Volume 4, No. 8 Auguts 2025
p-ISSN 2980-4868 | e-ISSN 2980-4841
https://ajesh.ph/index.php/gp

Improving Material Code Process Using Lean Service in Oil and Gas Company (Case Study: PT. XYZ)

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ABSTRACT:
This study addresses inefficiencies in the Material Identification Code (MIC) request process at PT XYZ, an upstream oil and gas company, where delays in material procurement hinder operational performance. Using a Lean Service approach, the research identifies and eliminates non-value-added activities through Service Value Stream Mapping (SVSM) and Root Cause Analysis (RCA). The current process was mapped, revealing significant bottlenecks, including redundant approval steps, manual data verification, and fragmented communication, which extended lead times to 7.68–20.44 days despite an actual process time of only 0.52 days. The analysis classified process activities into Value-Added (VA), Non-Value-Added (NVA), and Necessary Non-Value-Added (NNVA), showing that 89.47% of the total process time was consumed by NVA and NNVA activities. Key wastes included delays in verification (7.27 days) and manual rework (3.03 days). To address these issues, a Future State Map was developed, incorporating digital automation, integrated communication tools, and streamlined workflows. The proposed improvements reduced process time by 46% (to 0.27 days) and cut lead time by 94.81% (to 0.60–1.06 days), while increasing the Value-Added Ratio (VAR) from 1.7% to 12.85%. This research demonstrates how Lean Service methodologies, combined with digital transformation, can optimize administrative processes in the oil and gas sector. The findings offer practical solutions for PT XYZ and serve as a model for similar industries seeking to enhance efficiency, reduce waste, and improve compliance with service-level agreements.

Keywords: Lean Service; Service Value Stream Mapping (SVSM); Root Cause Analysis (RCA)

INTRODUCTION

PT XYZ Indonesia's upstream oil and gas sector plays a pivotal role in ensuring national energy security and generating state revenue. The government has set an ambitious target of producing one million barrels of crude oil per day by 2030 (*Komisi VII DPR RI*, 2022), placing increased pressure on operators such as PT XYZ to enhance operational efficiency. PT XYZ, responsible for *Regional 3* in Kalimantan—one of the country's top ten oil-producing areas—is expected to make significant contributions toward achieving this national target. A key factor in PT XYZ's drilling and production operations is the availability of critical materials, which relies on an efficient and responsive *Material Identification Code* (MIC) system. However, this growing operational demand is not matched by an increase in domestic oil output. On the contrary, Indonesia's crude production has declined in recent years, widening the gap between supply and demand and increasing dependence on imported oil and gas (PWC, 2023).

To reduce this dependency, PT XYZ must sustain and scale its production activities by ensuring reliable access to materials needed for drilling and facility maintenance. Central to this effort is the MIC system, which assigns a unique code to each item in the procurement and inventory systems. Since August 2022, MIC creation at PT XYZ has been standardized across four operational zones, yet data from 2023 reveal persistent delays. Average lead times for MIC creation continue to exceed *Service Level Agreements* (SLAs), particularly for operating supplies, which accounted for 88% of the more than 600 MIC requests received that year. These delays reflect structural inefficiencies, including overlapping roles, segmented approval workflows, and excessive document revisions. Users are often required to resubmit documentation due to incomplete or inconsistent information, resulting in process bottlenecks that jeopardize drilling timelines. Addressing these inefficiencies is crucial to achieving faster procurement cycles and supporting national production goals.

A critical analysis of prior research reveals gaps this study addresses. Wibisono et al. (2021) applied *Lean Service* to oil and gas logistics but focused narrowly on physical supply chains, overlooking administrative workflows like MIC processes. Similarly, Fauzan et al. (2022) highlighted digital transformation in energy-sector administration but lacked a systematic Lean framework to quantify waste. This research bridges these gaps by integrating *Lean Service* tools (*SVSM*, *RCA*) with digital solutions to streamline MIC workflows, offering a measurable approach to eliminate redundancies and delays.

This research applies a *Lean Service* framework to analyze and optimize the MIC codification process at PT XYZ. The aim is to develop a future-state process map that reduces lead times, eliminates redundancies, and strengthens interdepartmental coordination. The scope is limited to internal processes within *Regional 3*, drawing on 2023 operational data, *SOPs*, and stakeholder interviews to identify improvement opportunities.

The study aims to redesign PT XYZ’s MIC process by combining Lean methodologies with digital integration, targeting lead time reduction, waste elimination, and improved interdepartmental coordination. The outcomes will enhance procurement efficiency, support national production goals, and provide a replicable model for Lean-driven administrative improvements in the energy sector.

RESEARCH METHODS

This research is a case study conducted at PT XYZ, an upstream oil and gas company operating in Kalimantan. The study aims to evaluate and improve the *Material Identification Code* (MIC) request process, which plays a crucial role in supporting procurement and drilling operations. The methodology applies a descriptive quantitative approach and incorporates *Lean Service* tools to identify inefficiencies, analyze root causes, and design a more efficient process model. The following outlines the flow of the methodology.

1. Data Collection

Data collection was conducted using both primary and secondary sources. Primary data were obtained through direct observation of the MIC request process and semi-structured interviews with stakeholders, including MIC users, cataloguers, and administrators. These methods provided insights into actual workflows and bottlenecks. Secondary data were gathered from system logs, historical lead time records, and *SAP* reports for MIC requests submitted in 2023. The collected data served as the foundation for analyzing delays and identifying repetitive or non-value-adding activities. For instance, historical lead time data were collected from internal systems, logbooks, and stakeholder feedback. This data was used to measure delays and categorize process steps as *Value-Added* (VA), *Non-Value-Added* (NVA), or *Necessary Non-Value-Added* (NNVA), as per *Lean* methodology standards. In 2023, the *operating supplies* category alone accounted for over 600 MIC requests, making up approximately 88% of the total volume. *Operating supplies* include externally procured items used to support production, maintenance, and equipment operations. This category was the primary focus of analysis.

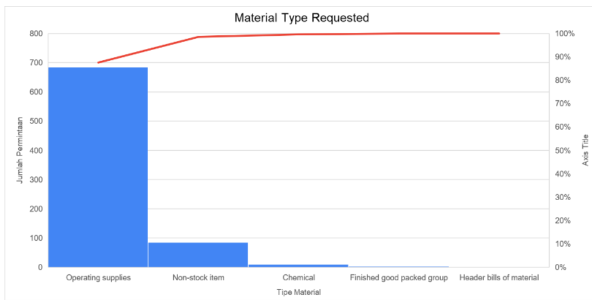

Figure 1. Material Type Request Diagram 2023

Source: Material Identification Code Request Report – PT XYZ

2. Data Analysis

The collected data were analyzed using *Service Value Stream Mapping* (SVSM) to visualize the current process and measure lead times across each step. All activities were classified into *Value-Added* (VA), *Non-Value-Added* (NVA), or *Necessary Non-Value-Added* (NNVA) categories based on *Lean Service* criteria. Root causes of inefficiencies were identified using *Fishbone Diagrams*, while statistical analysis using *Excel* and *Pareto analysis* was employed to assess data normality. This analysis allowed the research team to isolate key delay factors and determine where improvements were most needed.

Following this flow, the final objective of this research is the development of a *Future State Map*, incorporating digital tools and *Lean* strategies to reduce waste, shorten lead times, and improve overall efficiency. The proposed improvements were reviewed by subject matter experts to ensure alignment with PT XYZ's operational practices and technological capabilities. Based on the analysis, a new MIC request process model was developed to reduce waste, eliminate delays, and improve overall efficiency through digitization and standardization. The proposed future state model was validated by experts from PT XYZ's *Supply Chain Management* division. Among several alternative recommendations, the final solution was selected based on expert evaluation using the following criteria:

a. Desirability: The extent to which the solution meets user needs.
b. Visibility: Whether the solution is practical and implementable within existing constraints.
c. Sustainability: The likelihood that the solution remains effective over time, even with minimal enforcement.

RESULTS AND DISCUSSION

This section presents the findings of the study alongside a comprehensive discussion of the business process inefficiencies identified in the Material Identification Code (MIC) or familiarity with Kode Identifikasi Material Pertamina (KIMAP) request workflow at PT XYZ. Using Lean Service methodology, including Service Value Stream Mapping (SVSM), Process Activity Mapping (PAM), and root cause analysis (Fishbone Diagram), the research identifies key sources of waste and proposes targeted improvements.

1. Analysis of the Current State Process

Service Value Stream Mapping (SVSM) is used to identify the process flow and time taken at each stage in the creation of KIMAP (Pertamina Material Identification Code). This SVSM illustrates the flow of both physical work and information at each stage, as shown in Figure 3, which represents the current state mapping at PT XYZ (Salwin, M. 2021). Several processes were found to contribute significantly to the overall process time, resulting in a prolonged total process and lead time. These processes have the potential to be eliminated to reduce waste throughout the entire workflow (Vidre, S. V. 2020).

As illustrated in the Figure 3, The current process map reveals excessive lead time ranging from 7.68 to 20.44 days despite an actual process time of only 0.52 days. The SVSM illustrates significant bottlenecks, particularly in verification stages where delays reached 7.27 days, and manual rechecking by users took an average of 3.03 days (Patil, A. S. 2021). This inefficiency is compounded by form-based submissions, lack of system integration, and repetitive rework due to incomplete data (Costa, B. 2024).

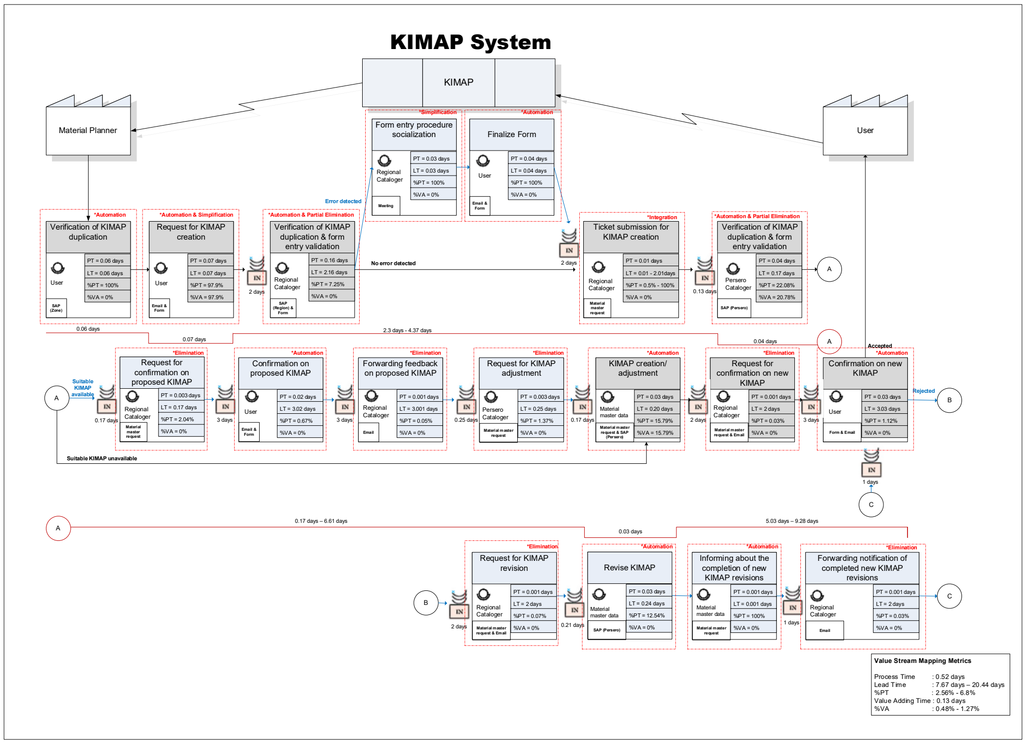

Figure 2. Current State Map

Source: Service Value Stream Mapping (SVSM) analysis conducted by researchers (2024)

2. Process Activity Mapping (PAM) In the Current State Process

To further diagnose inefficiencies, Process Activity Mapping (PAM) was developed based on actual observation data and stakeholder interviews. This mapping outlines the detailed steps in the KIMAP process, from initial material code requests to verification, approval, and finalization by the cataloguing team and related units. Each activity in the process was classified into three categories based on its contribution to value creation:

a. Value-Added (VA): Activities that directly support process goals and deliver clear benefits to the end user. Non-Value Added (NVA): Activities that do not contribute to value creation and are considered wasteful within the process flow.
b. Necessary but Non-Value Added (NNVA): Activities that do not add value directly but are required to meet internal procedures or external regulatory requirements.

Based on the PAM analysis, activities contributing to these expectations were categorized as VA, while those prolonging the process without adding value were marked as NVA. Compliance-related but non-value-adding tasks were identified as NNVA, as is explained Table 1.

Table 1. Summarizes PAM Activity Types and Average Durations

Activities	No.	Step of the Activity	Channel / Tools	Average (Days)	Process Time (Days)	Identification
KIMAP Duplication Verification (by user)	1	User checks via SAP whether the required KIMAP is available. (User checks in the plant under their authorization, i.e., respective Zone).	Manual	0.06	0.06	NNVA
Submission for a new KIMAP creation	2	User prepares a KIMAP request.	Manual form	0.07	0.07	VA
	3	User submits a new KIMAP creation request to the Cataloger.	E-mail	0.00		NNVA
KIMAP Duplication Verification & Form Completion Compliance (by Regional Cataloger)	4	Regional Cataloger receives the KIMAP creation request.	E-mail	2.00	0.16	NVA
	5	Regional Cataloger checks via SAP whether the required KIMAP is available. Regional Cataloger checks the plant under their authorization, i.e., Regional and Zone.	Manual	0.13		NVA
	6	Regional Cataloger verifies and validates the completeness and accuracy of the Form.	Manual	0.03		NNVA
Form Completion Procedure Socialization	7	Regional Cataloger discusses with the User regarding the KIMAP request and assists in completing the initial KIMAP Request Form.	Meeting	0.03	0.03	NVA
Form Completion Finalization Based on Cataloger Feedback	8	User completes the Form based on the Cataloger's guidance and submits it to the Cataloger.	Manual form	0.04	0.04	NVA
	9	User submits a new KIMAP creation request to the Cataloger.	E-mail	0.00		NNVA
Submission of KIMAP Request Ticket	10	Regional Cataloger receives the request outcome from the discussion.	E-mail	2.00	0.01	NVA
	11	Cataloger submits the KIMAP request in the Persero system.	Material master request	0.01		NNVA
KIMAP Duplication Verification & Form Completion Compliance (by Persero)	12	Persero Cataloger receives the KIMAP creation request.	Material master request	0.13	0.03	NVA
	13	Persero Cataloger checks whether the required KIMAP	__	0.02		VA

Activities	No.	Step of the Activity	Channel / Tools	Average (Days)	Process Time (Days)	Identification
		is available by performing checks across all plants.				
	14	Persero Cataloger validates and verifies the Form if there are missing data or related to the KIMAP proposal from Persero.	__	0.01		VA
	15	Persero Cataloger confirms with the Regional Cataloger whether the KIMAP proposal from Persero meets the requirements.	Material master request	0.00		NNVA
Request for KIMAP Proposal Confirmation (by Regional)	16	Regional Cataloger receives information from Persero Cataloger.	Material master request	0.17	0.003	NVA
	17	Regional Cataloger confirms with the User whether the KIMAP proposal from Persero meets the requirements.	E-mail	0.00		NNVA
Confirmation of KIMAP Proposal (by User)	18	User receives information on the cataloger proposal from Persero.	E-mail	3.00	0.02	NVA
	19	User reviews the KIMAP proposal from Persero Cataloger.		0.02		NNVA
Feedback on KIMAP Proposal to Cataloger Persero (by Regional)	20	Regional Cataloger receives confirmation from the User.	E-mail	3.00	0.00	NVA
	21	Regional Cataloger forwards the User's confirmation to the Persero Cataloger regarding missing data / KIMAP proposal.	__	0.00		NNVA
Request for KIMAP Adjustment	22	Persero Cataloger receives confirmation from the Regional Cataloger.	Material master request	0.25	0.00	NVA
	23	Persero Cataloger requests Material Master Data Persero Procurement to create a new KIMAP in the system.	__	0.00		NNVA
Creation/Adjustment of KIMAP in the System	24	Material Master Data receives the new KIMAP request.	Material master request	0.17	0.03	NVA
	25	Material Master Data " Persero creates a new KIMAP as requested.	__	0.03		VA

Activities	No.	Step of the Activity	Channel / Tools	Average (Days)	Process Time (Days)	Identification
Request for New KIMAP Confirmation	26	Material Master Data " Persero requests confirmation from the Cataloger whether the data is accurate.	__	0.00	0.00	NNVA
	27	Regional Cataloger forwards the confirmation request to the User whether the data is accurate.	E-mail	2.00		NVA
Data Verification on New KIMAP	28	User receives information from the Regional Cataloger.	E-mail	3.00	0.03	NVA
	29	User reviews the uploaded data.	E-mail	0.03		NNVA
Request for KIMAP Revision	30	User sends info related to review results	E-mail	0.00	0.00	NNVA
	31	Regional Cataloger receives confirmation from the User.	E-mail	2.00		NVA
	32	Regional Cataloger forwards User's information to Material Master Data Persero Procurement stating that data is inaccurate/accurate.	E-mail	0.00		NVA
Revision of Information by Material Master Data	33	Material Master Data receives the information for revision.	Material master request	0.21	0.03	NVA
	34	Material Master Data " Persero Procurement makes the revision.	__	0.03		NVA
Reporting of New KIMAP Request Fulfillment	35	Material Master Data " Persero Procurement informs that the new KIMAP is complete.	__	0.00	0.00	NNVA
Provision of Information on New KIMAP Request Fulfillment	36	Regional Cataloger receives information that the request has been fulfilled.	Material master request	0.00	0.00	NVA
	37	Regional Cataloger forwards the information that the request has been fulfilled.	E-mail	1.00		NVA
Receipt of Information on New KIMAP Request Fulfillment	38	User receives information that the request has been fulfilled.	E-mail	1.00	0.00	NVA

Source: Process Activity Mapping (PAM) analysis by researchers (2024)

The Process Activity Mapping (PAM) exercise classified a total of 35 distinct activities into three categories:

a. Value-Added (VA): 4 activities (10.53%)
b. Necessary but Non-Value-Added (NNVA): 15 activities (39.47%)
c. Non-Value-Added (NVA): 19 activities (50%)

To quantify the proportion of time that genuinely contributes to user value, we calculate the Value-Added Ratio (VAR) as follows Figure 4:

Figure 4 – Value-Added Ratio

Applying these steps yields a VAR of 1.70%, confirming that over 98% of the process time is consumed by NNVA and NVA activities. Such a low VAR highlights a critical need for a systemic redesign to eliminate waste and enhance operational efficiency. involves the identification of analogous systems that are already in existence within the oil and gas industry.

3. Waste Identification

Based on the analysis of the current state mapping, several major types of waste were identified as key obstacles to process efficiency. These issues were further examined using a Root Cause Analysis, visualized through a Fishbone Diagram as shown in Figure 5 below. The analysis specifically highlights two dominant forms of waste, Delay and Unnecessary Movement which together account for approximately 80% of the total identified waste in the KIMAP process.

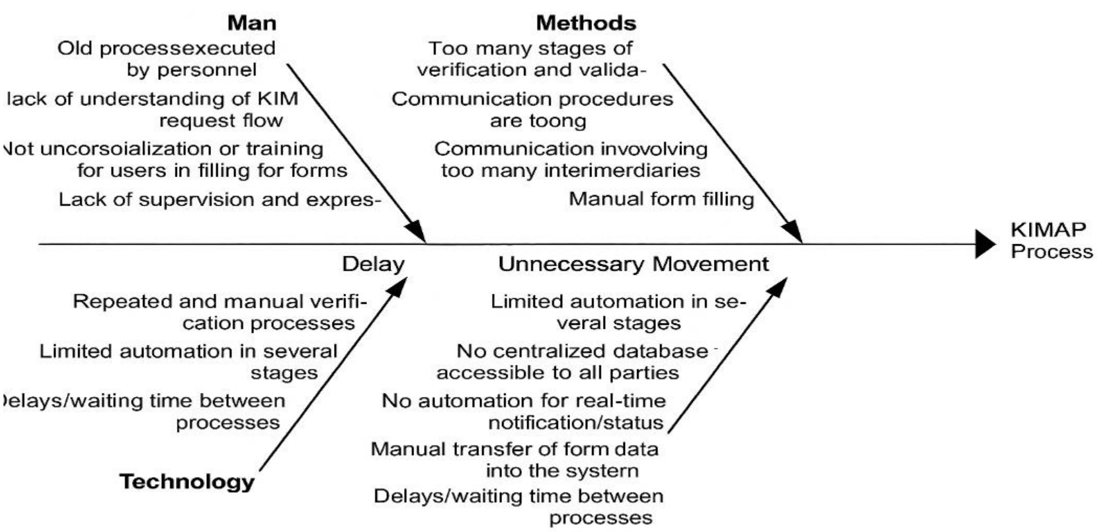

Figure 5. Fishbone in the Existing Process

Source: Root Cause Analysis (RCA) performed by researchers (2024)

These findings align with previous studies by Wibisono et al. (2021) and Fauzan et al. (2022), which also highlighted administrative redundancy and digital system gaps as leading sources of waste in oil and gas operations.

4. Improvement Plan with Future State Mapping (FSM)

The proposed improvement strategy is developed by focusing on the elimination of process inefficiencies and the enhancement of value-added activities. The strategic interventions include:

1) Automation of data validation processes to reduce manual checking and eliminate delays and rework;
2) Integration of communication tools (e.g., build information systems such as Catalogue Management Tools/CMT) to replace fragmented, email-based coordination;

3) System linkage between front-end user interfaces and the ERP system to enable seamless data flow and minimize redundant input.
4) Implementation of structured training programs aimed at improving human capital effectiveness and reducing errors caused by skill gaps.

These initiatives are informed by the Root Cause Analysis and SVSM conducted in the earlier stages of the research (see the Figure 6). The redesigned process was modelled through Future State Mapping (FSM), applying collaborative digital tools to streamline workflows and realign process responsibilities.

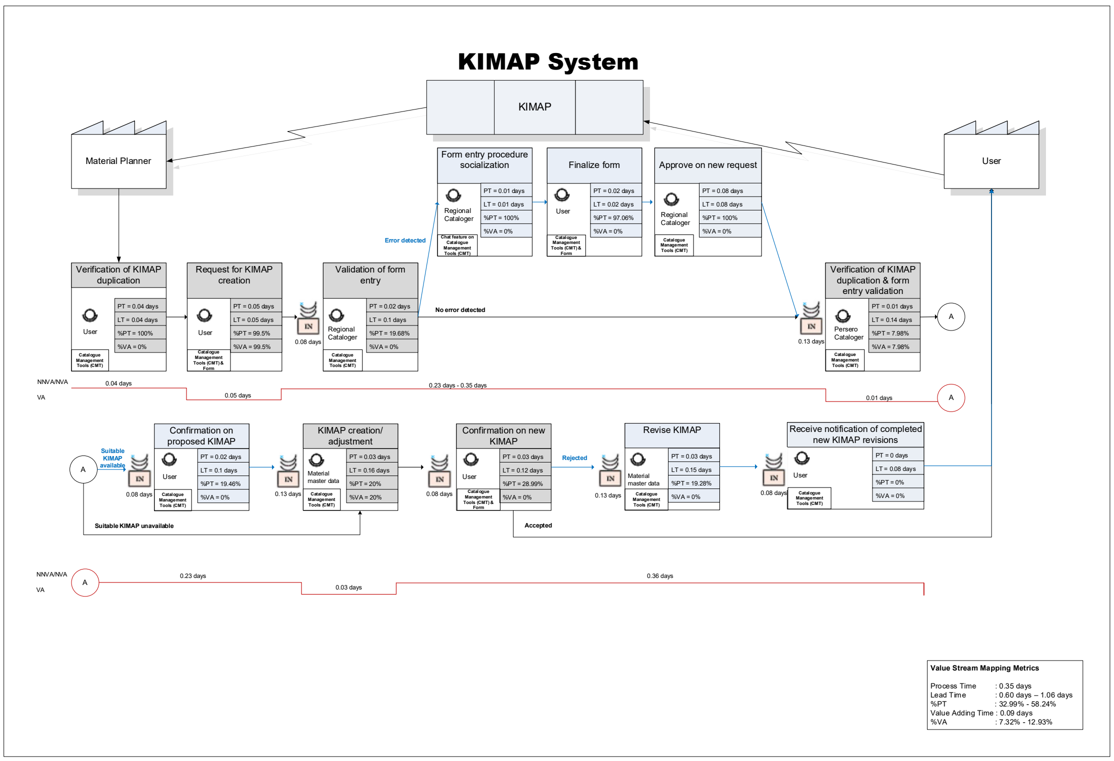

Figure 6. Current State Map

Source: Proposed redesign by researchers (2024)

To evaluate the impact, a Future State Map was developed, leveraging collaborative digital tools to streamline workflows and reduce waste. The redesigned workflow demonstrated substantial process improvements:

a. Process time was reduced by 46% (from 0.52 to 0.27 days).
b. Lead time decreased by up to 94.81% (from 7.67–20.44 days to 0.60–1.06 days).
c. Value-Added Time increased significantly, with VA ratio improving from 0.64–1.7% to 8.35–12.85%.

This highlights the critical impact of combining Lean thinking with digital integration in high-complexity service environments like oil and gas logistics by embedding real-time dashboards, automated tracking, and digital notifications, the redesigned process not only becomes faster and more reliable but also promotes transparency, user accountability, and data-driven decision-making.

CONCLUSION

This research examined inefficiencies in the *Material Identification Code* (MIC) request process at PT XYZ, an upstream oil and gas company, using a *Lean Service* approach. The methodology integrated *Service Value Stream Mapping* (SVSM), *Process Activity Mapping* (PAM), and *Root Cause Analysis* (RCA) to uncover non-value-added activities, redundancies, and delays that hindered the efficiency of procurement operations. The analysis revealed that a significant portion of the existing workflow was consumed by wasteful steps, leading to extended turnaround times and low value-added performance. In response, a redesigned process model—referred to as the *Future State Map*—was developed to address these issues. This model integrates digital tools for automation, real-time coordination, and centralized communication, resulting in a more streamlined, transparent, and accountable workflow. The implementation of this lean-driven, digitally supported model demonstrated clear improvements in overall process efficiency and responsiveness. It not only accelerated task completion but also enabled better visibility across departments, reducing delays caused by manual checks and fragmented communication. The recommended solution was chosen through expert validation, based on three core criteria: *desirability* (alignment with user needs), *feasibility* (practicality and readiness for implementation), and *sustainability* (long-term usability and support from stakeholders). This ensures that the proposed improvements are both actionable and enduring. This study contributes to a growing body of knowledge demonstrating that strategic process redesign, grounded in *Lean* principles and supported by digital integration, can substantially transform administrative workflows in the energy sector.

REFERENCES

Albanna, M. (2018). Root cause analysis in lean implementation: Case study of QWZ delivery service. International Journal of Operations and Logistics Management, 7(2), 105–114.

Bala, B. K., & Sahoo, B. G. (2015). Lean thinking in administrative processes: A case study. International Journal of Production Quality Management, 15(3), 345–359.

Bonaccorsi, R., Carmignani, A., & Zammori, F. (2011). Service value stream management (SVSM): Developing lean thinking in the service industry. Journal of Service Science and Management, 4(4), 476–491. https://doi.org/10.4236/jssm.2011.44055

Cavdur, M., Ertek, A., & Gunel, Y. (2019). A lean approach to maintenance and repair operations at a public university. Journal of Management Science, 17(34), 23–36.

Costa, B. (2024). Development of a value stream map to optimize the production process. MDPI. https://www.mdpi.com/2227-9717/12/8/1612

Fauzan, M., Prasetyo, R. R., & Setiadi, B. (2022). Digital transformation of administrative processes in the energy sector. Proceedings of the International Conference on Industrial Engineering and Operations Management.

Gaspersz, J. (2011). Lean six sigma for service: Meningkatkan kinerja layanan dan jasa dengan lean six sigma. Gramedia Pustaka Utama.

Jasti, A., & Sharma, A. (2015). Lean manufacturing implementation using value stream mapping as a tool: A case study from auto components industry. International Journal of Lean Six Sigma, 6(2), 118–137. https://doi.org/10.1108/IJLSS-07-2013-0047

Komisi VII DPR RI. (2022). Target produksi minyak 1 juta barel per hari: Kebijakan strategis energi nasional. DPR RI.

Lambert, D. M., & Cooper, M. C. (2020). Issues in supply chain management. Industrial Marketing Management, 29(1), 65–83. https://doi.org/10.1016/S0019-8501(99)00113-3

Patil, A. S. (2021). Application of value stream mapping to enhance the lead time reduction. Scielo. https://www.scielo.org.mx/scielo.php?pid=S1665-64232021000100011&script=sci_arttext

PWC Indonesia. (2023). Indonesia's oil and gas industry – Investment and taxation guide 2023. PWC Indonesia. https://www.pwc.com/id

Rohani, M., & Zahraee, S. (2015). Production line analysis via value stream mapping: A lean manufacturing process of color industry. Procedia Manufacturing, 2, 6–10. https://doi.org/10.1016/j.promfg.2015.07.002

Salwin, M. (2021). Using value stream mapping to eliminate waste: A case study. MDPI. https://www.mdpi.com/1996-1073/14/12/3527

Skeldon, T. (2014). Implementation of lean methodology in an academic uro-oncology outpatient clinic. Healthcare Management Forum, 27(3), 136–139. https://doi.org/10.1016/j.hcmf.2014.03.008

Setiawan, U. (2023, July 17). Realisasi produksi migas baru capai 93 persen, ini penjelasan SKK Migas. Kompas. https://www.kompas.id/

Saputra, H., & Singgih, R. (2012). Aplikasi root cause analysis untuk mengurangi waste pada proses produksi (Studi kasus di PT. XYZ). Jurnal Teknik ITS, 1(1), A129–A132. https://doi.org/10.12962/j23373539.v1i1.1234

Uly, H., & Diumena, M. (2023, January 5). SKK Migas genjot pengeboran 991 sumur migas pada 2023. Kontan. https://industri.kontan.co.id/

Vidre, S. V. (2020). Implementation of lean philosophy through value stream mapping. Diva Portal. https://www.diva-portal.org/smash/get/diva2%3A1448265/FULLTEXT01.pdf

Wibisono, A. Y., Sutrisno, T., & Anggraeni, E. (2021). Lean service implementation in oil and gas logistics: A case study. Journal of Engineering and Technology Sciences, 53(1), 101–117.