ISSN: 2338-8412 e-ISSN : 2716-4411

Ekombis Review – Jurnal Ilmiah Ekonomi dan Bisnis
Available online at : https://jurnal.unived.ac.id/index.php/er/index
DOI: https://doi.org/10.37676/ekombis.v14i2

Reducing Procurement Lead Time For Maintenance Spare Parts At Pt Bukit Asam Tbk

Oktavia Indriani [1]; Yuanita Handayati [2]
[1]Study Program of Master of Business Administration, Institut Teknologi Bandung, Indonesia
[2] Department of Business Administration, Faculty of Business and Management, Institut Teknologi Bandung, Indonesia
Email: [1] 29123422@mahasiswa.itb.ac.id ;[2] yuanita@sbm-itb.ac.id

How to Cite :
Indriani, O., Handayati, Y. (2026). Reducing Procurement Lead Time For Maintenance Spare Parts At Pt Bukit Asam Tbk . EKOMBIS REVIEW: Jurnal Ilmiah Ekonomi Dan Bisnis, 14(2). DOI: https://doi.org/10.37676/ekombis.v14i2

ARTICLE HISTORY
Received [04 November 2025]
Revised [25 April 2026]
Accepted [28 April 2026]

KEYWORDS
Procurement Lead Time, Maintenance Spare Parts, Business Process Reengineering, E-Signature, Umbrella Contract, Risk Dashboard, Digital Procurement.

ABSTRACT

PT Bukit Asam Tbk (PTBA) processed 2,679 procurement requests in the first half of 2025 with 55% consist of maintenance spare parts that are essential to keep operations run smoothly and reliably contains 1,368 PR (Purchase Requisition). The focus of this study was to examine and enhance the procurement lead time for maintenance spare parts from PR is submitted until a purchase order (PO) is finalized. The research methodology combined quantitative analysis of transaction data used BPMN modeling process and simulation through Bizagi software. Additional insights were gathered through interviews and focus group discussions (FGD) with relevant stakeholders. The As-Is process simulation shows that the total procurement lead time reached 60.5 days from start to finished well beyond the company's target of 50 days. The main delays occurred during the procurement execution phase and when PO creation, largely because of repetitive procedures and approval processes that required manual intervention. To tackle these challenges the Author proposed several business solution and approach Business Process Reengineering (BPR) mentioned electronic signatures to speed up approvals, establishing umbrella contracts to eliminate redundant procurement cycles, vendor rating system and a risk dashboard implementation that provides real-time visibility into potential issues. The To-Be simulation from proposed improvements in a blended scenario where 45% of procurements adopt umbrella contracts and 55% remain under conventional methods showed results the average lead time decreased to 44.7 days which is exceed to the expected KPI target. These results indicate that combination of digital approval workflows, standardized contract arrangements and proactive risk monitoring can substantially improve how

efficiently procurement operates. Furthermore, this study also demonstrates the practical value of BPR can improve procurement operations more responsive and dependable within the mining sector.

INTRODUCTION

Mining companies play a vital role as providers of primary raw materials such as metal ores, coal, or critical minerals that form the foundation for manufacturing, energy, and high-tech industries. The mining supply chain involves many interrelated processes starting from the mine site, then processing, loading, transportation to port and distribution facilities that require cross-functional coordination and have the potential to cause obstacles such as stockpiles, delays, and increased operational risks. Coal remains a key energy source in Indonesia and plays a significant role in the electricity and export sectors. (Coast Reporter, 2024) reports that national production continues to increase, reaching a record 836 million tons in 2024 that is an increase of approximately 8% compared to the previous year despite a downward trend in demand from export markets such as China and India in early 2025. PTBA is a member of MIND ID holding company which is a state-owned coal mining company that plays a strategic role in supporting the national economy.

PTBA in its operations relies heavily on suppliers for the procurement of goods and services. In modern procurement practices, all procurement activities are no longer viewed as purely administrative processes but rather as key elements of strategic procurement that support the achievement of the company's overall business objectives.

Figure 1. Procurement Best Practice Business Process

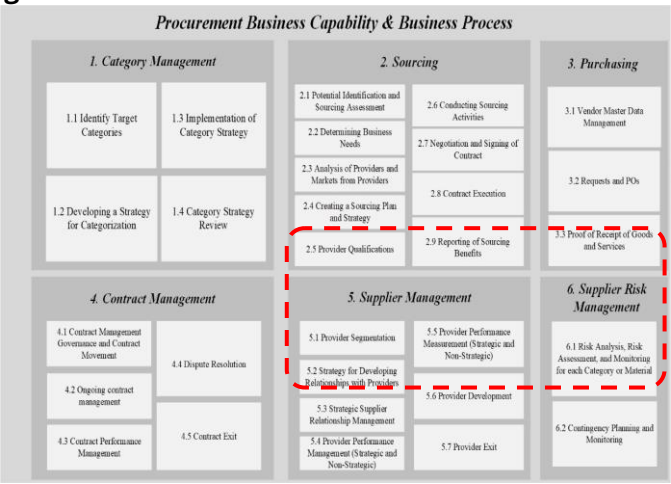
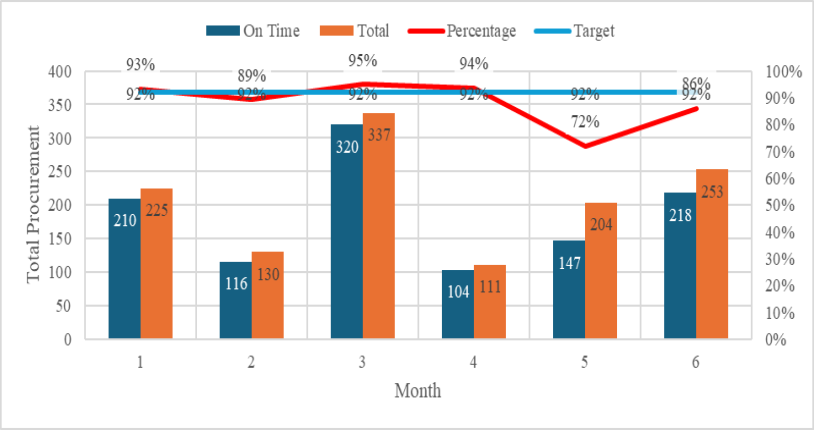


Figure 1 shows the best practice framework used by Independent Consultant in developing BPR at PTBA where procurement activities can be grouped into six main business processes that are Category Management, Sourcing, Purchasing, Contract Management, Supplier Management, and Supplier Risk Management. Every stage of the process represents the organization's ability to integrate its business functions in order to achieve a procurement system that is both efficient and transparent. The best practice procurement business process highlights the need for a holistic perspective covering the entire cycle from planning and supplier selection to contract administration and risk control.

The procurement process at PTBA is classified as "on time" if the entire cycle from the creation of a PR until goods are received by the user is completed within 50 days. However, if the duration exceeds 50 days, it is categorized as "delayed."

Figure 2. Total Procurement Duration (Days) from January - June 2025 in Percentage



The average of ontime procurement process from January to June 2025 recorded rate of 88% that below the company's KPI target of 92%. In several months such as February (89%), May (72%), and June (86%), fell short of the target that indicates the recurred inefficiencies in process execution. The procurement cycle involves four main stages contains PR/ROS creation, Owner's Estimate verification, bid process, and PO monitoring each carried out through the e-procurement platform integrated with the Ellipse ERP system.

Table 1. Comparison of Realization Process and KPI Procurement Target

Process	Realization Total Time (days)	KPI Total Time (days)	Differences/ Gap (days)
Owner's Estimate Verification	8	9	-1
Procurement Execution	37	30	7
PO Creation	12	10	2
PO Monitoring	3	1	2
Total	**60**	**50**	**10**

The As-Is analysis shows that the total average lead time reached 60 days that beyond the KPI target of 50 days by 10 days. The bid process alone consumed 37 days that made the primary bottleneck because manual approval layers, paper-based document verification and repetitive administrative tasks which extend the process duration and increase workloads. The lack of digital integration across stages also leads to higher administrative expenses, estimated at around Rp90 million per month or Rp1.08 billion per year as shown by the recur costs for paper and ink where the current procurement process not only fails to meet efficiency targets but also incurs substantial operational costs due to limited digital connectivity.

LITERATURE REVIEW

To ensures that the right materials are delivered to the right place at the right time so procurement in supply chain management support the smooth operations through coordination between vendors, internal teams, and distribution systems. In modern contexts the procurement must be fast and flexible that adapt to change. Procurement in Indonesian State-Owned Enterprises (SOEs) is governed by Ministry of SOEs Regulation No. PER-08/MBU/12/2019 and its amendment PER-02/MBU/03/2023 that ensure transparency, efficiency, accountability, and fair competition in procurement. The regulation mandates principles of efficiency, effectiveness, transparency, accountability, and consideration of occupational health, safety, and

environmental factors and applied to all procurement activities funded by SOE budgets. It strengthens governance through standardized documentation, mandatory digital report and integration with national e-procurement systems (LKPP). At PTBA, these regulations provide a structured framework but challenges persist in interpretation and e-procurement infrastructure which affects the coordination among divisions. PTBA aligns with PER-02/MBU/03/2023 and MIND ID policies, operationalized through Decree No. 143-0100-2024 which continues to evolve with organizational needs.

To provides a radical approach to redesign inefficient or outdated processes through stages to map the current (As-Is) process that identify root causes and design the improved (To-Be) BPR is used to process and validate also institutionalize the new workflows (Rasool et al., 2020). In procurement, BPR helps eliminate redundant approvals, enhance interdepartmental communication, and implement system-based controls for consistency. Rasool et al. (2020) found that in e-tender systems, 80% of delays occur in manual bid evaluations and administrative processes, and after automation, cycle times decreased by over 30%, and improve transparency and efficiency. Cross-functional flow analysis helps identify coordination gaps among departments that cause procurement delays. Kumar and Strehlow (2004) highlight that cross-functional teamwork and process map to clarify departmental roles, eliminate bottlenecks, and strengthen accountability. Used the tools like Swimlane Diagrams, organizations can visualize processes by department, identify redundant activities, and enhance collaboration. Sun et al. (2009) observed that in complex procurement networks, limited visibility across processes often leads to inefficiencies; thus, simulation and modeling allow managers to assess how policy or structural adjustments affect overall performance and cooperation. This analysis supports BPR by improve transparency and provide evidence for redesign decisions.

METHODS

To examine the causes of procurement delays for maintenance spare parts in the Procurement Division of PTBA the research methodology used to focuse on internal process inefficiencies and interdepartmental coordination challenges that contribute to prolonged procurement cycles.

This study employs a mixed-methods design that combines quantitative and qualitative approaches to obtain the comprehensive findings. Secondary data were collected from internal company documents that cover 1,368 PR and 1,271 PO from January to June 2025 while primary data were obtained through interviews and FGD with key stakeholders such as buyers, warehouse administrators, maintenance planners, and procurement analysts. The analysis applied descriptive statistics, process mapping using BPMN and Cross Functional Flow Diagrams, content and thematic analyses, as well as process simulation through Bizagi to identify the root causes of delays and design measurable improvement strategies to reduce lead time and enhance operational efficiency.

The Bizagi simulation results for the As-Is condition indicate that the OE Verification process requires a total of 8.01 days, with the most time that consumed activities are in PR and OE preparation (approximately 3 days each) while other steps contribute minimally to the total duration. Furthermore, the As-Is simulation of the Procurement Execution process by the Buyer revealed a total cycle time of 37.5 days with the longest stages include prequalification, bid submission, bid opening, and evaluation, each taking around 7 days. Administrative steps such as winner determination, negotiation, vendor invitation, and document preparation required 1–4 days.

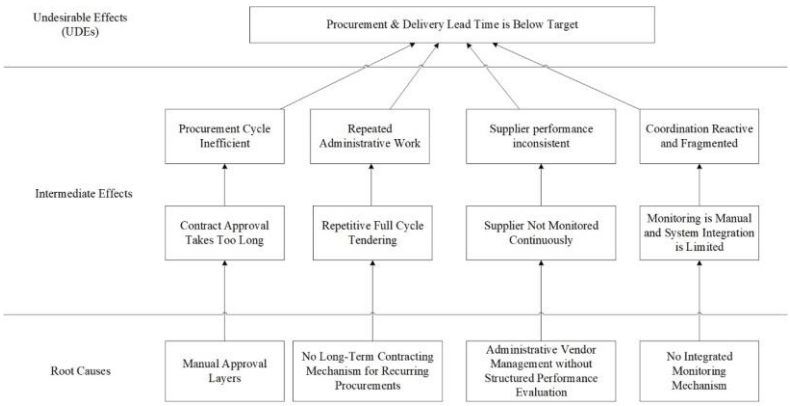
Overall, the tender phase contributes the most to procurement delays and should therefore be prioritized for process improvement initiatives aimed at accelerate the entire procurement cycle.

RESULTS

Root Cause Analysis using CRT (Current Reality Tree) Analysis

This subchapter presents the results of the root cause analysis obtained from the integration of quantitative and qualitative findings with the purpose of this analysis is to identify the main factors that cause delays in the procurement process of maintenance spare parts at PTBA. The analysis was conducted by Interview Findings and FGD through Respondents with the purpose is to identify and visualize the relationships between underlying problems and their result of undesirable effects in a structured manner. Instead of numerical calculations the CRT is used to causal reasoning which allows the issues observed in the procurement and delivery process to be systematically connected and diagnosed.

Figure 3. Root Cause Analysis of Procurement Lead Time for Maintenance Spare Parts using CRT



Based on Figure 3, the three causal pathways identified in the Current Reality Tree (CRT) analysis focuses on the second causal pathway concern on non optimal frontend documentation and manual multilevel approvals in the maintenance spare parts procurement cycle. This pathway was chosen because it makes a significant contribution to failure of the system to respond adaptively to demand changes and field disturbances. After previously mentioned the CRT analysis identifies four main root causes namely low time efficiency, high procurement costs, weak supplier quality and reliability, and elevated operational risk. These main root causes and these findings from as-is process analysis will be used as a criteria basis for designing improvement strategies in the further chapters. Based on the CRT analysis and the as-is procurement process, Table 2 presents the relationship between each root cause of the problem and the corresponding process stage. This alignment provides the basis for proposing focused and practical recommendations to shorten the overall procurement lead time.

Table 2. Analysis Root Cause & Recommendation

Problem	Process Stage	Recommendation
Manual Approval Layers	PO / Contract Drafting & Finalization	Implement **e-signature** to accelerate approval process and reduce waiting time, ensuring documents are validated and archived digitally.
No Long-Term Contracting Mechanism for Recurring	Procurement Execution (Bidding Preparation, Bid Opening, Bid Submission, Evaluation, Negotiation)	Apply **umbrella contract** scheme for repetitive procurement items to minimize tender repetition and stabilize procurement cost.

Problem	Process Stage	Recommendation
Procurements		
Administrative Vendor Management without Structured Performance Evaluation	Praqualification	Establish a **vendor rating system** as a basis for creating an approved vendor list to guarantee supplier consistency and reliability.
	Evaluation	
	PO Delivery	
No Integrated Monitoring Mechanism	PO / Contract Monitoring	Develop a **risk dashboard** as an early warning system to detect potential delivery delays and operational disruptions.
	Delivery Coordination	

Business Solution

In order to overcome the four root causes identified in the previous subsection (poor time efficiency, high procurement cost, weak supplier quality and reliability, and high operational risk), a comprehensive business solution is required.

E-signature Implementation

The implementation of an E-Signature system offers a practical solution to reduce delays in the procurement cycle, particularly in the PO Creation and Contract Approval stages where manual signing often takes several days. By digital signatures proposed solution, the approval process can be conducted online without require the physical presence of signatories, and so could minimize the waiting times and eliminate bottlenecks associated with document circulation. The flow of e-signature implementation visualized in Figure 4 below.

Figure 4. Activity PO Creation use Proposed E-signature Implementation

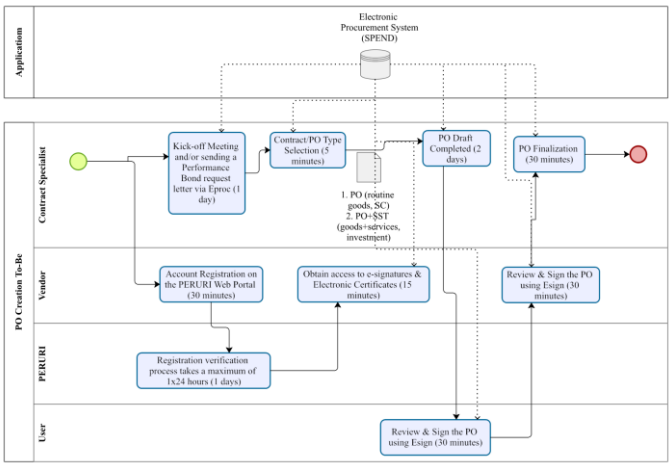
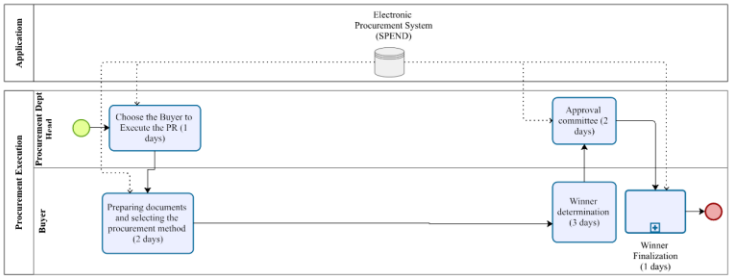


Figure 4 visualized the activity of PO Creation use proposed e-signature implementation while in terms of governance in PTBA, the use of e-signature aligns with regulatory standards on electronic transactions and provides a secure mechanism for authentication, authorization, and audit trails. Every approval is time stamped and digitally verified which will strengthens accountability and transparency. In addition, this solution supports remote approval where decision makers are not physically available at the office but still can approve the approval document.

Umbrella Contract with a Prequalified Vendor List

This section illustrates the workflow of the procurement execution process under the Umbrella Contract framework. Figure 6 below depicts the simplified flow of procurement execution under the Umbrella Contract with a prequalified vendor list.

Figure 5. Activity of Procurement Execution using Umbrella Contract



Based on Figure 5, the business solution to address these challenges is the implementation of an Umbrella Contract with a Prequalified Vendor List. This framework establishes long-term agreements with selected vendors where the price, service level agreements (SLA) and quality standards mechanisms are set upfront based on contractual between PTBA and vendor. PR can be processed through a simplified call-off mechanism instead of a full tender which reduces lead time and improves cost control through economies of scale and standardized terms. Therefore, the umbrella contract framework is most effective when applied to recurring and specialized spare part categories with a limited pool of qualified vendors, while more generic procurement needs should continue to be managed through the conventional open tender mechanism because in the field it could be supplied by any vendor based on tender facts.

Pre-approved vendors are utilized for enhanced reliability with the aims to minimize risk, penalty rules and procedures are also in place for dealing with potential problems. The implementation of an Umbrella Contract is expected to shorten the procurement cycle because the duration of the bidding process reduced significantly which currently takes more than a month for each SPPH.

Vendor Rating System

Vendor rating system designed to evaluate the performance of goods and service providers based on the parameters such as delivery timeliness, quality of received items, compliance with HSE standards, work progress, contract adherence, and the accuracy of report submission. Assessments are carried out periodically through the system or manual forms and result in classifications of “Good,” “Fair,” or “Poor” as shown in Figure 6. The vendors with high scores are placed on the approved vendor list, while those with low scores may face sanctions or be suspended. The average performance reports are then used as a reference to make the decision in future procurement activities.

Figure 6. New Business Process, Vendor Rating System

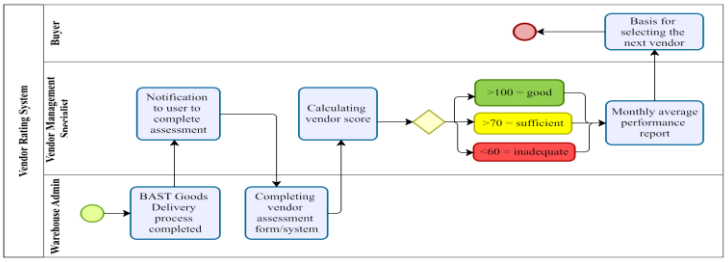


Figure 6 is new business process proposed by Author. The scope of this system development covers the integration of vendor performance reporting between user in units or divisions and procurement division also warehouse division so that the information produced is consistent and can be shared across functions. Clear and measurable evaluation criteria are also established to ensure that all parties can easily understand and apply them in an objective manner. System testing and implementation is conducted to ensure that vendor performance data is collected effectively. Once ready, training is provided to all users so they understand how the evaluation works and can contribute with the expected outcome is to make the procurement process more transparent, accountable, and useful to all user in PTBA.

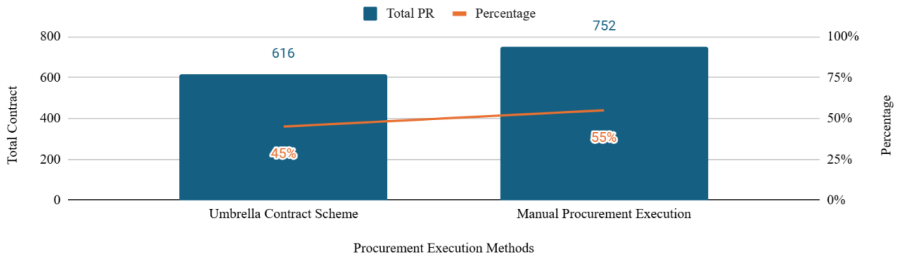
Develop a Risk Dashboard

To serve as an early warning system that identify potential delivery delays and operational disruptions in the procurement process Author proposed the development of a risk dashboard. The dashboard is designed to present key information in real time so management can quickly detect deviations from performance targets and take corrective actions without delay. The scope of the dashboard covers data integration from PO, monitoring status, and reminder records, presented in a clear and user-friendly format. Key indicators include the total number of PO, the number of orders approaching expiry, and the total active reminders. Each PO is displayed in a detailed table with attributes such as PO number, order date, due date, location, monitoring status, reminder status, supplier name, and item description.

To-Be Process Analysis with Cross-Functional Diagram & BPMN Simulation

This subsection explains the blended impact of applying both umbrella contracts and conventional tender mechanisms within the redesigned procurement process. By combining these two approaches, the analysis reflects a more realistic view of how the procurement cycle will perform once the proposed business solutions are implemented.

Figure 7. Procurement Execution Methods Breakdown



Based on Figure 7 shown the breakdown of procurement execution methods divided in two, approximately 45% of contracts involve specific items that can be implemented under the umbrella contract scheme while the remaining 55% consist of general items with manual procurement execution method. This limitation arises because contracts for general items where many vendors are able to participate, cannot be restricted into umbrella contracts in order to preserve fairness and open competition. Consequently, the umbrella contract framework is best applied to recurring and specialized spare part categories with limited qualified vendors while more generic procurement needs must remain under the conventional open-tender mechanism.

The To-Be simulation is designed to illustrate the expected improvements after applying the proposed business solutions with the same scenario (45% consisting of umbrella contract schemes and the other 55% consisting of general contract schemes). The cross-functional diagram provides a side-by-side representation of activities across divisions which shows how redesigned roles, simplified approvals, and vendor readiness can shorten lead time and reduce unnecessary repetitions compared to the current process. The visual simulation results include a color-coded legend to help interpret the data, where each color represents a specific

performance indicator in the process model. The small colored boxes above each activity show simulation data:

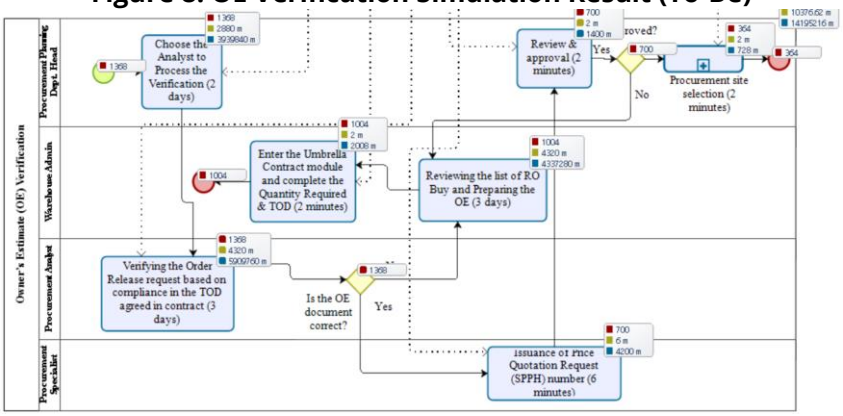
- Red means completed, indicates the number of PR processed
- Yellow is average time represents the average duration per process instance
- Blue means total time represents the total accumulated duration of all instances

Each lane represents a responsible actor contains the Procurement Department Head, Buyer, Vendor, and Electronic Procurement System.

Simulation Result of To-Be OE Verification

The simulation results of the To-Be OE Verification process in Bizagi Modeler shown in Figure 8 below.

Figure 8. OE Verification Simulation Result (To-Be)



The color-code legends:

- Red means completed, indicates the number of PR processed
- Yellow is average time represents the average duration per process instance
- Blue means total time represents the total accumulated duration of all instances

Figure 8 shows the result of To-Be process while the clearer breakdown of the simulation outcome, the detailed activities and their corresponding durations are presented in Table 4.

Table 4. Simulation Results of OE Verification (To-Be)

Activity	Occurrences	Total Time (minutes)	CT (minutes/ instance)	CT (hours)	CT (days)
Choose the Analyst to Process the Verification	1,368	2,880	2.11	48	2.0
Verifying the Order Release request based on compliance in the TOD agreed in contract	1,368	4,320	3.16	72	3.0
Reviewing the list of RO Buy and Preparing the OE	1,004	3,012	3	10.2	6
Issuance of Price Quotation Request (SPPH) numberVerifying the Owner's Estimate and analyzing proposed prices	700	4,200	6	70	2.9
Enter the Umbrella Contract	1,004	2,008	2	33.5	1.4

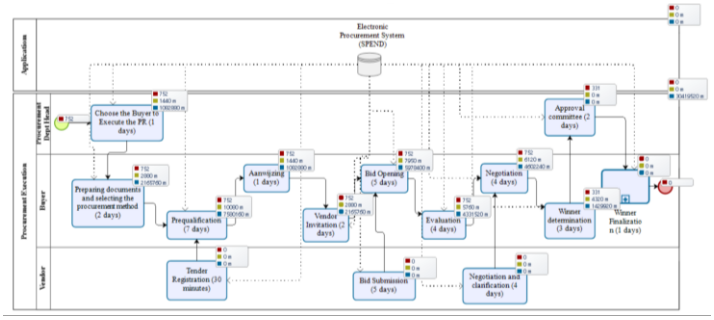
Activity	Occurrences	Total Time (minutes)	CT (minutes/ instance)	CT (hours)	CT (days)
module and complete the Quantity Required & TOD					
Review & Approval	700	1,400	2	23.03	0.97
Procurement site selection	364	728	2	12.1	0,5
Total					12.0

The simulation results show that the OE Verification To-Be process can be completed in approximately 12 days. The main activities include analyst assignment, document verification, and OE preparation, which remain the longest stages. However, by integrating the Umbrella Contract module, the process eliminates repetitive revisions and manual clarifications, replacing them with a shorter step of entering data directly into the system. Additionally, issuing the SPPH number and site selection are handled more efficiently within the e-procurement platform. Overall, the redesigned flow provides a clearer and faster path to verification compared to the As-Is process.

Simulation Result of To-Be Procurement Execution by Buyers

The Procurement Execution stage is streamlined by introducing the Umbrella Contract scheme. Under this design, the lengthy tender steps such as prequalification, bid submission, bid opening, and evaluation are eliminated because vendors have already been pre-assessed and secured under long-term framework agreements. The simulation results of the Procurement Execution by Buyers in Bizagi Modeler are divided into two comparison groups from a total of 1,368 samples.

Figure 9. Simulation Result of Procurement Execution by Buyers Using Manual Method (To-Be)

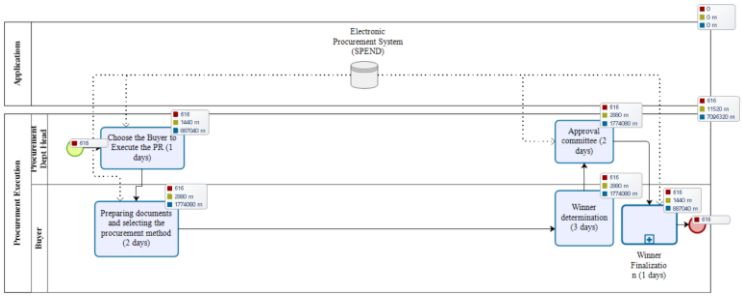


The color-code legends:
Red means completed, indicates the number of PR processed
Yellow is average time represents the average duration per process instance
Blue means total time represents the total accumulated duration of all instances

Among them 616 samples (45%) were processed using the To-Be business process while the remaining 752 samples (55%) followed the existing process (manual prcurement execution). This condition occurs because not all maintenance procurement activities can be standardized under the Umbrella Contract scheme. Some specific brands cannot supply the full range of required parts which makes the continuation of open tender and regular procurement methods necessary. The simulation results show that 55% or 752 PR samples of the To-Be process were still handled through manual procurement execution.

The process starts with "Choose the Buyer to Execute the PR" and continues through multiple tender activities such as prequalification, vendor invitation, bid submission, bid opening, evaluation, negotiation, committee approval, winner determination, and finalization. Meanwhile, 45% of the 1,368 samples equivalent to 616 PRs were processed using the new business process as shown in Figure 11 below.

Figure 10. Simulation Result of Procurement Execution by Buyers Using Umbrella Contract (To-Be)



The color-code legends:

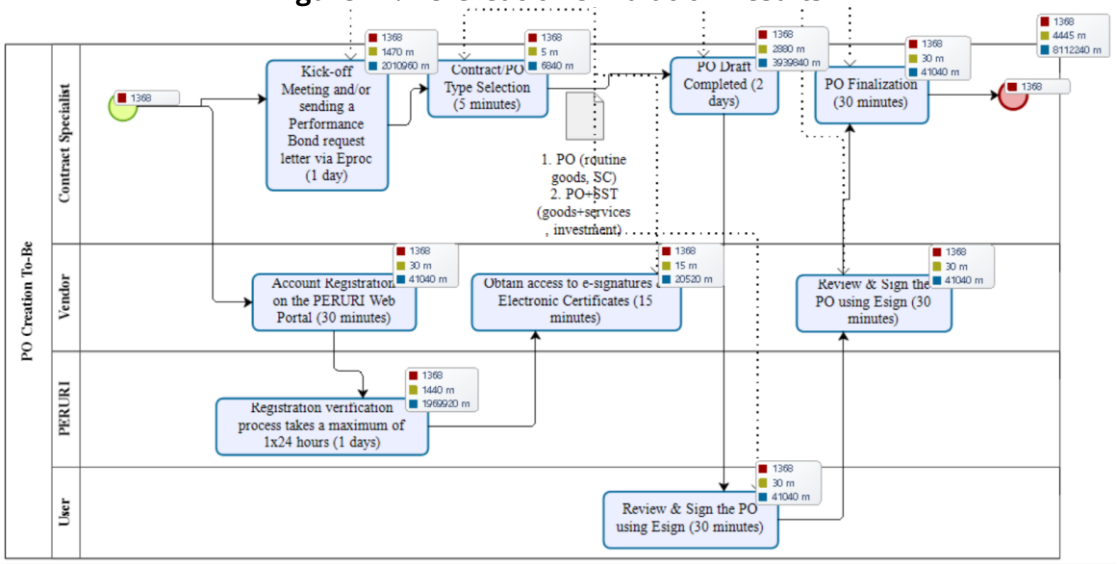
- Red means completed, indicates the number of PR processed
- Yellow is average time represents the average duration per process instance
- Blue means total time represents the total accumulated duration of all instances

Figure 10 shows the simulation of 616 PR samples processed through the Umbrella Contract scheme, reflecting the improved efficiency of the To-Be procurement workflow.

Simulation Result of To-Be PO Creation

In the proposed To-Be process, the PO Creation stage integrates an E-Signature system through PERURI to replace manual signing in Figure 12.

Figure 11. PO Creation Simulation Results



The color-code legends:

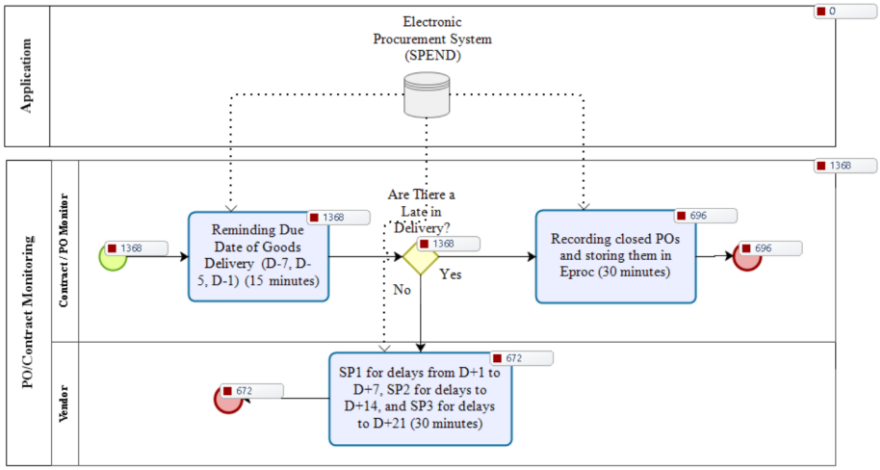
- Red means completed, indicates the number of PR processed
- Yellow is average time represents the average duration per process instance
- Blue means total time represents the total accumulated duration of all instances

Figure 11 is the PO Creation simulation results where the process begins with the kick-off meeting and/or sending a performance bond request letter via Eproc. Then after the Contract/PO type is selected and the PO draft is prepared within 2 (two) days. Before signing, vendors must register an account on the PERURI web portal followed by a verification process (maximum one day). Once verified, vendors obtain access to e-signatures and electronic certificates within 15 minutes. After that, both the Procurement Division and vendors can review and sign the PO digitally, each step requiring only 30 minutes. The cycle concludes with PO finalization, also completed in 30 minutes. Compared to the As-Is process, this redesign reduces the approval cycle significantly, cutting down the signing stage from several days to less than one day.

Simulation Results of PO Monitoring

This section shows the simulation of PO Monitoring in the To-Be process. Figure 12 presents the simulation results of the PO Monitoring process under the To-Be model.

Figure 12. Simulation Results of PO Monitoring



The color-code legends:

- Red means completed, indicates the number of PR processed
- Yellow is average time represents the average duration per process instance
- Blue means total time represents the total accumulated duration of all instances

Figure 12 shows the simulation results in Bizagi Modeler that the PO/Contract Monitoring To-Be process requires only about 0.05 days (75 minutes in total). Activities such as delivery due date reminders, recording closed POs, and issuing warning letters (SP1–SP3) are now performed directly within the e-procurement system.

DISCUSSION

Cost and Benefit Analysis

There are two main cost reduction benefits from this proposed solution. The first is material cost savings from reduced paper and ink usage for printing, filing, and distributing documents. The second is labor efficiency, as digital workflows minimize manual tasks and free staff from repetitive documentation work. These benefits result from the implementation of digital and contractual improvements in the procurement process, namely the Umbrella Contract, E Signature, and Risk Dashboard, which aim to reduce administrative and operational costs caused by paper-based approvals, repetitive tendering, and long procurement cycle time.

Figure 13. Total Benefit (Cost) of the Proposed Implementation

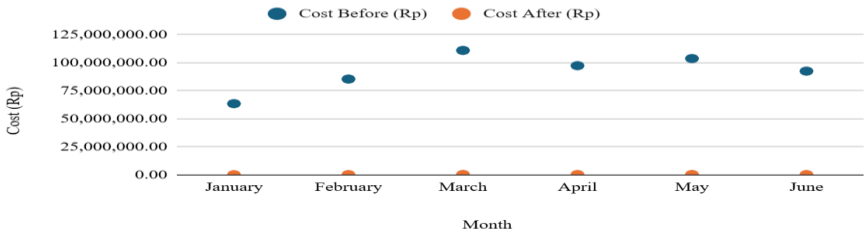


Figure 13 shows the comparison between total procurement costs before and after the proposed implementation for the period of January to June 2025. The blue points represent the cost before implementation while the orange points show the cost after implementation. Before the implementation procurement costs were much higher ranging from around Rp 60 million to Rp 120 million per month. After the implementation the costs dropped sharply and stayed low throughout the six months period. This decrease shows the real financial benefit gained through improvements such as digital workflow integration streamlined approval stages and reduced manual activities. The summary of cost–benefit results is shown in Table 5.

Table 5. Cost-Benefit Analysis Results Before and After Implementation

Months	Cost Before Implementation (Rp)	Cost After Implementation (Rp)
January	Rp 63,457,000	Rp 420,232
February	Rp 85,322,500	Rp 443,922
March	Rp 110,804,000	Rp 331,722
April	Rp 97,235,500	Rp 748,430
May	Rp 103,581,900	Rp 401,596
June	Rp 92,362,867	Rp 301,364
Total	Rp 552,763,767	Rp 2,647,266

Table 5. presents the summary of cost benefit analysis results before and after the implementation for the period of January to June 2025. The table compares the total procurement costs recorded each month before and after the new process was applied. The data show that before implementation the monthly cost ranged between around Rp63 million and Rp111 million while after implementation the cost dropped to less than one million rupiah per month. This sharp decline indicates that the proposed solution successfully reduced operational expenses related to the procurement process.

The total cost before implementation reached about Rp552 million while after implementation it decreased to around Rp2.6 million. This result demonstrates a major efficiency improvement showing that the new process not only shortens lead time but also minimizes the financial burden associated with manual and repetitive procurement activities.

Furthermore, this cost and benefit analysis is conducted to analyze the financial feasibility and long-term impact of the proposed digital and contractual solutions on procurement efficiency and operational performance. It evaluates how the investment in system development and process integration can generate measurable savings, improve workflow speed, and support sustainable cost optimization within PTBA's procurement function.

E-Signature Implementation

The adoption of an e-signature system in the PO Creation stage is prioritized in the short term because it requires relatively low investment and can be quickly integrated into the existing e-procurement system. The justification lies in its urgency: manual signing currently takes up to seven days, whereas digital approval can reduce this to less than one day. The potential impact is immediate lead-time reduction and higher accountability, as every approval is timestamped and digitally verified.

Risk Dashboard Development

The risk dashboard can also be implemented in the short term as it mainly involves system integration and visualization of existing procurement monitoring data. Its justification is the need for real-time visibility of risks (e.g., late deliveries) which is currently managed manually through Excel files. The dashboard provides quick wins by enabling early detection of potential delays and support the proactive corrective actions.

Medium Term Implementation & Justification

This section explains how the selected solution will be implemented within the procurement process by outline the expected improvements in both lead time and cost efficiency as well as describing the step roadmap for short term medium term and long- term implementation.

Vendor Rating System

The vendor rating system is positioned in the medium term since it requires the development of evaluation parameters, alignment across functions both procurement, warehouse, user divisions and socialization to ensure objective adoption. The justification is its relevance for building long-term supplier reliability and accountability with integrate vendor performance data, the system strengthens decision making for the future procurement activities and contributes to higher service quality.

Long Term Implementation & Justification

In the long term, the focus is on sustain and optimize the umbrella contract mechanism to ensure continuous improvement and alignment with evolving operational requirements.

Umbrella Contract with Prequalified Vendor List

The umbrella contract is planned as a longterm solution because it involves the established framework agreements, prequalify the vendors, and negotiate the standardized terms. The justification is its strategic value in significantly reduce procurement execution time with remove the tender steps. However, it is important to note that not all purchase requisitions can be covered under umbrella contracts. Based on vendor cooperation and product characteristics, the estimated maximum coverage is about 50% of total PRs.

CONCLUSION

Through quantitative lead time analysis, interviews, FGDs, and root cause analysis used CRT found four main causes of delays were identified: (1) manual approval layers where multiple levels of manual approval create long process time and extend document circulation, (2) no longterm contract mechanism cause by repeated tender for similar items and higher administrative workload, (3) unstructured vendor management limited to document compliance without consistent performance evaluation (4) no integrated monitoring system that hinder early delay detection and cross-department coordination.

To address these issues, four business solutions were developed and validated through process redesign and simulation contains implementation of e-signatures to accelerate approvals, adoption of umbrella contracts to shorten repetitive procurements, development of a risk dashboard for real-time monitoring, and establishment of a vendor rating system to enhance supplier accountability.

The improved process reduced lead time to 44.7 days 15.8 days faster than the current process and significantly lowered administrative costs from about Rp 552 million to Rp 2.6 million. An implementation roadmap is structured into short-term (e-signature and risk dashboard), medium-term (vendor rating system), and long-term (umbrella contract expansion)

stages. For sustainability, these improvements should be integrated into PTBA's ERP migration from Ellipse to SAP. Future research may assess financial benefits and examine organizational readiness to support long term digital transformation in procurement.

LIMITATION

The study aims to reduce procurement lead time for maintenance spare parts at PTBA has several limitations. The research was conducted within a single company that limit the generalization of results to other contexts. Data collection relied on internal documents and selected employee interviews which may introduce bias so the time constraints restricted the assessment of external factors such as supplier performance and market dynamics. Moreover, the analysis focused mainly on operational processes without deeply explore in financial or technological influences. Despite these limitations, the findings provide practical insights to enhance procurement efficiency.

REFERENCES

Abouzid, I., & Saidi, R. (2019). Proposal of BPMN extensions for modelling manufacturing processes. *Proceedings of the 2019 IEEE International Conference on Industrial Engineering and Engineering Management (IEEM)*, 1–8. IEEE. https://doi.org/10.1109/IEEM44572.2019.8978903

Brito, F. M. de, da Cruz Júnior, G., Frazzon, E. M., Basto, J. P., & Alcalá, S. G. (2020). Design approach for additive manufacturing in spare part supply chains. *IFAC-PapersOnLine*, *53*(2), 10892–10897. https://doi.org/10.1016/j.ifacol.2020.12.3129

Durán, O., Roda, I., & Macchi, M. (2018). Civil aircraft spare parts prediction and configuration management techniques: Review and prospect. *Advances in Mechanical Engineering*, *10*(2), 1–15. https://doi.org/10.1177/1687814018759957

Frazzon, E., Israel, E., Albrecht, A., & Hellingrath, B. (2013). Spare parts estimation and risk assessment conducted at Choghart Iron Ore Mine: A case study. *Journal of Quality in Maintenance Engineering*, *19*(4), 371–386. https://doi.org/10.1108/JQME-09-2012-0033

Ghodrati, B., Kumar, U., & Akersten, P. (2007). Simulation of logistical support for the engineering of spare parts management in multi-site contexts. *IFAC Proceedings Volumes*, *40*(13), 65–70. https://doi.org/10.3182/20071022-3-FR-3907.00012

Hachimi, H. (2019). *2019 International Conference on Optimization and Applications (ICOA): April 25–26, 2019, ENSA of Kenitra, Ibn Tofail University, Kenitra, Morocco*. IEEE.

Hsu, B., Hsu, L., & Shu, M. (2013). Evaluation of supply chain performance using delivery-time performance analysis chart approach. *Journal of Statistics and Management Systems*, *16*(1), 73–87. https://doi.org/10.1080/09720510.2013.10701628

Kementerian Badan Usaha Milik Negara. (2019). *Peraturan Menteri BUMN Nomor PER-08/MBU/12/2019 tentang Pedoman Umum Pelaksanaan Pengadaan Barang dan Jasa BUMN*. https://peraturan.bpk.go.id/Details/146702/permen-bumn-no-per-08mbu122019-tahun-2019

Kementerian Badan Usaha Milik Negara. (2023). *Peraturan Menteri BUMN Nomor PER-02/MBU/03/2023 tentang Pedoman Umum Pelaksanaan Pengadaan Barang dan Jasa BUMN*. https://peraturan.bpk.go.id/Details/264291/permen-bumn-no-per-2mbu032023-tahun-2023

Kuleshova, E., Levina, A., & Esedulaev, R. (2018). Preface: International scientific conference. *MATEC Web of Conferences*, *193*(00001). EDP Sciences. https://doi.org/10.1051/matecconf/201819300001

Kumar, S., & Strehlow, R. (2004). Business process redesign as a tool for organizational development. *Technovation*, *24*(10), 853–861. https://doi.org/10.1016/S0166-4972(02)00182-7

Mohammed, I., & Mandal, J. (2023). The impact of lead time variability on supply chain management. *International Journal of Supply Chain Management*, *8*(2), 41–55. https://doi.org/10.47604/ijscm.3075

O'Byrne, R. (2025, February 4). A guide to supply chain lead time. *Logistics Bureau*. https://www.logisticsbureau.com/supply-chain-lead-time/

Oumaima, B., & Krishnan, K. (2020). The performance evaluation of the spare parts supply chain. *Journal of Quality in Maintenance Engineering*, *26*(4), 521–538. https://doi.org/10.1108/JQME-02-2020-0019

Pan, G., Feng, D., & Jiang, M. (2010). Application research of shortening delivery time through value stream mapping analysis. *Proceedings of the 2010 IEEE International Conference on Industrial Engineering and Engineering Management (IEEM)*, 733–737. IEEE. https://doi.org/10.1109/IEEM.2010.5674219

Popa, C., & Goia, I. (2024). The modelling of cargo transshipment operations using the business process modelling tools. *Scientific Journal of Silesian University of Technology. Series Transport*, *124*, 157–169. https://doi.org/10.20858/sjsutst.2024.124.11

PT Perusahaan Industri Pangan. (2023). *Pedoman Umum Pelaksanaan Pengadaan Barang dan Jasa*. https://pi-pangan.com/wp-content/uploads/2023/03/Pedoman-Umum-Pelaksanaan-PBJ-PIP.pdf

Rasool, F., Greco, M., & Grimaldi, M. (2020). Digital supply chain performance metrics: A literature review. *IFAC-PapersOnLine*, *53*(2), 10782–10787. https://doi.org/10.1016/j.ifacol.2020.12.2886

Sargent, R. G. (2010). Verification and validation of simulation models. *Proceedings of the 2010 Winter Simulation Conference*, 166–183. IEEE. https://doi.org/10.1109/WSC.2010.5679166

Schoenherr, T., & Rao Tummala, V. M. (2007). Electronic procurement: A structured literature review and directions for future research. *International Journal of Procurement Management*, *1*(1–2), 8–37. https://doi.org/10.1504/IJPM.2007.015353

Sun, J. W., Barjis, J., Verbraeck, A., Janssen, M., & Kort, J. (2009). Capturing complex business processes interdependencies using modeling and simulation in a multi-actor environment. In A. Albani, J. Barjis, & J. L. G. Dietz (Eds.), *CIAO!/EOMAS 2009: Enterprise Modelling and Information Systems Architectures* (Vol. 34, pp. 16–27). Springer-Verlag. https://doi.org/10.1007/978-3-642-03139-1_2

Tang, Y., Li, F., & Song, H. (2023). Improving lead time forecasting and anomaly detection for spare parts distributor supply chain. *Journal of Operations and Supply Chain Management*, *16*(2), 57–72.

The Canadian Press. (2024, May 27). Indonesian coal industry risking a tough transition as demand declines, report says. *Coast Reporter*. https://www.coastreporter.net/environment-news/indonesian-coal-industry-risking-a-tough-transition-as-demand-declines-report-says-10820332

Van Ommeren, C. (2019). *Reducing the duration and variance of external repair lead times* [Master's thesis, University of Twente]. https://essay.utwente.nl/79456/

Vega Mejía, C. A., Castellanos Arias, J. S., Aguirre Mayorga, H. S., Rincón, N., & Hernández Martinez, Y. P. (n.d.). *ERP and BPMS integration at a manufacturing simulation lab*. Javeriana University, Department of Industrial Engineering, Bogotá, Colombia.

Wang, X., Wang, J., Ning, R., & Chen, X. (2023). Joint optimization of maintenance and spare parts inventory strategies for emergency engineering equipment considering demand priorities. *Mathematics*, *11*(17), 3688. https://doi.org/10.3390/math11173688