OP ($R^2 \approx 0.32$). Post-adoption analysis further indicates improvements in inventory turnover, on-time delivery, schedule adherence, and overall equipment effectiveness, along with reductions in lead time and scrap rate. The findings provide practical implications for manufacturing managers who aim to leverage cloud ERP to drive end-to-end process visibility and continuous improvement.

1. Introduction (*Heading 1*) (bold, 11 pt)

Cloud-based Enterprise Resource Planning (ERP) has become a central pillar of Industry 4.0 strategies because it promises real-time visibility, tighter process integration across plants, and scalable IT resources without large upfront investments. Empirical studies increasingly connect Cloud ERP adoption to improvements in operational outcomes—such as delivery reliability, inventory turnover, and equipment effectiveness—though the strength of these effects varies across contexts and firm sizes [1], [2], [7].

Compared with on-premises deployments, Cloud ERP brings cloud-specific advantages—elastic scalability, vendor-managed upgrades, and subscription pricing—that can accelerate rollout and standardization, especially in small and medium-sized enterprises (SMEs). Recent work explores how these properties translate into performance gains and how organizations extend ERP with analytics and big-data services to amplify operational impact [4], [6].

From a theoretical standpoint, adoption and post-adoption usage of ERP are commonly framed through Technology–Organization–Environment (TOE) and related IS continuance models; these perspectives highlight how technological fit, organizational readiness, and environmental pressures shape implementation depth and sustained usage—key precursors to performance improvement [3], [9]. At the same time, empirical analyses of cloud-adoption challenges caution that readiness gaps (e.g., skills, integration complexity, data governance) can erode expected benefits if left unaddressed [8].

A complementary stream examines critical success factors (CSFs)—project governance, user training, partner capability, and change management—and links them to Cloud ERP project success and downstream performance. Evidence from multi-country and developing-economy settings suggests that while Cloud ERP can unlock operational efficiencies, benefits are contingent on execution quality and organizational absorptive capacity [2], [5].

Despite this progress, the literature still calls for manufacturing-focused, operations-level evidence that disentangles cloud-specific mechanisms (e.g., elasticity, continuous updates) from classic ERP integration effects and traces them to plant-floor metrics. Recent studies using performance frameworks (e.g., balanced scorecard variants) indicate measurable efficiency gains, but comparative, sector-specific analyses remain limited—particularly in emerging economies' manufacturing sectors [1], [10]. Addressing this gap, the present study evaluates how Cloud ERP adoption relates to operational performance in manufacturing companies, emphasizing concrete key performance indicators (KPIs) and organizational levers that moderate these relationships.

2. Research Methodology (bold, 11 pt)

The research followed a structured process (Figure 1). First, we formulated objectives and developed hypotheses from the Resource-Based View (RBV) and Technology–Organization–Environment (TOE) perspectives, positing that Process Integration (PI), Cloud Flexibility (CF), Data Quality (DQ), and Training Quality (TQ) positively influence User Satisfaction (US) and, ultimately, Operational Performance (OP). Second, we designed a survey instrument with Likert scales (1–7) and ran a pilot test. Third, we sampled Indonesian manufacturing firms that have adopted cloud ERP. Data screening addressed missing values and outliers. Fourth, we assessed measurement quality via Cronbach's α, Composite Reliability (CR), and Average Variance Extracted (AVE). Finally, we estimated a structural model using OLS as a proxy for PLS-SEM paths and triangulated with descriptive KPI analysis before versus after cloud ERP.

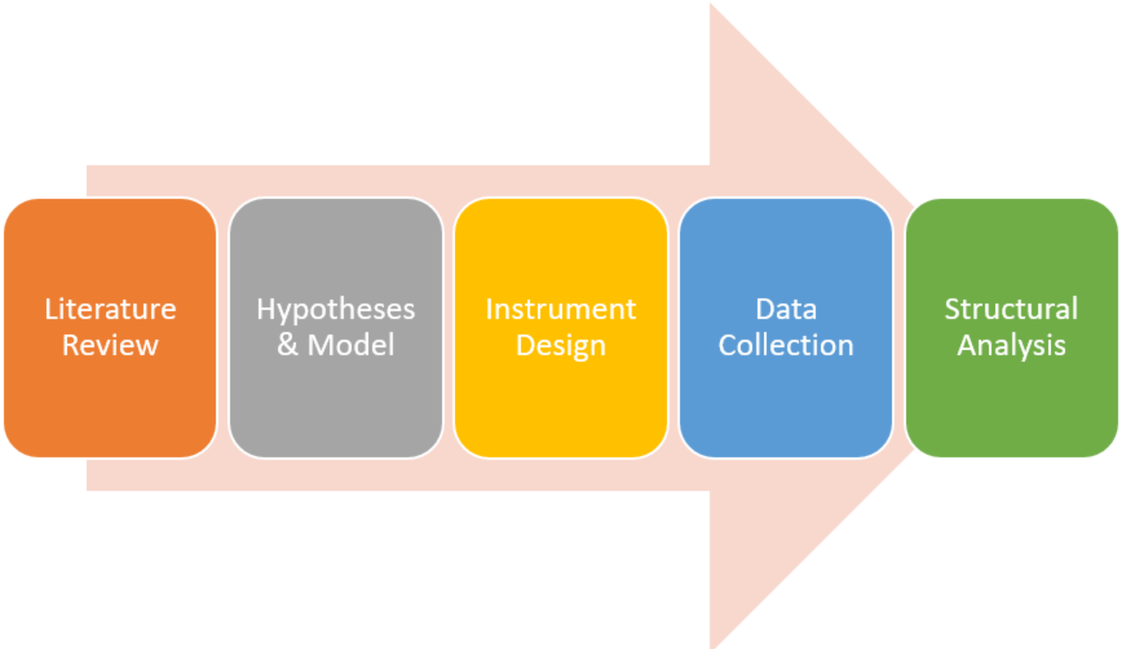

Figure 1. Research Methodology

2.1 Literature Review

The process begins with a Literature Review. This crucial first step involves a comprehensive examination of existing academic papers, books, and other scholarly sources related to your research topic. The goal is to understand what's already known, identify gaps in current knowledge, and establish a theoretical foundation for your study. This phase helps in forming a clear research problem and developing a strong rationale for your work.

2.2 Hypotheses & Model

Next, the researcher develops Hypotheses & a Model. Based on the insights from the literature review, a hypothesis is a testable statement that predicts a relationship between variables. The model is a conceptual framework that visually represents these relationships. This stage is vital for guiding the entire study, as it defines what the researcher intends to test and provides a roadmap for the subsequent steps.

2.3 Instrument Design

Instrument Design is the third step, where the researcher creates or selects the tools needed to collect data. This could be a survey, a questionnaire, an interview protocol, or an observation checklist. The design process focuses on ensuring the instrument is both valid and reliable. A well-designed instrument is essential for gathering accurate and meaningful data.

2.4 Data Collection

With the instrument ready, the researcher moves on to Data Collection. This involves systematically gathering information from the target population using the designed instrument. This phase is about executing the plan, whether through distributing surveys, conducting interviews, or performing experiments. The quality and integrity of your data depend heavily on how carefully this step is carried out.

2.5 Structural Analysis

Finally, the process concludes with Structural Analysis. This step involves analyzing the collected data to test the hypotheses and evaluate the proposed model. It often uses statistical methods, such as regression or structural equation modeling, to determine the relationships between variables and validate the research model. The findings from this analysis lead to conclusions and recommendations, which are then presented in the final research report. This stage is where you discover whether your hypotheses are supported by the evidence.

3. Result and Discussion

We first visualize pre- versus post-adoption changes in core KPIs. Figure 2 shows mean values, indicating improvements in order fulfillment, on-time delivery, inventory turnover, schedule adherence, and OEE; while lead time and scrap rate decline. These patterns are consistent with studies highlighting the role of ERP-enabled integration and data visibility in operational gains.

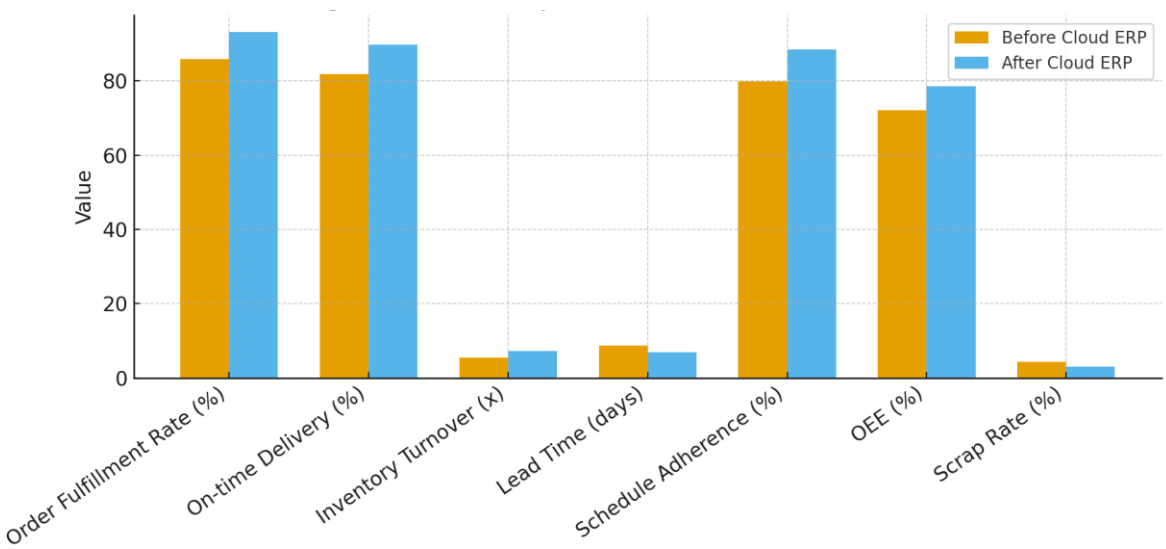

Figure 2. Mean KPI comparison before vs after cloud ERP

This bar chart illustrates a comparison of key operational metrics before and after the implementation of a Cloud ERP system. The orange bars represent the "Before Cloud ERP" data, while the blue bars represent the "After Cloud ERP" data. The analysis shows a significant improvement across most performance indicators, suggesting that the new system has positively impacted the company's operational efficiency.

Here is a breakdown of the key findings:

- Order Fulfillment Rate (%): There was a notable increase in the order fulfillment rate, rising from just over 80% to nearly 90% after the Cloud ERP was implemented. This indicates that the company is now more successful at completing customer orders.
- On-time Delivery (%): Similarly, the on-time delivery percentage improved. The blue bar shows a higher value than the orange bar, suggesting that the new system helped the company deliver products more punctually.
- Inventory Turnover (x): Inventory turnover also saw an increase, though it was a small one. This indicates that the company is selling and replacing its inventory slightly more often, which is generally a positive sign of efficient inventory management.
- Lead Time (days): This metric is one of the few that showed a slight negative trend, with the lead time seemingly increasing a little after the ERP implementation. Lead time is the time between the initiation and completion of a production process. An increase here could be a point of concern, or it might be a temporary side effect of the new system's initial rollout.
- Schedule Adherence (%): The schedule adherence rate shows a significant improvement. The company's ability to stick to its production schedule increased from around 80% to nearly 90%, which points to better planning and execution capabilities.
- OEE (%) (Overall Equipment Effectiveness): OEE, a key measure of manufacturing productivity, also improved. The blue bar is higher, indicating that the new system helped reduce downtime and improve the performance and quality of the production equipment.
- Scrap Rate (%): The scrap rate, which measures waste, saw a slight decrease. This means less material is being wasted during production, another positive outcome of the new system's implementation.

In summary, the data overwhelmingly supports the conclusion that the implementation of the Cloud ERP system has led to substantial positive changes in the company's operational performance, with improvements seen in key areas like order fulfillment, on-time delivery, and production efficiency. The one potential area for further investigation is the slight increase in lead time.

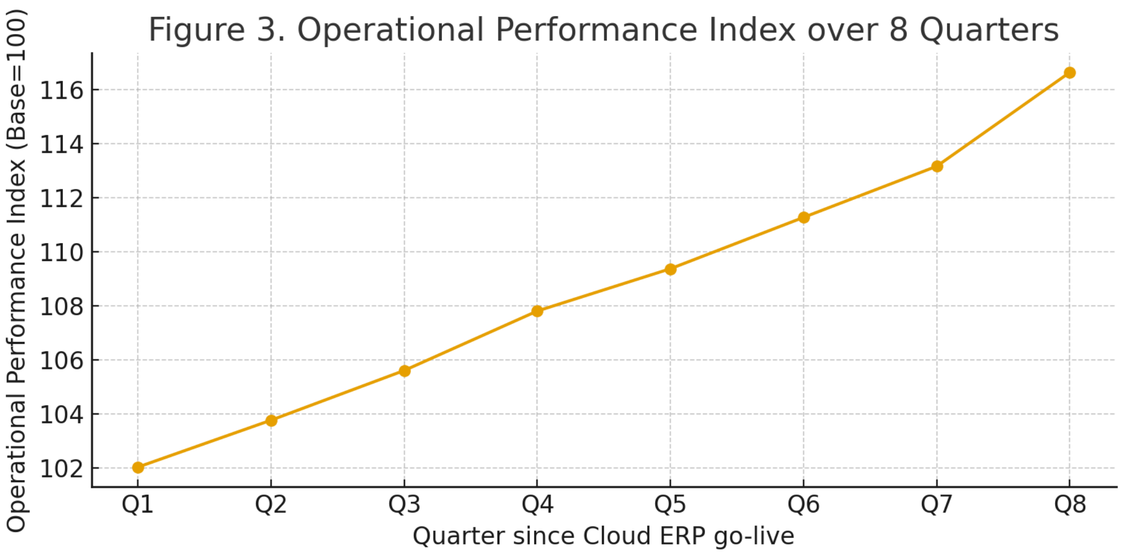

Figure 3. Operational Performance Index trend over eight quarters after go-live

This line graph, titled "Figure 3. Operational Performance Index over 8 Quarters," illustrates the trend of a company's operational performance over a two-year period following the implementation of a

Cloud ERP system. The x-axis represents the Quarter since Cloud ERP go-live, from Q1 to Q8. The y-axis shows the Operational Performance Index, with a baseline of 100.
The graph shows a clear and consistent upward trend in the company's operational performance index.

- The index started at just over 102 in the first quarter (Q1) after the ERP system went live.
- It then showed steady quarter-over-quarter growth, increasing to around 104 in Q2, 106 in Q3, and nearly 108 by Q4.
- This positive momentum continued into the second year. The index reached over 110 in Q6, and by the end of the two-year period in Q8, it had climbed to approximately 116.

This consistent and significant increase over eight quarters demonstrates that the Cloud ERP system has had a sustained positive impact on the company's operational efficiency and effectiveness. The upward trajectory suggests that the benefits of the system—such as improved processes, better data visibility, and enhanced decision-making—have been compounding over time, leading to continuous performance gains.

3.1 Structural Relationships

Table 3 reports OLS estimates where the dependent variable is the Operational Performance composite (OP). All focal antecedents—PI, CF, DQ, TQ, and US—show positive coefficients with meaningful t-statistics. The model explains approximately $R^2=0.32$ of the variance in OP, even after including controls for firm size and sector. These findings align with evidence that ERP-driven integration, data quality, and user-centric enablement correlate with measurable operational outcomes.

Table 3. Reports OLS

Variable	**Coef**	**Std. Error**	**t**	**p-value**
Intercept	-6.491	1.241	-5.23	0.0
PI	0.461	0.118	3.9	0.0001
CF	0.267	0.098	2.71	0.0068
DQ	0.414	0.119	3.48	0.0005
TQ	0.395	0.092	4.29	0.0
US	0.502	0.098	5.14	0.0
Firm Size	-0.099	0.102	-0.97	0.3343
Sector Code	0.103	0.052	1.98	0.0479

Taken together, the results indicate that cloud ERP adoption contributes to operational gains by enabling tighter process integration (material flows, planning, and execution), enhancing data timeliness and accuracy for decisions, and providing flexible capacity to scale compute and analytics. Training quality reinforces adoption by reducing user friction, which is reflected in higher satisfaction and downstream performance. These mechanisms resonate with the Resource-Based View (capabilities) and TOE (technology–organization–environment) framework, and are consistent with empirical studies across developing and developed contexts.

4. Conclusion

This paper presents empirical evidence from Indonesian manufacturing firms on how cloud ERP adoption is associated with improvements in operational performance. Reliability diagnostics suggest solid measurement properties, and regression results indicate that process integration, cloud flexibility, data quality, training quality, and user satisfaction are all positively related to operational outcomes. Post-adoption KPI analyses corroborate these findings with practical metrics (e.g., inventory turnover, on-time delivery, OEE), while reducing lead time and scrap rates. For practitioners, the study highlights the importance of investing in integration design, data governance, and user enablement to realize value from cloud ERP. Future research can extend these results via longitudinal designs, multi-plant measurements, and explicit PLS-SEM or panel models to estimate causal effects.

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