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Reducing the Procurement Lead Time for Agreed Stock Item in Procurement Division of PT Alami Mandala Indonesia

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ABSTRACT
This research addresses the persistent issue of extended procurement lead times for Agreed Stock Items (AGSI) at PT Alami Mandala Indonesia (AMI), which consistently exceed the 14-day target, disrupting mining operations and increasing costs. The study aims to identify the root causes of these delays and develop actionable solutions to enhance procurement efficiency. Employing a mixed-methods approach within a DMAIC framework, the research integrates qualitative insights from interviews with quantitative analysis of 2023–2024 SAP data. Tools such as fishbone diagrams, current reality trees, and the analytic hierarchy process (AHP) were used to diagnose bottlenecks—including repetitive bidding cycles, unclear specifications, and manual processes. Findings reveal that implementing long-term agreements (LTAs) with key suppliers is the most effective strategy, significantly reducing lead times by eliminating redundant bidding. The successful pilot of LTAs for critical categories like CHPP consumables and chemicals resulted in measurable lead time reductions and cost savings. The research provides a practical roadmap for procurement optimization, highlighting the importance of strategic supplier partnerships and process standardization to build a more resilient and efficient supply chain in the mining sector.

KEYWORDS Procurement Lead Time, Agreed Stock Items, Long Term Agreements, Supply Chain Efficiency

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INTRODUCTION

In today's fast-paced and competitive business environment, the efficiency of procurement processes has become a critical factor for organizational success. Procurement lead time, defined as the duration between the initiation of a purchase requisition and the release of the purchase order to suppliers, impacts a company's operational efficiency, cost management, and ability to meet customer expectations. Globally, industries face multifaceted challenges—such as supply chain disruptions exacerbated by geopolitical tensions, increasingly complex regulatory compliance requirements, volatile commodity markets, and rapidly evolving customer demands—that collectively intensify delays in procurement processes (Da Silveira et al., 2022; Kayikci et al., 2023).

The supply chain process forms the backbone of any industry, ensuring that materials and services are delivered in a timely manner to support operations. Effective supply chain management minimizes waste, reduces costs, and improves overall operational efficiency. In industries with complex operational demands, such as mining—characterized by remote locations, specialized equipment requirements, and stringent safety standards—the role of a robust and responsive supply chain becomes even more critical (Abdullateef et al., 2022; Harywibowo & Hariadi, 2022). Procurement inefficiencies within the supply chain can lead to delays, increased costs, and lost opportunities, highlighting the need for constant evaluation and improvement of these processes (Basiru et al., 2022, 2023; Seidman & Atun, 2017).

Indonesia, as one of the world's largest producers and exporters of coal, contributes significantly to the global energy market and national economy. However, the coal mining industry faces inherent operational challenges, including remote site locations in difficult terrain, strict environmental and safety regulatory compliance, dependence on highly specialized equipment and technical services, and complex logistics infrastructure (Harywibowo & Hariadi, 2022). These contextual factors create a particularly challenging procurement environment where traditional approaches often prove inadequate. As global attention increasingly focuses on sustainable development and environmental responsibility, the coal mining industry faces mounting scrutiny regarding its environmental and social impact. Companies are under growing pressure to adopt sustainable practices, including reducing carbon footprints, enhancing resource efficiency, and ensuring ethical supply chain operations. Procurement processes play a vital role in achieving these sustainability goals by sourcing eco-friendly materials, reducing waste in supply chain operations, ensuring supplier compliance with environmental standards, and promoting circular economy principles. Balancing operational efficiency with sustainability imperatives is crucial for companies aiming to remain competitive while addressing global environmental concerns and stakeholder expectations (Bhattacharjee et al., 2025; Nweje & Taiwo, 2025; Srivastava, 2024; Zakaria, 2025).

PT Alami Mandala Indonesia (AMI) is a prominent player in the Indonesian coal mining sector, having established itself as a reliable supplier of metallurgical coal essential for steel production. With an annual production capacity exceeding 5 million tons and operations spanning multiple mining sites across Kalimantan, the company's ability to maintain efficient operations is increasingly critical in a competitive global market. As global demand for sustainable energy solutions grows, procurement delays have emerged as a significant issue for AMI, impacting project timelines, operational costs, and overall competitiveness in the energy market (Eleiwi & Habeeb, n.d.; Elhamahmy et al., 2025; Mahmood et al., 2024; Oshilalu, 2024). Specifically, data from 2023–2024 revealed that 66.2% of AGSI procurement transactions exceeded the 14-day target, with an average lead time of 31.6 days—representing a 126% deviation from organizational objectives. This translates to USD 1.86 million in delayed procurement value, creating cascading effects on production schedules, inventory management, and equipment maintenance programs.

This study aims to investigate the factors contributing to these delays and propose actionable strategies to enhance the efficiency of procurement processes. The company has several OKRs (Objectives and Key Results) that are translated into divisional and individual job goals, with a primary focus on minimizing procurement lead time for repeat materials or Agreed Stock Items (AGSI), which are crucial for maintaining operational continuity. Given the magnitude of this challenge and its operational impact several critical research questions emerge: What are the primary root causes driving excessive procurement lead times for AGSI materials? Which process bottlenecks contribute most significantly to these delays? What strategic interventions can effectively reduce lead times while maintaining quality and compliance standards? How can best-practice procurement strategies be adapted to AMI's unique operational context?

To address these research questions systematically, this study establishes the following research objectives: (1) to identify and analyze the key factors contributing to delays in procurement lead time through comprehensive root cause analysis utilizing Fishbone Diagrams and Current Reality Trees; (2) to evaluate and prioritize potential solutions for minimizing these delays using the Analytic Hierarchy Process (AHP) and weighted scoring methods based on stakeholder input; (3) to explore and adapt best-practice procurement strategies—including Long-Term Agreements, consignment stock programs, and system enhancements—to improve procurement lead time performance within the mining industry context; and (4) to develop and validate an actionable implementation roadmap with measurable performance indicators to guide solution deployment.

The scope of the research is limited to the Procurement Division, particularly the Strategic Sourcing and Procurement Department, focusing on the OKR related to PR-to-PO lead time for repeat materials and utilizing data from 271 AGSI items across five critical categories: CHPP Spare Parts, Chemicals, CHPP Consumables, Electrical & Instrument, and Auxiliary Equipment Spare Parts. These represent a combined procurement value of USD 2.44 million during the study period.

This research addresses significant gaps in the existing literature. While previous studies have examined procurement optimization in manufacturing and service sectors (Ali & Deif, 2022; Gunasekaran & Ngai, 2008), limited research has focused specifically on AGSI procurement challenges in remote mining operations within the Indonesian context. Furthermore, few studies have systematically integrated multiple analytical frameworks (DMAIC, Fishbone, CRT, Kraljic Matrix, AHP) to address procurement inefficiencies in resource-intensive industries. This study contributes to both academic knowledge and practical application by demonstrating how established quality management and decision analysis tools can be synergistically applied to solve complex procurement challenges in demanding operational environments. The urgency of this research is underscored by the accelerating pace of global supply chain transformation, increasing competitive pressures in commodity markets, and the imperative for mining companies to demonstrate operational excellence while meeting sustainability commitments (Jayasinghe et al., 2025; Jones, 2024).

METHOD

The research adopted a pragmatic mixed-methods approach. This methodological triangulation enhanced the validity and reliability of findings while providing actionable insights grounded in empirical data and contextual understanding. Data collection combined qualitative and quantitative methods for a comprehensive view of the issues.

The methodology followed the DMAIC framework. In the Define phase, the problem was identified through observations and analysis of OKR reports, highlighting excessive lead times as a gap between current performance and targeted outcomes. The Measure phase analyzed procurement transaction data using Pareto analysis to pinpoint significant contributors to delays. The Analyze phase collected primary data through interviews with procurement agents and secondary data from SAP reports, employing Fishbone Diagrams and Current Reality Trees to identify root causes, including a repetitive bidding process. The Improve phase streamlined this bidding process and proposed solutions such as long-term agreements with vendors. The Control phase sustained these changes through process standardization and continuous monitoring. Integrating qualitative insights from interviews with quantitative data yielded practical strategies to enhance procurement efficiency and reduce lead times, supporting AMI's Procurement Department in achieving faster, more reliable procurement cycles aligned with operational demands.

RESULT AND DISCUSSION

Analysis

The Define phase initiates the improvement process by clearly identifying the core problem affecting the procurement cycle at AMI. The primary issue was excessive lead times between the creation of PR and the issuance of PO, notably for repeat purchases that should ideally be processed more quickly.

This problem was confirmed through initial observations of procurement workflows, as well as a review of key performance metrics from historical SAP data and OKR reports. The data consistently showed that lead times regularly exceeded the organizational target of 14 days, indicating a significant gap between current performance and desired goals.

To maintain a focused scope, the study concentrated on the PR to PO phase, excluding other subsequent procurement activities such as supplier delivery or stock management. Key stakeholders were engaged to validate the problem statement and establish measurable objectives centered on reducing lead time and improving efficiency.

If technical issues are identified, a Technical Clarification Meeting is held, and vendors may be asked to revise their quotations. Once the technical aspects are approved, the process advances to commercial negotiation. After receiving the final quotation, the Procurement Team prepares a Comparative Quotation Summary (CQS) to evaluate and justify vendor selection. This leads to the creation of a PO, which is then sent to the selected vendor to finalize the procurement. This structured process ensures both technical and commercial due diligence before committing to a purchase, while also highlighting potential delay points such as unclear PRs and extended technical approvals.

The area inside the red square is the most time-consuming part of the procurement process. These activities involve multiple stakeholders from vendors, user departments, and finance. External factors (from the procurement perspective) are beyond our control. This cycle can also repeat several times, causing significant delays before the final purchase order is issued. This research aims to simplify these activities by either reducing the number of cycles or even eliminating some steps through standardization.

Table 1 below shows the detailed lead time of the procurement cycle, which should take 14 days to complete. If it exceeds 14 days, the PR to PO process is considered delayed.

Table 1. Lead Time of Procurement Process

No.	Activity	Lead Time (days)
1	Receive and Analyze PR	1
2	Sourcing Vendor	1
3	Send RFQ and Receive Quotation	3
4	Review Quotation	2
5	Technical Clarification	2
6	Commercial Negotiation	3
7	Create CQS	1
8	Create PO	1
	Total Working Days	**14**

This delay in procurement processing has an impact on downstream operations, including potential stockouts, delayed project execution, and equipment failures that may ultimately lead to production shutdowns. Despite these materials being categorized as repeat or pre-agreed stock items, which ideally should facilitate faster processing due to established specifications, the actual process is encumbered by bottlenecks such as approval delays, system inefficiencies, or redundant CQS processes. The focus of this research is to identify the root causes and develop strategic solutions to reduce the PR to PO lead time for repeat materials, thereby directly supporting the achievement of the division's OKRs and enhancing overall procurement responsiveness and value contribution to the organization.

Data Interpretation and Visualization

The Measure phase focuses on quantifying the current performance of AMI's procurement process, specifically the lead time between PR creation and PO issuance. To establish an accurate baseline, procurement transaction data was extracted from AMI's SAP system, covering the period from 2023 to 2024. This data included key variables such as PR creation dates, PO issuance dates, and transaction values for all relevant purchase orders.

The first and most essential step in generating effective data visualizations was to thoroughly clean the data. This involved removing duplicate records, handling missing or null values, and ensuring data consistency and accuracy. After the cleaning process, the dataset was refined to 322 valid PR to PO line items across 9 commodity categories.

The analysis then focused on evaluating the extent of delays in the PR to PO process across these different categories. As shown in Table IV.2, the top five categories with the highest percentage of late PR to PO lead time were identified:

Chemicals (100%)
CHPP Spare Parts (71.76%)
CHPP Consumables (61.11%)
Electrical & Instrument (60%)
Auxiliary Equipment Spare Parts (54.67%)

Together, these four categories comprised 210 line items, representing approximately 65% of the overall dataset. The percentages were calculated by dividing the number of delayed PR to PO transactions by the total transactions within each respective category. This quantitative assessment highlights specific procurement areas where delays are most prevalent, offering targeted insights for focused process improvements.

$$PR\ to\ PO\ Lead\ Time = PO\ Approved\ Date - PR\ Approved\ Date \qquad \text{(IV.1)}$$

$$OKR\ PR\ to\ PO\ Late = \frac{Total\ Late\ Line\ Items\ PR\ to\ PO}{Total\ Line\ Items\ PR\ to\ PO} \qquad \text{(IV.2)}$$

Table 2. Total PO Line Items and PR to PO Lead Time

Category	Total PO Line Items	Total PR-PO Lead Time <=14 days (Ontime)	Total PR-PO Lead Time >14 days (Late)	%Ontime	%Late
Electrical & Instrument	20	8	12	40%	60%
Chemicals	4	0	4	0%	100%
CHPP Consumables	18	7	11	38.89%	61.11%
CHPP Spare Parts	170	48	122	28.2%	71.76%

Auxiliary Equipment Spare Parts	75	34	41	45.3%	54.67%
Total	**287**	**97**	**190**	**33.8%**	**66.2%**

The next table (IV.3) presents the total value of late PR to PO lead time for each category. These five categories represent 99.68% of the overall dataset, with a combined late value of USD 2,436,178.74 out of a total of USD 2,443,394.13.

Table 3. Total PO Value Transaction

Category	Total PO Value (USD)	Total Ontime PO Value (USD)	Total Late PO Value (USD)	%Ontime	%Late
Electrical & Instrument	64,140.61	2,982.32	61,158.30	4.65%	95.35%
Chemicals	468,693	0	468,693	0%	100%
Auxiliary Equipment Spare Parts	104,693.84	46,935.34	57,758.50	44.83%	55.17%
CHPP Consumables	406,053.88	146,369.33	259,684.55	36.05%	63.95%
CHPP Spare Parts	1,392,596.40	381,866.97	1,010,729.43	27.42%	72.58%
Total	**2,436,177.74**	**578,153.96**	**1,858,023.77**	**23.7%**	**76.27%**

Figure 1 presents the Pareto diagram, which provides valuable insight into which categories contribute most significantly to the overall issue. By applying the Pareto Principle, the diagram highlights that a small number of categories are responsible for the majority of the problems. This visualization allows decision-makers to identify and prioritize the most critical areas for improvement. By focusing on these high-impact categories, the organization can achieve more effective and efficient problem-solving, ultimately reducing delays and enhancing overall performance in the procurement process.

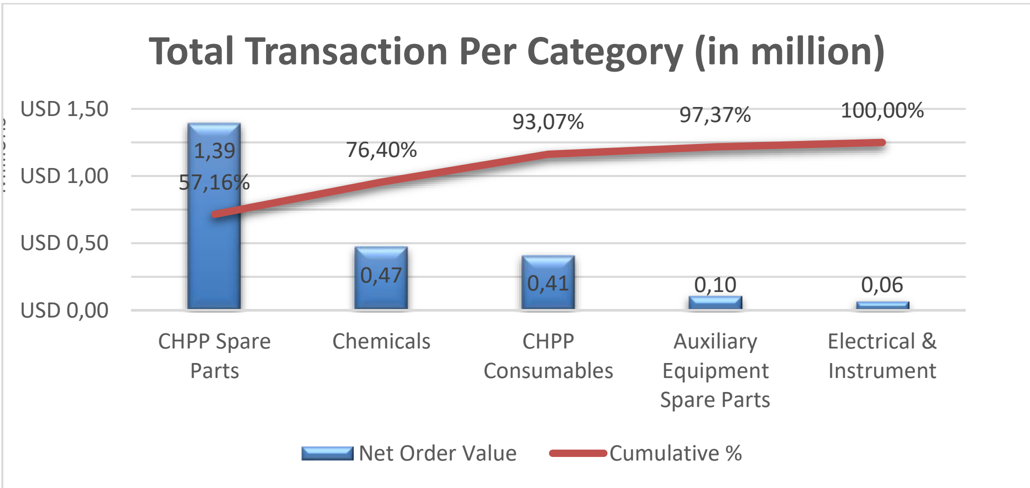

Figure 1. Total Transaction per Category

Statistical Process Control

This analysis tool begins with organizing the monthly average lead time data across each category over the two-year period. Each monthly average lead time acts as a data point mean (X). To assess the process stability, the first step is calculating the overall average lead time (center line, X̄) for each category using:

$$\bar{X} = \frac{1}{n}\sum_{i=1}^{n} X_i \qquad \text{(IV.3)}$$

Where X_i is the average lead time for month i, and n is the total number of months observed. Next, the variability of the process is evaluated by calculating the moving range

($\bar{MR}$) or average range of differences between successive months. The moving range for each pair of consecutive months is

$$MRi = | Xi - Xi - 1 | \qquad \text{(IV.4)}$$

and the average moving range is:

$$\bar{MR} = \frac{1}{n-1}\sum_{i=1}^{n} MR_i \qquad \text{(IV.5)}$$

These statistics are then used to establish control limits that define the expected natural variation boundaries of the process. The control limits are calculated as:

$$UCL = \bar{X} + 3\sigma \qquad \text{(IV.6)}$$

$$LCL = \bar{X} - 3\sigma \qquad \text{(IV.7)}$$

The results are shown in Figure 2 and illustrate the performance of procurement lead time over the span of two years. The center line is at 31.6 days which significantly exceeds the management's target of 14 days. The upper control limit (UCL), calculated at 85.49 days, represents the maximum expected variation in lead times under normal process conditions, while the lower control limit (LCL) is set at zero since lead time cannot be negative.

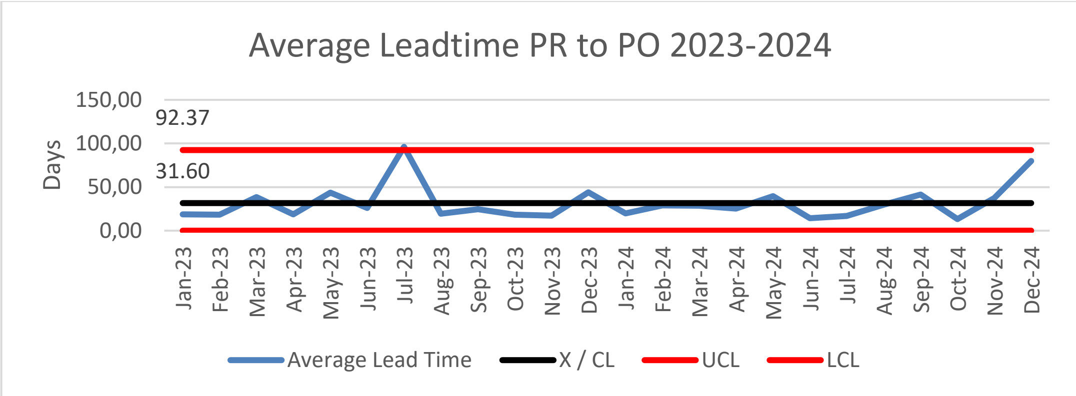

Figure 2. Control Chart

This delay highlights critical inefficiencies in the procurement process that cannot be overlooked. It is urgent that the organization focuses on improving internal procurement procedures, as many of the delays are likely caused by internal bottlenecks such as slow approval workflows, process inefficiencies, or communication gaps between departments. To effectively address these challenges, a thorough root cause analysis must be conducted promptly to identify the specific drivers of delays within the process. By pinpointing exact pain points—whether they stem from supplier performance, internal coordination issues, or systems limitations—the company can develop targeted actions aimed at streamlining workflows, enhancing transparency, and reducing unnecessary lead time.

1. Root Cause Analysis

In this study, the focus is on the long lead time between Purchase Requisition (PR) and Purchase Order (PO) for AGSI materials in the Procurement Department. To find the root causes of these delays, a Fishbone Diagram (Ishikawa Diagram) is used. This tool helps visualize and organize the different factors contributing to the problem, making it easier for the procurement team to identify priorities and make better decisions.

Based on interviews with procurement agents, five main categories of causes were identified:

a. Man: Refers to the personnel directly involved in the procurement process, including their roles, workload, and competencies.

b. Method: Encompasses the standard operating procedures, internal policies, rules, and workflows applied during the procurement cycle.
c. Material / Supplier: Focuses on the characteristics of the materials, including specification clarity and supply consistency.
d. Environment: Covers external and internal environmental factors, such as logistics challenges, remote site conditions, and organizational culture.
e. Tools: Refers to the system used by procurement agents to perform their tasks.

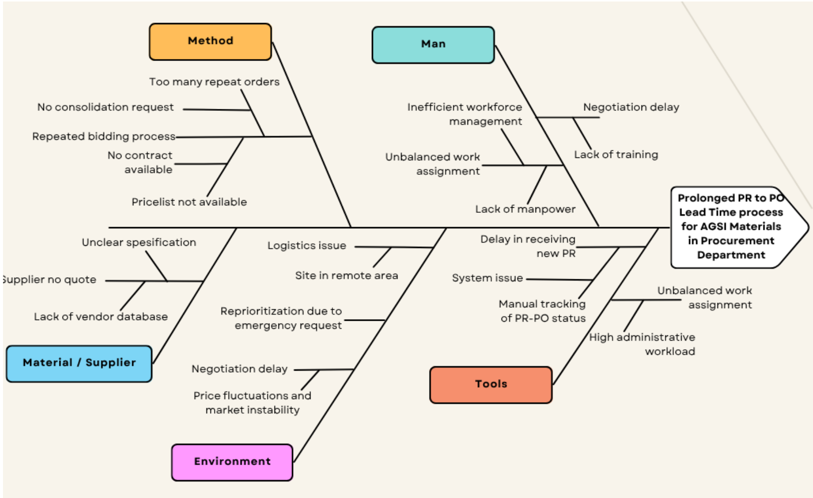

Figure 3. Fishbone Diagram

The diagram reveals several key issues contributing to the prolonged PR to PO process in the procurement of AGSI materials:

a. Too many repeat orders due to unplanned requests and a lack of consolidation efforts require the bidding process to be conducted repeatedly.
b. There has been inefficiency in workforce management, resulting in unbalanced work assignments. This causes some employees to be overloaded while others remain idle.
c. The site is located in a remote area, making it difficult for suppliers to access.
d. The current procurement system is still not optimal. Several processes require manual handling and extensive administrative work, causing delays in receiving and processing new PRs.
e. Suppliers are unable to submit quotations due to unclear material specifications. In addition, the lack of a vendor database delays the sourcing process.

Table 4 shows the summarize of key issues within each category, detailing what the problems are, when and where they occur, who is involved and how these factors contribute to delay.

Table 4. Summary of Root Causes

Category	What	When	Where	Who	How
Method	Too many unplanned requests, repeat orders, and repeated bidding. Lack of consolidation. Pricelist unavailability	During initial PR creation to order stage	Office, System, Site at AMI	Procurement agents, approvers, requester	Extra steps and paperwork due to repeating processes and missing standardized agreements
Man	Inefficient workforce management, unbalanced	Across whole procurement cycle		Procurement agents, team	Overloaded staff slows processing;

Category	What	When	Where	Who	How
	assignment, lack of training			leaders, managers	lack of skills causes negotiation delays
Material / Supplier	Unclear specifications, no supplier quotes, lack of vendor database	During supplier selection and RFQ stage		Suppliers, requester, strategic sourcing	Delayed quotes and sourcing as suppliers lack info and contacts
Environment	Remote site, logistics issue, emergency orders, market instability	When arranging delivery or emergency situation		Suppliers, logistics teams, strategic sourcing	Suppliers struggle to deliver, emergency needs cause reprioritization and delay
Tools	System/manual tracking issues, high admin workload, delay in PR receipt	PR submission, PO creation, status tracking		Procurement agents	Manual work and system delay slow approvals and tracking

Current Reality Tree

The Current Reality Tree (CRT) diagram depicted in Figure IV.5 systematically illustrates the root causes contributing to two major problems within the procurement process: the lack of framework agreement and overall system inefficiency. The CRT reveals that repetitive bidding and redundant administrative processes are primary drivers of these issues. For instance, repetitive bidding is often a consequence of poor purchase planning, which in turn results from emergency orders, the absence of material requirements planning (MRP), and a lack of consolidation requests. Furthermore, the chain extends to operational gaps such as the unavailability of price lists and insufficient negotiation skills, underscoring the absence of a robust framework agreement.

Additionally, the CRT highlights system inefficiency, rooted in factors like lack of system automation and poor specification validation. Manual tracking and the absence of automated processes lead to excessive administrative overhead. On the solutions side, inadequate budgets and unclear specifications—stemming from insufficient system validation and a lack of PR submission requirements—contribute to delays and errors. Collectively, these interconnected causes emphasize the need for strategic improvements such as better integration of automation, enhanced planning mechanisms, and clearly defined procurement protocols to eliminate inefficiencies and bolster overall system effectiveness.

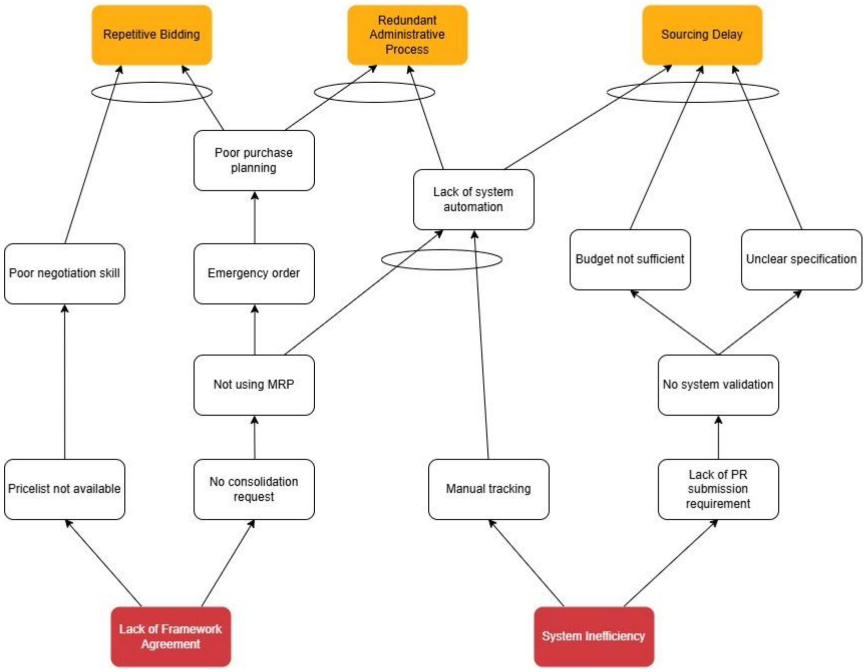

Figure 4. Current Reality Tree

Alternative Solution Analysis

Based on previous analysis and interview with procurement agents, the three alternative procurement improvement strategies—Developing LTAs, Implementing Consignment Stock Programs, and Initiating SAP System Enhancements—were carefully chosen and approved by the procurement leadership team. This selection reflects alignment with strategic priorities and operational feasibility, ensuring that the analysis focuses on actionable and supported solutions. Table 5 shows the comparison of cost and benefit analysis for each proposed alternative solution.

Table 5. Cost and Benefit Analysis

Alternative Solution	Cost Analysis	Benefit Analysis	Reference
Long-Term Agreement (LTA)	- Significant upfront administrative and negotiation effort.	- Volume leverage discounts and price stability.	Terzi & Flores Callejas, 2013; Shen et al., 2020
	- Risk of supplier dependency and reduced competition.	- Eliminates repetitive bidding cycles, reducing administrative workload.	
	- Contract rigidity may limit responsiveness to market changes.	- Strengthens supplier relationships fostering collaboration and innovation.	
Consignment	- Increased complexity in inventory and supplier management.	- Improves cash flow by deferring payment until consumption.	Calapre & Paspasan, 2024; Saraswati, 2021
	- Potentially higher supplier pricing to cover inventory risk.	- Reduces stock-out risks with buffer inventory.	
	- Buyer exposed to risks tied to supplier-owned inventory.	- Reduces administrative burden by eliminating frequent bidding for replenishment.	
System Enhancement	- High initial costs for software, integration, and training.	- Increases transparency and enables data-driven procurement decisions.	Ali et al., 2021; Corboș et al., 2023

Alternative Solution	Cost Analysis	Benefit Analysis	Reference
	- Change management challenges.	- Automates processes reducing errors and cycle times.	
	- Time lag before full benefits are realized.	- Enhances risk management capabilities.	

Analytical Hierarchy Process

Following the identification of root causes impacting procurement performance, an Analytical Hierarchy Process (AHP) was conducted to prioritize the key criteria guiding the selection of the most effective procurement improvement strategy. The process involved a structured survey among five procurement agents, selected for their expertise in both operational and strategic procurement functions.

Respondents engaged in pairwise comparisons of four critical criteria: Lead Time Reduction, Cost Impact, Inventory Availability, and Timeline Development. The aggregated results yielded the weighted priority scores shown in Figure 5.

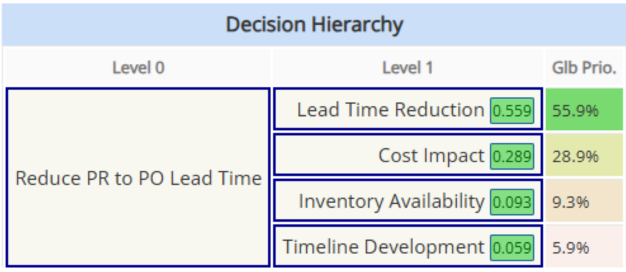

Figure 5. Consolidated Priority Criteria

As established, Lead Time Reduction was the highest priority with a weight of 0.559 (55.9%), indicating a strong consensus that reducing the cycle time from PR to PO is paramount. Efficient and predictable procurement cycles are critical for minimizing operational delays and meeting business objectives.

Cost Impact followed with a weight of 0.289 (28.9%), reflecting procurement agents' recognition of the importance of cost considerations, though secondary to lead time efficiency. Meanwhile, Inventory Availability (0.093) and Timeline Development (0.059) were considered less impactful in this decision context but still important factors. Figure 6 shows consolidated result of the four criteria.

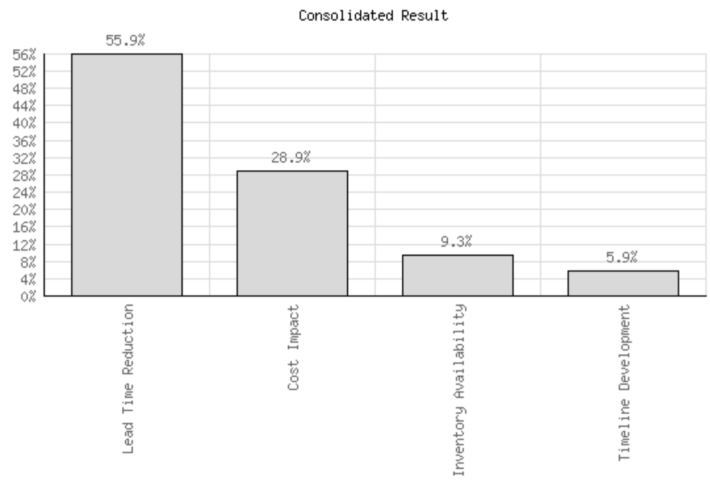

Figure 6. Consolidated Result of Priority Criteria

Subsequent to weighting the criteria, each proposed procurement improvement solution was evaluated against these priorities. Figure 7 presents the weighted scoring analysis for the three alternatives across the criteria.

Level 1		Glb Prio.	Develop Long Term Agreement	Implement Consignment	Initiate SAP Enhancement
Lead Time Reduction	0.559	55.9%	0.557	0.373	0.069
Cost Impact	0.289	28.9%	0.448	0.467	0.085
Inventory Availability	0.093	9.3%	0.270	0.655	0.075
Timeline Development	0.059	5.9%	0.598	0.085	0.316
		1.0	50.2%	41.0%	8.9%

Figure 7. Proposed Solution Scoring

The LTAs solution achieved the highest overall score 50.2%, driven primarily by its excellent performance in the most heavily weighted criterion: Lead Time Reduction. This indicates that LTA is the most effective strategy to reduce procurement lead time and address the key business challenges identified.

Based on this AHP-driven analysis, the LTAs approach is recommended as the optimal procurement improvement strategy. It balances critical measures of efficiency and cost, aligning closely with organizational priorities derived from expert assessments.

This rigorous application of AHP ensures that solution selection is data-driven, transparent, and substantiated by stakeholder expertise, thereby enhancing the robustness and credibility of the decision-making process.

Kraljic Matrix

The Kraljic Matrix analysis begins by quantitatively assessing each procurement category using two scales, ranging from 1 (low) to 5 (high), for both Profit Impact (PI) and Supply Risk (SR). Profit Impact measures how important an item is to the organization's profitability, factoring in both its total spend and its criticality to production processes. Supply Risk evaluates the vulnerability of the supply chain for each item, considering elements such as the scarcity of reliable suppliers, logistical complexities, and market instabilities. As shown in Table 6, CHPP spare parts hold the highest rank due to their significant financial value and the limited availability of suppliers.

Table 6. Profit Impact and Supply Risk Scoring

Category	Profit Impact (PI)	Supply Risk (SR)
CHPP Spare Parts	5	5
Chemicals	4	5
CHPP Consumables	3	3
Electrical & Instrument	2	2
Auxiliary Equipment Spare Parts	2	3

Based on interview insights and quantitative scoring, CHPP spare parts, Chemicals and CHPP Consumables are identified as "Strategic Items" due to their significant financial investment, critical role in operations, and supply risks including limited availability supplier. Figure 8 shows the detail quadrant of 5 category material.

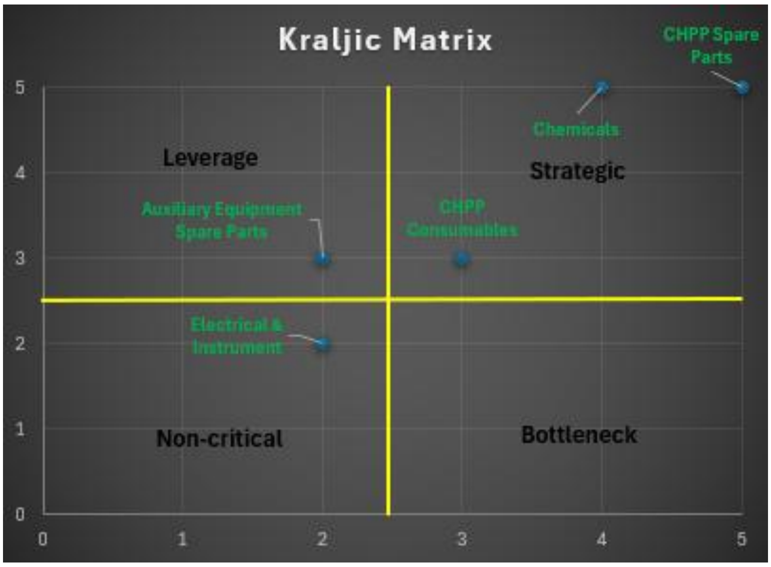

Figure 8. Kraljic Matrix Quadrant of AMI Category Material

Table 7 shows the recommended strategy for each quadrant & category. The implication of this analysis is that Strategic items, such as CHPP Spare Parts, Chemicals and CHPP Consumables—each with over 70% of their value delayed and representing high aggregate spend—require concentrated management actions. These include building long-term supplier relationships, implementing mitigation measures like dual sourcing, standardizing contracts, and maintaining close oversight of supply continuity. In contrast, Leverage items benefit from competitive sourcing and price efficiencies and Non-Critical items can be managed with streamlined, transactional processes.

Table 7. Summary of Recommended Strategies for Each Category

Quadrant	Category	Recommended Strategy
Strategic	CHPP Spare Parts, Chemicals, CHPP Consumables	Develop strong supplier partnerships, secure long-term contracts, implement risk mitigation (e.g., dual sourcing), and closely monitor supply continuity.
Leverage	Auxiliary Equipment Spare Parts	Focus on competitive sourcing, negotiate better prices and terms, maximize cost efficiency.
Non-Critical	Electrical & Instrument	Simplify procurement processes

Business Solution

Following the thorough root cause analysis in the Analyze phase, the Improve phase focuses on designing and implementing targeted solutions to address the key challenges in AMI's procurement process, particularly the prolonged lead time between PR and PO issuance. Guided by insights gained from the Fishbone Diagram, Current Reality Tree (CRT), and Kraljic Matrix segmentation, this phase prioritizes interventions that tackle the root causes of process inefficiency, repetitive bidding, and redundant administrative tasks.

Key improvement initiatives include the development of standardized LTAs for critical categories such as CHPP spare parts and Chemicals. These LTAs aim to reduce repetitive bidding cycles by establishing consolidated contract terms with reliable suppliers, thereby minimizing delay and administrative overhead. Alongside contract standardization, the implementation of a Consignment Stock Program will optimize inventory management, reducing procurement frequency and smoothing supply continuity for high-risk items. Figure IV.10 shows how the procurement process can be streamlined with an LTA in place. There will be no more repetitive bidding cycles, and the process will proceed directly to creating the PO in the SAP system; therefore, the lead time from PR to PO will be significantly reduced.

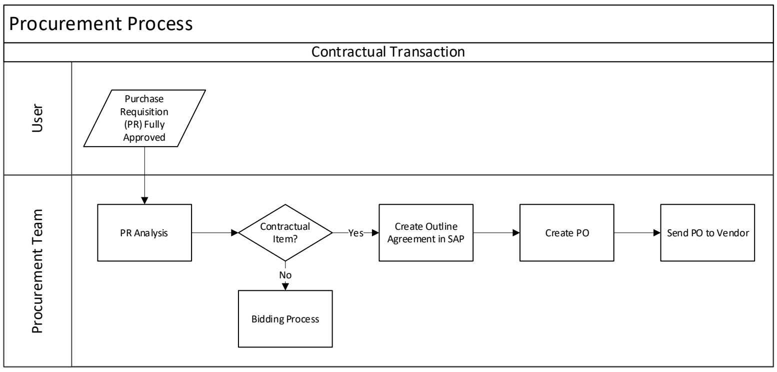

Figure 9. Flowchart of Procurement Process for Contractual Transaction

To complement these contractual and inventory solutions, AMI will initiate critical enhancements to the existing SAP system. These include automating procurement workflows, improving purchase order tracking, and facilitating real-time communication with vendors through an integrated vendor management system. The SAP enhancements will reduce manual administrative tasks, improve data accuracy, and enable seamless coordination across procurement teams. Pilot testing and phased rollout of these system upgrades will ensure smooth adoption, with continuous feedback loops to refine processes.

By combining strategic contracting, inventory optimization, and digital process automation, the Improve phase is designed to deliver measurable reductions in PR to PO lead times, increase procurement efficiency, and strengthen supplier partnerships. These targeted improvements position AMI to transition into the Control phase with sustainable supply chain resilience and enhanced operational performance. Table IV.8 outlines the key steps that can guide organizations in formulating robust LTAs.

Table 8. Implementation Plan of LTA

Step	Key Activities	Stakeholder	Timeline
Needs Assessment & Analysis	Historical spending & usage analysis, stakeholder engagement	Material Management and Operation	2 weeks
Supplier Shortlisting	Vendor performance, sourcing, historical purchase	Procurement and Strategic Sourcing	2 weeks
Define Objective and Scope	Requirements/specs development	Operation, Procurement, Logistics and Finance	1 week
Develop Template Agreement	Contract drafting	Legal and Contract Management	2–4 weeks
Bidding Process	Procurement process, technical clarification, commercial negotiation	Procurement and Strategic Sourcing	4-8 weeks
Implementation	Kick off meeting, system setup	Procurement, Strategic Sourcing and Operation	1 week
Monitoring	Performance tracking	Procurement, Strategic Sourcing and Operation	Continuous

The solution of developing and implementing LTAs has been successfully executed within AMI's procurement process for critical categories such as CHPP spare parts and Chemicals. Following the rollout of these standardized framework contracts, early results indicate a meaningful reduction in the lead time between PR and PO issuance. Analysis of procurement data throughout 2025 reveals a consistent downward trend in average lead times, reflecting enhanced process efficiency and reduced delays.

Moreover, as shown in Figure 10, the volume of procurement transactions executed under contractual agreements has been steadily increasing, demonstrating growing adoption and reliance on LTAs within the organization. This gradual rise highlights improved supplier collaboration and procurement planning, which are key enablers of streamlined workflows and more predictable sourcing cycles. The positive trajectory of contractual transactions, alongside measurable lead time improvements, confirms the practical applicability and effectiveness of the LTAs solution in addressing long-standing challenges.

In conclusion, the implemented LTAs have proven to be a viable and impactful approach to mitigating repetitive bidding and administrative inefficiencies. The encouraging data not only validates the solution's success in reducing procurement lead times but also supports its continued expansion as a core component of AMI's strategic procurement framework.

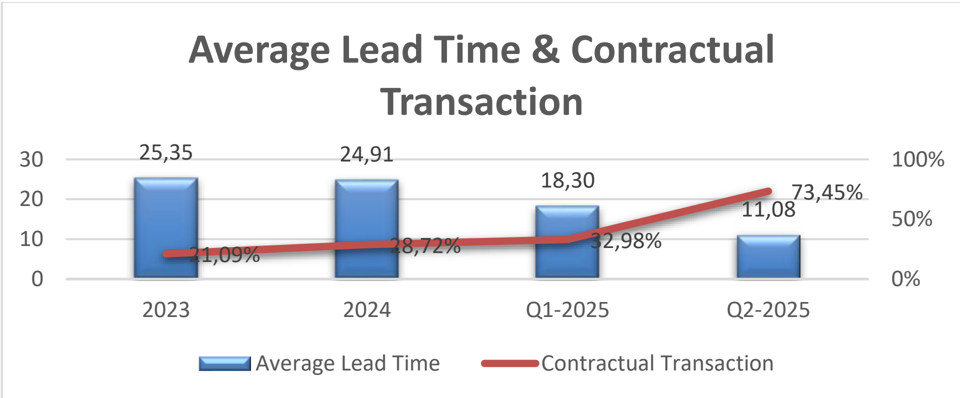

Figure 10. Average Lead Time PR to PO and Contractual Transaction

From the spending perspective, Figure IV.12 shows the progression of the total number of transactions. In the previous two years, late transactions were above 60%, while in 2025 year-to-date, only 25% are late.

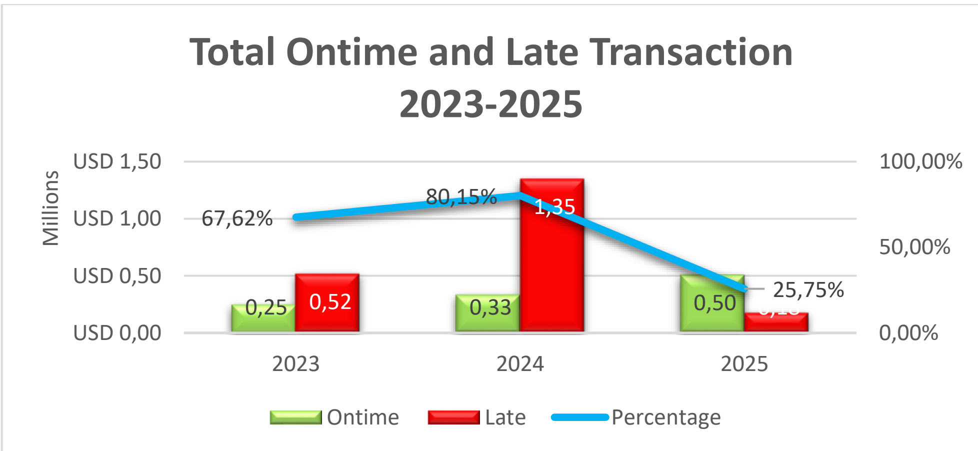

Figure 11. Total PO Transaction 2023-2025

Several LTAs are already in place, resulting in cost efficiencies achieved through a successful negotiation strategy by consolidating orders. Table 9, Figure 12 and Figure 13 shows

2 pilot projects on implementing LTA which are CHPP Consumables-Hydrated Lime and Chemicals-Caustic Soda Flake.

Table 9. Impact Cost Reduction of LTA Implementation

Year	CHPP Consumables (Hydrated Lime)			Chemicals (Caustic Soda Flake)		
	Average Order Quantity Per Year (Ton)	Average Unit Price (USD)	Net Order Value (USD)	Average Order Quantity Per Year (Kg)	Average Unit Price (USD)	Net Order Value (USD)
2023	650	322	208,987	1,000,000	0.87	869,444
2024	650	316	205,487	1,000,000	0.84	838,267
2025	650	300	195,000	1,000,000	0.80	801,257
	Cost Saving (USD)		**10,487**	**Cost Saving (USD)**		**37,010**

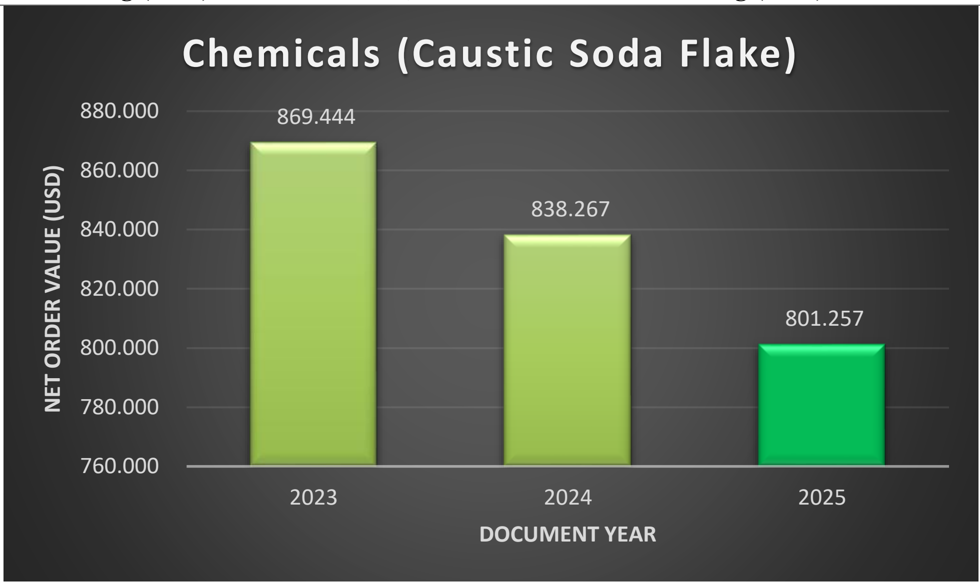

Figure 12. Caustic Soda Flake Spending 2023-2025

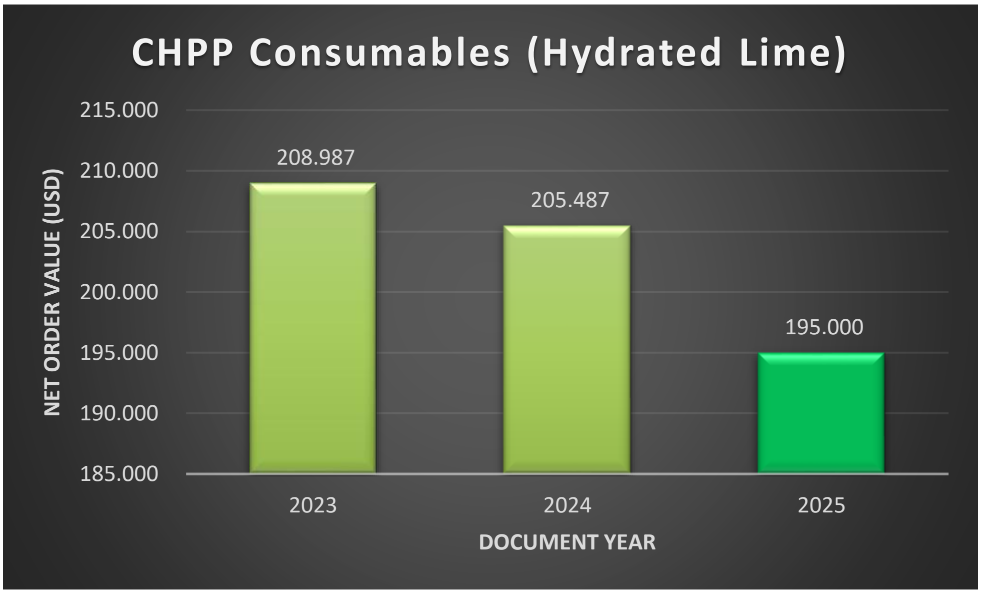

Figure 13. Hydrated Lime Spending 2023-2025

Implementation Plan

To ensure continuous and sustainable improvement in AMI's procurement process, the PDCA (Plan-Do-Check-Act) cycle is embedded within the Control phase of the DMAIC framework. This cyclical approach provides a clear and systematic way to maintain the progress achieved through the implementation of LTAs. Table IV.10 describes all the actions needed on each PDCA stage.

Table 10. PDCA Cycle

Stage	Description	Actions/Details
Plan	Needs assessment and objective setting	- Engage stakeholders to identify critical procurement categories (e.g., CHPP spare parts, Chemicals)
		- Analyze procurement data, supplier capabilities, and risks
		- Key Objective: Reduce PR to PO lead time
Do	Develop and implement LTAs	- Draft standardized contract templates covering pricing, delivery, quality, service levels
		- Collaboratively negotiate contracts balancing supplier flexibility and company needs
		- Formalize and communicate agreements to related stakeholders
		- Key Objective: Agreement signed
Check	Monitoring and control of LTAs effectiveness	- Use Power BI software to make a dashboard to track PR to PO lead times, contract compliance, and supplier delivery performance
		- Generate weekly reports for tracks performance of the procurement department
		- Identify delays or bottlenecks promptly to enable data-driven adjustments
Act	Corrective actions and ongoing improvement	- If results lag, renegotiate contracts, train staff, or improve system functionality
		- Use Pareto chart to select next procurement categories for LTAs rollout
		- Prepare for next PDCA cycle iteration
		- Key Objective: continuous improvement and replication

To support ongoing monitoring and control during the implementation phase, the author has developed a dedicated procurement performance dashboard using Power BI software. This interactive dashboard consolidates key metrics such as PR to PO lead times, contract transaction, delivery performance, and inventory availability, and other matters providing real-time visibility into procurement activities. The dashboard allows procurement teams and leadership to track progress, identify bottlenecks promptly, and make data-driven decisions. Weekly reports generated from Power BI further enhance transparency and facilitate continuous improvement efforts by enabling scheduled performance reviews and timely corrective actions. Integrating this digital tool into the implementation plan ensures robust monitoring aligned with the Control phase of the DMAIC and PDCA frameworks, supporting sustainable procurement process improvements.

CONCLUSION

The research revealed that procurement lead time delays at PT Alami Mandala Indonesia stemmed from inefficient manual procedures, unclear communication, organizational bottlenecks, lengthy negotiations, complex documentation, inconsistent coordination, supplier unreliability, transportation issues, and incomplete technical specifications, all of which disrupted material flows and operational performance. Key solutions included streamlining processes with e-procurement systems to automate tasks and reduce errors, fostering stakeholder collaboration, simplifying approvals, clarifying requirements, monitoring suppliers, optimizing logistics via consolidated shipments, and adopting best practices like long-term agreements (to eliminate repetitive bidding), consignment stock programs (to improve cash flow and availability), and ERP enhancements (for transparency and automation)—ultimately creating a more agile procurement function. For future research, organizations could explore AI-driven predictive analytics integrated with blockchain for real-time supplier tracking and risk mitigation in remote mining contexts, validating their impact through longitudinal studies across multiple Indonesian coal firms.

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