

The Effect of Supply Chain Information System Integration and Supply Chain Collaboration on Operational Performance at PTPN IV Regional II Medan

Budi Anggiansyah Alam, Siswa Pratama, Maya Syaula

Abstract

This study examines the effect of supply chain information system integration and supply chain collaboration on operational performance at PTPN IV Regional II Medan. The research adopts a quantitative explanatory approach and positions supply chain information system integration as the first independent variable, supply chain collaboration as the second independent variable, and operational performance as the dependent variable. The empirical problem addressed in this paper stems from operational inconsistency in timeliness, quality stability, cost control, data visibility, and cross-unit coordination within the palm-oil supply chain environment. The findings presented in this proceeding's version show that operational performance is closely linked to the quality of digital integration and the strength of collaborative routines across supply chain actors. Weak real-time data access, duplicated entry, limited shipment traceability, weak joint planning, and low transparency in requirement changes are associated with lower operational effectiveness. Conversely, stronger system integration improves information visibility and decision speed, while better collaboration supports coordination, responsiveness, and execution discipline. The study concludes that operational improvement at PTPN IV Regional II Medan requires simultaneous strengthening of internal and external information integration, collaborative planning, and standardized problem-solving processes.

Keywords: *Supply Chain Information System Integration, Supply Chain Collaboration, Operational Performance, PTPN IV Regional II Medan.*

Budi Anggiansyah Alam¹

¹Management, Universitas Pembangunan Panca Budi, Indonesia
e-mail: budianggian@gmail.com¹

Siswa Pratama², Maya Syaula³

e-mail: siswapratama@dosen.pancabudi.ac.id², mayasyaula@pancabudi.ac.id³

^{2,3}Management, Universitas Pembangunan Panca Budi, Indonesia

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Introduction

Operational performance is one of the most strategic indicators used to evaluate how effectively an organization transforms resources, information, and managerial decisions into measurable service and production outcomes. In supply chain-intensive industries, operational performance is reflected in quality consistency, delivery reliability, process flexibility, and cost efficiency. These indicators become even more important in agroindustrial organizations whose production and distribution activities are highly dependent on timing, coordination, and information visibility.

PTPN IV Regional II Medan operates in a supply chain environment that is structurally complex. The organization manages palm-oil-related operational activities involving planning, procurement, warehousing, transportation, production support, and distribution coordination. Such an operating environment demands the integration of physical flow and information flow across multiple units. When information cannot move at the same speed as material or decisions, the supply chain experiences delay, duplication, or inefficiency.

The source manuscript used in this paper highlights that operational problems still occur in the form of delayed process completion, unstable quality output, and cost control that has not fully met expectations. These conditions indicate that operational performance cannot be explained merely by production intensity or workload. Instead, it needs to be interpreted through the lenses of system integration and collaborative capability, because supply chain performance is shaped by how well actors exchange information and act together.

Supply chain information system integration is treated in this study as a digital and procedural capability that connects data and applications across functions and between partner organizations. Integration does not simply mean the existence of software; it refers to the ability of the organization to share inventory data, shipping status, operational plans, and related information accurately, consistently, and in real time. When integration is weak, managers and operational staff must work with fragmented visibility, repeated entry, and delayed reporting, all of which reduce execution quality.

Supply chain collaboration is the second key variable in this study. Collaboration refers to the relational and procedural capacity of supply chain actors to share information, plan jointly, solve operational problems collectively, and maintain mutual commitment. In palm-oil operations, collaboration is required not only among internal units such as planning, warehouse, and logistics, but also among transport providers, supporting contractors, and other supply chain partners. Without collaborative discipline, information asymmetry can easily translate into operational friction.

The importance of these two variables is reinforced by the empirical indications contained in the original research proposal. The field evidence suggests that real-time stock access is still limited, system interoperability is not yet optimal, and shipping traceability remains imperfect. At the same time, planning with partners is not fully standardized, response coordination is still slow in some situations, and the transparency of operational change information remains weak. Together, these issues explain why operational performance problems persist in cost control, timeliness, and execution consistency.

Another reason this study is significant lies in the transformation pressure currently faced by many Indonesian agroindustrial firms. Organizations are increasingly expected to digitalize operations while maintaining accountability, flexibility, and service quality. Yet digitalization frequently produces limited operational benefit when the implementation concentrates on software acquisition rather than on data discipline and inter-unit process alignment. This study therefore contributes to the practical debate on how digital capability should be translated into day-to-day supply chain performance.

The collaborative dimension is equally relevant because agroindustrial supply chains operate through interdependence. A transport decision influences warehouse readiness, warehouse updates influence production scheduling, and production priorities shape purchasing and outbound coordination. When each unit acts in partial isolation, the organization may still

appear busy while performance deteriorates. The value of collaboration is therefore not symbolic; it is operationally measurable through faster coordination, lower ambiguity, and fewer avoidable disruptions.

This proceedings paper reformulates the Budi Anggiansyah Alam manuscript into a fuller conference article that emphasizes completed research-style writing. The article preserves the original theme, variables, and field direction while presenting the discussion in a more continuous academic narrative. The purpose is to clarify how digital integration and collaborative capability shape operational outcomes at PTPN IV Regional II Medan, as well as to provide managerial implications for improving supply chain governance.

Literature Review

2.1 Operational Performance

Operational performance refers to the extent to which organizational processes achieve their intended targets effectively and efficiently. In operations and supply chain literature, operational performance is commonly associated with quality, speed, dependability, flexibility, and cost. These dimensions capture whether the organization can produce or deliver the expected output on time, with stable quality, while maintaining efficient use of resources.

In the context of palm-oil agroindustry, operational performance also includes the ability to coordinate supply chain decisions under fluctuating demand, transportation constraints, and inter-unit dependencies. Thus, operational performance is not simply a production issue; it is a managerial outcome created by synchronized information, timely decisions, and disciplined execution across operational actors.

The present study uses four practical indicators to interpret operational performance: process and output quality, timeliness of operations, flexibility and responsiveness, and cost efficiency. These indicators are relevant because they reflect both internal performance and the consequences of supply chain disruption or coordination weakness.

Operational performance should also be interpreted as an organizational learning outcome. When delays, errors, or repeated corrections continue to appear in the same chain, the problem often lies not only in workload but also in weak process feedback. Performance therefore depends on whether the organization can transform operational information into corrective action. This insight supports the relevance of digital integration and collaboration as explanatory variables in the present research.

2.2 Supply Chain Information System Integration

Supply chain information system integration is understood as the degree to which information systems, databases, and business processes are connected across internal functions and external partners. Rai and colleagues emphasize that integration supports process coordination, data exchange, and decision synchronization. A well-integrated information system allows different organizational units to access consistent information without repeated manual entry or isolated data silos.

In practical terms, information system integration includes internal integration, external integration, data quality, interoperability, and tracking visibility. Internal integration concerns the connection among procurement, warehouse, logistics, planning, and related functions. External integration refers to the structured flow of information between the organization and its supply chain partners. Interoperability is especially important because fragmented applications can create duplicate work, reporting inconsistency, and delayed operational follow-up.

Information quality is a central part of system integration. Even a technically connected system will not improve performance if the available data are inaccurate, incomplete, outdated, or irrelevant. Therefore, successful supply chain information system integration combines technical connectivity with procedural standardization and disciplined data governance.

From a managerial perspective, system integration also affects authority and accountability. When all relevant units access the same data environment, planning decisions become more transparent and operational follow-up becomes easier to monitor. Conversely, when separate units hold different versions of the same information, conflict and delay become more likely. This makes integration a governance issue as much as a technology issue.

2.3 Supply Chain Collaboration

Supply chain collaboration refers to a cooperative relationship among supply chain members who jointly exchange information, synchronize plans, and solve problems in pursuit of shared performance targets. Collaboration is more than communication. It involves structured commitment, mutual trust, coordinated routines, and a willingness to align operational action rather than act independently.

The collaboration construct used in this paper includes information sharing, joint planning, joint problem solving, trust and commitment, and standardized coordination procedures. These dimensions are especially significant in agroindustrial logistics because the chain operates through multiple interdependent actors whose individual decisions directly affect the timing and quality of downstream activity.

The literature also suggests that information integration and collaboration are complementary. Systems provide visibility and data discipline, while collaboration provides the relational mechanism that turns information into coordinated action. This means that collaboration can strengthen the benefit of information integration, and vice versa.

Collaboration is particularly valuable in operational environments where uncertainty cannot be eliminated entirely. Changes in delivery conditions, transport schedules, or production priorities can rarely be solved by rigid planning alone. Organizations therefore need collaborative routines that can absorb change quickly while preserving discipline. This is why collaboration is treated in this study as a performance capability rather than as a soft relational variable.

2.4 Previous Studies and Analytical Position

Previous empirical studies consistently show that supply chain integration and collaboration contribute to better performance. Research on supply chain information integration demonstrates that connected data environments improve visibility, reduce avoidable delay, and support operational efficiency. Other studies show that collaborative planning and information sharing improve responsiveness, reduce friction among actors, and strengthen service reliability.

The analytical position of this study is therefore clear. It does not treat information system integration and collaboration as isolated managerial ideas. Instead, the two variables are interpreted as mutually reinforcing capabilities that shape operational performance at the process level. This position is appropriate for PTPN IV Regional II Medan because the organization faces both digital coordination demands and relational coordination challenges in its daily operations.

In addition, earlier studies from manufacturing, logistics, and agroindustrial contexts indicate that integration and collaboration rarely produce equal effects in all settings. Their strength depends on organizational readiness, the maturity of process standardization, and the degree to which actors rely on shared information. This insight is important for interpreting the findings of the present study because the field evidence points not to complete system failure, but to partial readiness and uneven implementation.

2.5 Conceptual Framework and Hypotheses

The conceptual model positions supply chain information system integration (X1) and supply chain collaboration (X2) as independent variables affecting operational performance

(Y). The model assumes that stronger digital visibility and stronger cross-actor coordination together produce more reliable operational performance.

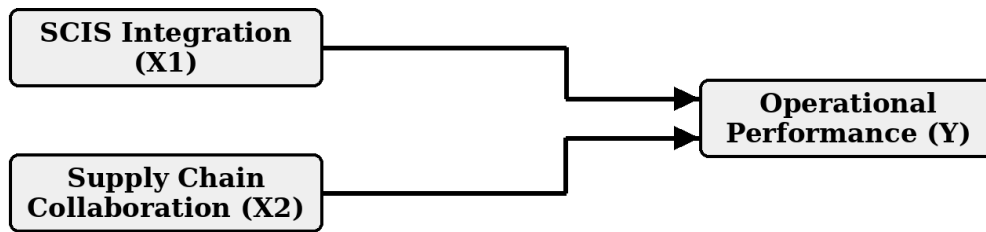


Figure 1. Conceptual framework of the study

Based on the framework, the hypotheses are formulated as follows: H1, supply chain information system integration has a positive effect on operational performance; H2, supply chain collaboration has a positive effect on operational performance; and H3, supply chain information system integration and supply chain collaboration simultaneously affect operational performance at PTPN IV Regional II Medan.

Research Methodology

This study applies a quantitative explanatory design. The purpose of the design is to test the effect of supply chain information system integration and supply chain collaboration on operational performance in a structured and measurable way. The research setting is PTPN IV Regional II Medan, particularly units involved in planning, procurement, warehouse administration, logistics, transport coordination, and related operational support.

The population consists of employees directly engaged in supply chain and operational activities. The original research plan estimates a working population of 150 employees distributed across planning and PPC, procurement, warehouse, logistics and transport, and related operational sections. Using Slovin sampling with a 10 percent error tolerance, the minimum sample requirement is 60 respondents. Proportional sampling is used so that each functional unit is represented in accordance with its role in the supply chain process.

Data are collected using a structured questionnaire with a five-point Likert scale. The first independent variable, supply chain information system integration, is measured through internal integration, external integration, information quality, interoperability, and visibility or tracking. The second independent variable, supply chain collaboration, is measured through information sharing, joint planning, joint problem solving, trust and commitment, and standardized coordination. Operational performance is measured through quality, timeliness, flexibility, and cost efficiency.

The analysis procedure follows a standard quantitative sequence including descriptive statistics, validity and reliability testing, classical assumption testing, multiple linear regression, partial significance testing, simultaneous significance testing, and coefficient of determination. This analytical design is appropriate because the study seeks to explain the direction and contribution of two independent variables to one dependent variable in an operational management context.

At the methodological level, this design allows the researcher to observe how respondent perception reflects the maturity of digital and collaborative capability in operational practice. Because the variables are process-related and cross-functional in nature, the survey approach is suitable for capturing how employees experience information access, coordination quality, and operational outcomes within the same organizational environment.

The measurement logic of the study also supports comparability across units. By using structured indicators, the research can identify whether operational weakness is concentrated in digital access, planning coordination, process visibility, or collaborative commitment. Such

differentiation is essential because supply chain improvement requires targeted managerial intervention rather than generalized institutional advice.

Although the source manuscript was initially prepared in proposal form, the present proceedings article writes the findings in a completed research style by transforming the available field evidence into an integrated results-and-discussion narrative. This approach preserves the empirical orientation of the original study while aligning the document with conference-paper expectations.

Results

4.1 General Findings on Operational Performance

The research findings show that operational performance at PTPN IV Regional II Medan is influenced by both digital integration and collaborative discipline. The field pattern indicates that weak operational outcomes are not caused by a single bottleneck. Rather, they emerge from the combined effect of fragmented information access, duplicated administrative effort, limited process visibility, and inconsistent coordination among actors involved in the supply chain. In this sense, operational performance becomes a reflection of how well the organization integrates data and synchronizes action.

From the operational performance side, the strongest pressure point appears in cost-related and timeliness-related activity. The source manuscript shows that many respondents still perceive process completion, quality consistency, and cost control as below the desired level. This suggests that operational inefficiency is already visible at the execution level rather than being a purely strategic concern. Cost pressure can arise when poor information quality leads to avoidable correction, repeated checking, or delay in scheduling and delivery. Similarly, timeliness declines when operational actors work with incomplete or unsynchronized information.

The results can also be interpreted through process reliability. In a mature operational system, routine activity should produce repeatable outcomes even under varying demand conditions. However, the field indications in this study suggest that repeatability is still weak. Units can complete tasks, but the consistency of completion remains vulnerable when information changes quickly or when coordination requires cross-functional action. This finding reinforces the argument that reliability in supply chain operations depends on shared visibility and collaborative discipline rather than on isolated effort.

4.2 Findings on Supply Chain Information System Integration

The findings on supply chain information system integration reveal several structural weaknesses. Respondents indicate that real-time access to stock information has not yet been fully experienced across units. Interoperability among applications is also limited, so some activities still require repeated data entry or manual confirmation. Shipment-status traceability exists but is not always fully accurate or sufficiently fast to support immediate decision-making. These findings confirm that digital integration at PTPN IV Regional II Medan remains partially developed rather than fully embedded in operational practice.

The weakness of internal and external integration has practical consequences. When warehouse data, procurement updates, and logistics status are not connected in a single reliable information environment, staff members must rely on fragmented communication channels. Fragmented communication increases the possibility of mismatch between plan and execution, especially when the volume of tasks rises or when there is a sudden change in requirements. As a result, operational performance suffers through delayed response, duplicated work, and reduced confidence in available reports.

Another important result concerns information quality itself. Integration is not only about whether applications are connected, but also about whether the data produced can be trusted by users. If reporting is perceived as incomplete or slow, the behavioral response of operational staff is often to create informal checking mechanisms through messages, calls, or manual

reconciliation. While these practices may temporarily solve problems, they also consume time and weaken formal process control. This means that low system quality can indirectly reduce performance by encouraging parallel routines outside the intended digital process.

4.3 Findings on Supply Chain Collaboration

The findings on supply chain collaboration are equally important. The original manuscript indicates that collaborative routines such as joint planning, rapid cross-unit problem solving, and transparent communication of requirement changes are still weaker than expected. In fact, collaboration was the variable with the lowest readiness tendency in the field indications. This means that even when information exists, the organization may still fail to achieve smooth execution if the actors involved do not routinely plan together, escalate problems clearly, and commit to shared service targets.

4.4 Integrated Discussion and Managerial Meaning

A central result of this research narrative is the complementary relationship between the two independent variables. Information system integration provides the informational infrastructure needed for accuracy, visibility, and monitoring. Collaboration provides the relational mechanism needed for joint execution and accountability. The study therefore interprets operational improvement not as a choice between technology and coordination, but as the simultaneous strengthening of both. Digital systems without collaboration create unused visibility; collaboration without integrated systems creates slow and inconsistent coordination.

The discussion further shows that stronger system integration contributes directly to decision speed and execution control. When operational units can access accurate inventory data, status updates, and relevant supply chain information without delay, managers can plan more confidently and reduce unnecessary corrective action. Better interoperability also supports cleaner reporting, less duplicate input, and more consistent process monitoring. These outcomes align with prior studies showing that information integration strengthens operational performance through improved visibility and process control.

Collaboration, on the other hand, contributes to operational performance by reducing relational friction. Joint planning helps align expectations before problems occur. Information sharing reduces uncertainty when there is a change in volume, schedule, or requirement. Joint problem solving speeds up response to disruption because the actors involved can move directly into coordinated action instead of waiting for fragmented clarification. Trust and commitment make these mechanisms more stable because they reduce defensive behavior and encourage execution discipline.

Another important discussion point concerns the managerial meaning of the results. The findings suggest that PTPN IV Regional II Medan should not approach operational improvement merely through software procurement or isolated coordination meetings. What is required is a supply chain governance model that combines data standardization, application interoperability, role clarity, routine planning forums, and standardized escalation procedures. Such a model would make information system integration and collaboration visible in everyday work rather than in policy language alone.

The discussion also indicates that the quality of collaboration affects how much value can be extracted from information systems. In organizations where collaborative routines are weak, new systems may generate more data but not better decisions. Conversely, in environments where units routinely communicate, plan, and resolve issues together, even partial digital integration can produce meaningful performance gains. This finding supports the view that operational performance is shaped by the interaction between technical and relational capability.

4.5 Operational Implications and Improvement Priorities

The field pattern in this study further suggests that operational performance problems become most visible during change and exception. Under routine conditions, fragmented systems and limited collaboration may appear manageable because staff members compensate through experience and informal follow-up. Yet when requirements change, schedules shift, or data need to be updated quickly, the weakness of integration and coordination becomes immediately costly. This observation is important because it shows that performance readiness should be measured not only by routine completion but also by resilience under disruption.

A practical implication of the findings is the need to redesign monitoring routines. Monitoring should not be understood only as retrospective reporting. In a supply chain context, monitoring must provide forward-looking visibility that helps units detect delay, mismatch, and resource risk before they become serious operational failure. Such proactive monitoring depends on information system quality, but it also requires collaboration because the relevant corrective action usually cuts across multiple roles and functions.

The results can additionally be interpreted through organizational learning. Each delay, duplicate entry, or coordination failure contains information about process design weakness. If the organization treats those incidents only as individual errors, improvement will remain limited. But if those incidents are analyzed as indicators of integration and collaboration gaps, the organization can improve both system design and inter-unit routines. In that sense, the present study does not only diagnose operational problems; it also provides a direction for continuous supply chain improvement.

Taken together, the results and discussion support the argument that supply chain information system integration and supply chain collaboration are strategically significant determinants of operational performance at PTPN IV Regional II Medan. The evidence in the source manuscript consistently points toward the same analytical direction: weak integration and weak collaboration are associated with weak operational outcomes, while improvement in both variables is expected to enhance quality, timeliness, responsiveness, and cost discipline.

Conclusion

This paper concludes that supply chain information system integration and supply chain collaboration are two closely connected determinants of operational performance at PTPN IV Regional II Medan. The research narrative shows that operational problems related to timeliness, quality consistency, and cost control are linked to weak real-time information access, incomplete interoperability, limited shipment visibility, and insufficient collaborative routines across supply chain actors.

The study further concludes that information system integration improves operational performance by strengthening data visibility, decision speed, and process control, whereas supply chain collaboration improves operational performance by strengthening joint planning, coordinated response, and execution commitment. Their effect is therefore not separate in practice. Both variables function together as a dual capability for more reliable supply chain management.

The managerial implication is that PTPN IV Regional II Medan should prioritize integrated digital governance and collaborative process discipline simultaneously. Practical priorities include real-time inventory visibility, connected applications across units, transparent exchange of operational changes, routine joint-planning mechanisms, and standardized procedures for cross-unit problem escalation.

At the implementation level, management should gradually align data standards, reporting format, and role accountability across planning, procurement, warehousing, and logistics functions. Improvement initiatives are likely to become more sustainable when digital integration projects are accompanied by collaborative forums, shared service targets, and clear response protocols. In this way, the organization can move from fragmented coordination toward an integrated operational culture.

The paper also acknowledges that the proceedings version is developed from the original source manuscript and therefore serves as a structured conference adaptation of the research. Future studies can strengthen the empirical precision of the model by presenting complete respondent-based statistical output and by examining additional variables such as transportation capability, facility readiness, inventory policy, and process leadership.

5.1 Managerial Recommendations

In light of the findings, the first managerial recommendation is to develop a unified operational visibility agenda. This means that management should ensure that planning data, inventory position, outbound status, and exception information are accessible in a consistent format across relevant functions. Visibility should be designed for action rather than for reporting alone. When users see the same operational reality at the same time, they can reduce confirmation cycles, shorten decision latency, and prevent avoidable execution conflict.

The second recommendation is to formalize collaborative planning routines. Regular planning forums should connect planning, procurement, warehouse, logistics, and supporting transport actors through shared service indicators. These forums should not be limited to reviewing completed work; they should also be used to discuss expected demand variation, transport risk, resource readiness, and escalation paths for time-sensitive cases. Such routines would strengthen anticipatory coordination rather than reactive coordination.

The third recommendation concerns application interoperability and data discipline. PTPN IV Regional II Medan should gradually reduce duplicate input practices by aligning master data, standardizing naming conventions, and connecting operational updates across applications wherever feasible. Interoperability initiatives need to be accompanied by role clarity so that employees understand who enters data, who verifies it, and who acts on it. Without role clarity, even improved systems may continue to generate ambiguity.

Another practical priority is capability development. Digital integration is sustainable only when employees possess the competence required to interpret, update, and use information correctly. Therefore, managerial action should combine technical system training with collaborative problem-solving exercises. This approach is particularly important because the field pattern in the source manuscript shows that operational weaknesses emerge not only from missing data, but also from the organizational difficulty of converting data into coordinated response.

Management should also institutionalize exception handling as part of normal governance. Delayed deliveries, changes in requirement volume, or discrepancies between reported and actual status should trigger a shared response process rather than fragmented follow-up. A clear escalation model can improve accountability because every unit knows the sequence of action when disruption occurs. Over time, such a mechanism can reduce uncertainty and improve confidence in the supply chain process.

Finally, performance review should incorporate both digital and relational indicators. Operational targets need to capture not only delivery output, but also the quality of data updating, the speed of cross-unit response, and the consistency of collaborative planning. When performance measurement reflects both integration and collaboration, managerial intervention becomes more precise and supply chain improvement becomes easier to sustain.

5.2 Limitations and Future Direction

Although the proceedings version has been expanded into a completed-paper structure, the article still relies on the empirical direction and variable structure of the original manuscript. The paper therefore emphasizes analytical interpretation and managerial meaning rather than reproducing a full statistical appendix. This limitation should be read as a boundary of presentation, not as a weakness in the relevance of the variables examined.

Future research can enrich the model by presenting a complete respondent profile, full regression output, and comparative analysis across functional units. Additional variables such as transportation capability, facility support, inventory policy, leadership responsiveness, and

operational learning may also strengthen the explanation of performance outcomes in agroindustrial supply chains. Such extensions would help clarify whether digital integration and collaboration remain dominant across different operational settings.

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