ANALYSIS OF THE IMPACT OF AUTO REQUEST IMPLEMENTATION ON THE TOOLING MANAGEMENT SYSTEM WORKFLOW AT PT. XYZ

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Abstract

The manual tool request system at PT. XYZ often causes waiting time waste and delays in production, hindering process smoothness and reducing equipment readiness. This problem is rooted in the reliance on manual user input. Responding to these constraints, this study introduces the integration of an Auto Request dashboard into the Tooling Management System (TMS). This feature automates tool requests based on the integration of production schedule data with the Work Order system. This study aims to analyze the impact of Auto Request on TMS workflow changes using a qualitative approach and Value Stream Mapping (VSM). VSM maps the process conditions before (Before State) and after (After State) implementation. The analysis results show that the application of Auto Request totally eliminates waiting time (100% NVA reduction), reduces lead time from 35 minutes to 20 minutes, and successfully increases Process Cycle Efficiency (PCE) from 57.14% to 100%. This system implementation is proven to provide significant added value to the smoothness of work processes and support a more responsive work culture.

Keywords : Auto Request, Tooling Management System, Value Stream Mapping, Waiting Time, Lean Manufacturing.

1. Introduction

In the manufacturing industry, particularly in high-volume production environments such as PT. XYZ, the smooth operation of business processes is a crucial factor in maintaining competitiveness. The smooth operation of production processes is heavily dependent on the readiness of resources, including equipment and production tools. One of the main challenges frequently encountered is the delay or unavailability of tools, which can hinder the progress of processes and result in financial losses. This situation systematically creates a waste of time (non-value-added time), which in the concept of Lean Manufacturing is known as Muda or waste [1].

At many companies, including Company XYZ, the tooling request and preparation system (Tooling Management System) still relies on manual methods. Tooling requests are often submitted close to the start of production, sometimes as late as one hour before the process begins. This leaves the production team with insufficient time to prepare, thereby disrupting the smooth flow of the workflow [2]. Additionally, manual systems cannot provide real-time information regarding the availability of production tools. Consequently, production teams often start the process without certainty that the tools are available, forcing them to wait for confirmation—a form of wasted time [3]. This situation becomes even more complicated when sudden schedule changes or mismatched equipment requests occur, leading to inefficiencies. The inflexibility of manual systems has proven ineffective in anticipating demand variability, and rushed preparations increase the risk of errors and potential rework.

To address the challenges of workflow efficiency and effectiveness, in line with the concepts of Smart Manufacturing and Industry 4.0—which require automation and digital integration [4] PT. XYZ decided to migrate its Tooling Management System. Previously using a vendor-provided system (CodeIgniter–MySQL), the company switched to a more standards-compliant platform (ASP.NET–SQL Server). This migration aims not only to strengthen the technological foundation but also to implement an integrated Auto Request Tools dashboard within the Work Order system. With this feature, the system can automatically submit tool requests well in advance according to the schedule listed in the Work Order, so that the production team receives information earlier and synchronization between production needs and tool readiness improves, minimizing delays [5].

To analyze the impact of Auto Request, this study employs Value Stream Mapping (VSM) to visualize workflows and deeply evaluate waste [6]. VSM maps the current process (Before State Map) to identify waste [7], which is further analyzed via interviews and observations. Finally, VSM designs the future state (After State Map) implementing Auto Request to eliminate the identified waste [8].

Therefore, this study focuses on a qualitative comparative analysis between the Before State and After State processes using VSM. The main outputs generated include the identification of specific waste narratives (e.g., waiting time), the design of a leaner business process, and a qualitative analysis of the factors influencing the smoothness of the workflow. The results of this study will provide an in-depth qualitative evaluation of the improvement in business process efficiency at PT. XYZ [9].

2. Research Method

A. Research Flow

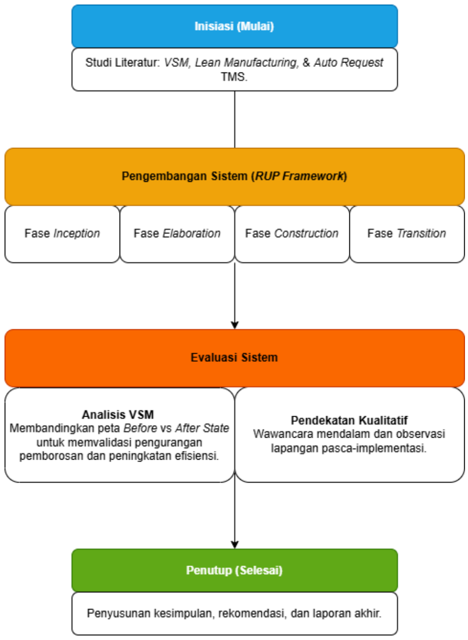

Figure 1. Research Flow

The research methodology is structured into four main stages, starting with the initiation phase, which involves a comprehensive literature study on Value Stream Mapping (VSM), Lean Manufacturing, and the Auto Request Tooling Management System (TMS). Following this, the system development phase is executed utilizing the Rational Unified Process (RUP) framework, progressing through the Inception, Elaboration, Construction, and Transition stages. Once the system is deployed, a dual-method system evaluation is conducted; this includes a VSM analysis to compare the "Before" and "After" state maps to validate waste reduction and efficiency improvements, alongside a qualitative approach utilizing in-depth interviews and post-implementation field observations. Ultimately, the research wraps up in the conclusion phase, culminating in the formulation of conclusions, recommendations, and the preparation of the final report.

B. Application Development Stages

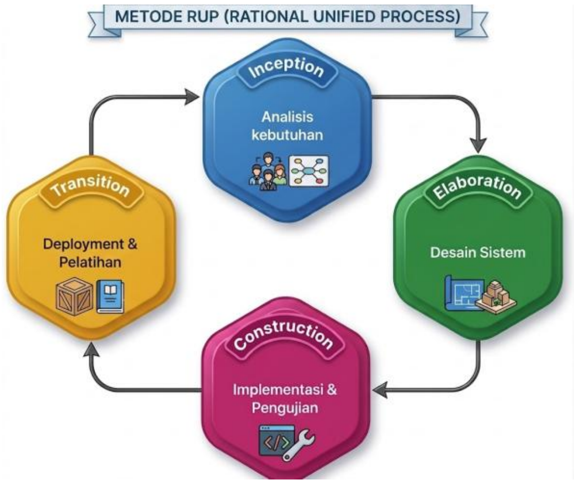

Figure 2. Development Methods

The Rational Unified Process (RUP) method is an iterative, incremental, and use-case-driven software development framework [10]. RUP was selected as the contextual framework for the development of the Tooling Management System (TMS) at PT. XYZ because it is highly effective in managing complex projects, particularly those involving integration with other enterprise systems (such as Work Orders from an ERP) and requiring a robust architecture (such as the migration to SQL Server) [11].

1. Inception Phase: Diagnoses manual workflow inefficiencies by mapping the "Before State" VSM and conducting initial interviews to justify the need for automation.
2. Elaboration Phase: Focuses on the core system architecture (migrating to ASP.NET–SQL Server) and produces technical diagrams (Use Case, Activity, ERD) to enable real-time integration between Work Orders and the TMS.
3. Construction Phase: Involves the iterative implementation and testing of the Auto Request dashboard. It includes resolving database trigger issues and interviewing users to analyze their adaptation to the new workflow.
4. Transition Phase: Evaluates the system's qualitative impact by narratively comparing the "Before" and "After" VSMs, ultimately formulating procedural recommendations for workflow sustainability.

C. System Overview

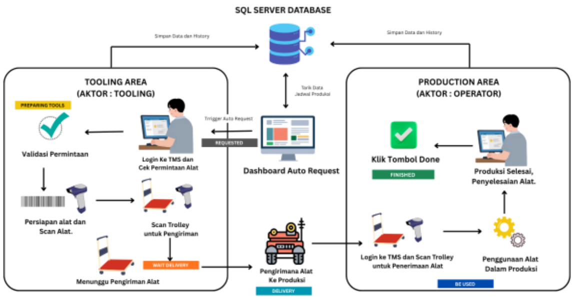

Figure 3. System Flow Overview

The Tooling Management System (TMS), developed with ASP.NET architecture and a SQL Server database, functions as an integration platform between the production area and the tooling area, eliminating waiting time through automation. System operation begins when the Auto Request Dashboard pulls production schedule data from SQL Server, triggering an automatic tool request as soon as the status changes to "Requested." In the Tooling Area, staff log in to validate the request, followed by physical preparation by scanning the tool and delivery cart to ensure data accuracy. Once the scanning process is complete, the status changes to "Waiting for Delivery" until the tool is delivered to the Production Area.

On the production operator's side, tool receipt is performed by re-scanning the cart in the system before the tool is used in the manufacturing process (status "Be Used"). This workflow is systematically closed when production is complete, when the operator clicks the "Done" button, which changes the status to "Finished" and automatically saves all usage history data back into the SQL Server database. Through this closed-loop mechanism, the TMS not only digitizes manual processes but also ensures real-time visibility of tool status across all operational lines.

D. Functional Requirements

Table 1. Functional Requirements

Code	Functional Requirements
FR01	The system displays information on Work Orders, Projects, Time Remaining, and Tool Statuses (ON LINE, IN PROGRESS, NEXT ORDER) on a monitoring dashboard.
FR02	The system automatically generates tool requests based on Work Order data processed using "Next Order" logic.
FR03	The system provides a role-based authentication mechanism (Tooling Team and Operator) to ensure secure access to system features.
FR04	The system displays tool request notifications to the Tooling Team once the Auto Request is generated with a "REQUESTED" status.
FR05	The Tooling Team validates the tool requests by updating the status from "REQUESTED" to "PREPARING TOOLS".
FR06	The Tooling Team scans the tools to verify that the physically prepared tools match the system's request.
FR07	*The Tooling Team scans the delivery trolley to change the status from "WAIT DELIVERY" to "DELIVERY".*
FR08	The Operator scans the trolley upon receiving the tools in the production area, updating the status from "DELIVERY" to "BE USED".
FR09	The system allows the tool status to be updated to "FINISHED" once the production process is complete.
FR10	The system manages user access rights based on roles (Tooling and Operator).

E. Non-Functional Requirements

Table 2. Non-Functional Requirements

Code	Non-Functional Requirements
NFR01	The system must be capable of processing Auto Requests and generating notifications automatically with a fast response time to support a smooth workflow without manual intervention.
NFR02	The system must guarantee the accuracy and consistency of Work Order and Tooling data through automated validation, logging, and error-handling mechanisms.
NFR03	The system must implement secure company API-based authentication, utilize database encryption, and ensure data communication via the HTTPS protocol and authorization token mechanisms.
NFR04	The system must use English for the user interface, in accordance with the company's internal system standards, to maintain consistency in usage.

F. Usecase Diagram

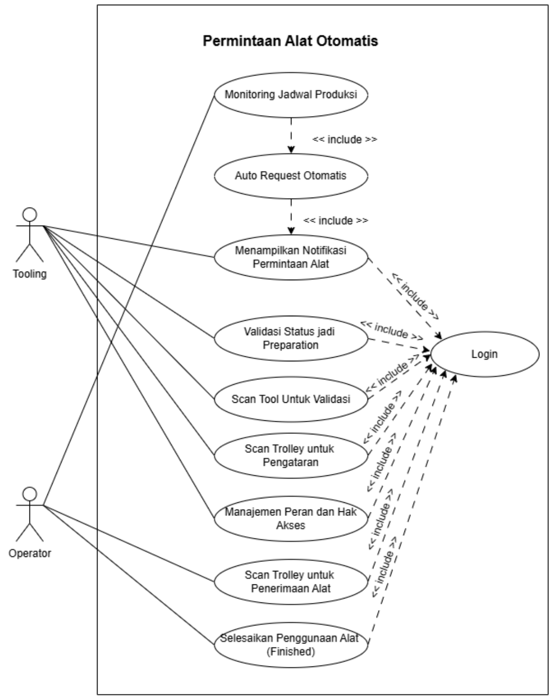

Figure 4. Usecase Diagram

The Use Case Diagram for the Auto Request Tools System illustrates the interactions between two primary actors—Tooling and Operator—and the system's features using standard UML notation.

The system's core feature is the Automatic Auto Request, which internally generates tool requests based on Work Order data using "Next Order" logic, requiring no direct user intervention. Once a request is generated, the system notifies the Tooling actor to initiate the tool preparation process.

Authentication is mandatory for any activity that changes the system's status. The Tooling actor must log in (indicated by the <<include>> relationship) before accessing features such as Validate Status to Preparation, Scan Tools for Validation, and Scan Trolley for Delivery. Similarly, the Operator actor must also log in to access Production Schedule Monitoring, Scan Trolley (Receipt), and Complete Tool Usage (Finished) within the production area.

Overall, the diagram demonstrates that the system employs a Role-Based Access Control (RBAC) approach, ensuring that each actor has specific access rights and responsibilities aligned with their role in the business process.

G. ER Diagram

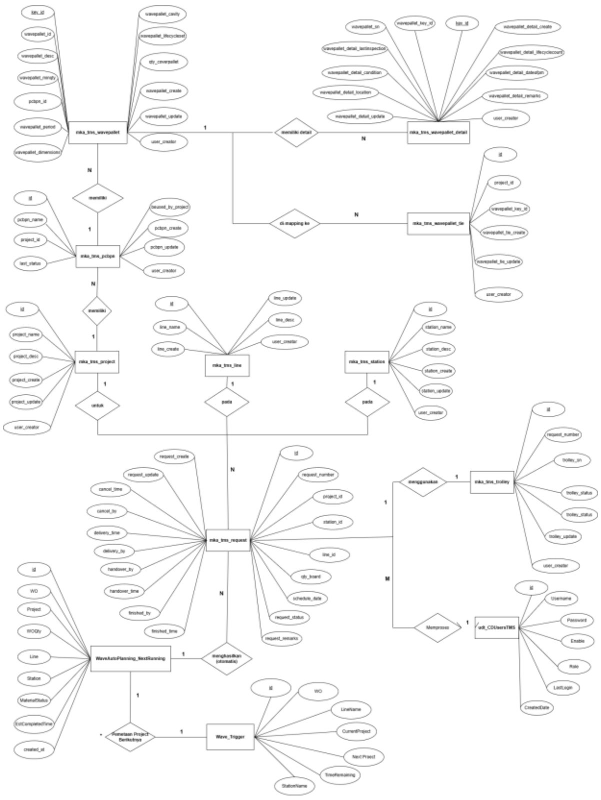

Figure 5. ER-Diagram

Figure 5 illustrates the Entity Relationship Diagram (ERD) for the Tooling Management System (TMS). The database structure centers on the mke_tms_request entity, which integrates production data (project, line, station) with tool distribution (trolley). The automation process is driven by WaveAutoPlanning_NextRunning, which receives input from Wave_Trigger to automatically generate tool requests based on Work Order schedules. Additionally, the udt_CDUsersTMS entity manages user access and audit trails, tracking user actions for each request. Overall, this interconnected structure ensures seamless automation, data consistency, and operational accountability.

H. Analysis Plan

This research employs a Qualitative Approach (Case Study). The research stages are systematically structured to compare the Before State and After State processes using Value Stream Mapping (VSM) as the analytical framework.

1. Process Diagnosis Stage (Before State)

a. Research Activities

1) VSM Before State: Visual mapping of the workflow and information flow of the tool request process while it was still operating manually.
2) Qualitative Interviews: In-depth interviews with production and tooling staff to describe the root causes of waiting activities and workflow bottlenecks (e.g., lack of advanced information).
3) Observation: Observing the manual workflow process to validate the waste identified in the Current State Map (CSM).

2. Solution Design Stage (After State)

a. Research Activities

1) VSM After State: Visual design illustrating the workflow transformation post-automation, narrating how the Auto Request feature eliminates Non-Value Added steps.
2) Document Analysis: Analyzing system design documents (RUP/migration blueprints) to ensure that the designed Future State Map (FSM) is technically realistic.

3. Qualitative Impact Analysis Stage

A. Research Activities

1) Comparative Interviews: Conducting post-implementation interviews to explore user perceptions regarding the qualitative impacts (e.g., smoother workflow, improved coordination, reduced waiting time).

2) Thematic Analysis: Analyzing qualitative data to identify the factors influencing the smoothness of the workflow and overall process effectiveness (e.g., automatic synchronization, proactive work culture).
3) VSM Synthesis: Narratively comparing the Before and After states to explicitly explain and support the qualitative findings regarding workflow improvements.

3. Result and Discussion

A. Implementation Results

1. Implementation of Work Order Dashboard

The Work Order Dashboard is a key component in the system that functions as the primary data source for the Auto Request mechanism as well as a visual monitoring medium displayed on a TV screen in the production area.

Figure 6. Dashboard View Before Auto Request

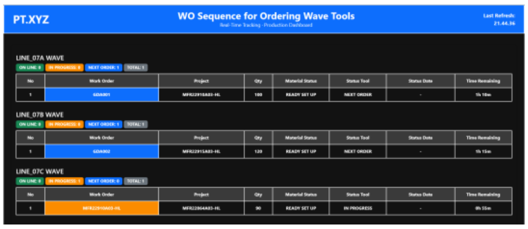

Figure 7. Dashboard View After Auto Request

This dashboard displays essential information related to production activities, including:

1) Production schedule (Work Order).
2) Type of product to be processed.
3) Production start time.
4) Auto Request status for each Work Order.

Figure 8. Auto Order Trigger Architecture

The Auto Request mechanism operates proactively by monitoring data in the Wave_Trigger table within the SQL Server database. The system will automatically execute the Generate Auto Request function if the currently running project (Current Project) has a Time Remaining of less than 1 hour (< 60 minutes). This logic ensures that the tool request for the next project (Next Project) is issued on the Tooling dashboard with a 'REQUESTED' status well before the Change Over process begins, thereby eliminating the reliance on manual input from the operator.

Functionally, this dashboard provides several main benefits:

1) Provides real-time production information without delays.
2) Reduces reliance on manual communication between departments.
3) Improves coordination between operators and the tooling department.
4) Prioritizes tasks based on production time.

With this dashboard, all involved parties can directly view production conditions, making the workflow more transparent and well-coordinated.

2. Implementation of Auto Request Flow (End-to-End Workflow)

The Auto Request system workflow implemented in this study reflects full integration between the production and tooling systems. This process is designed to run automatically from start to finish with minimal manual intervention.

a. Login to the System

Tooling or the Operator logs into the system using a registered account to access the dashboard.

Figure 9. Login View

The login page serves as the primary gateway to the system and performs several functions:

1) Authenticates users based on their username and password.
2) Identifies the user's role.
3) Restricts access exclusively to authorized users.

b. Check the Tooling Dashboard

After logging in, the tooling department is directed to the main dashboard to monitor the list of incoming Auto Requests.

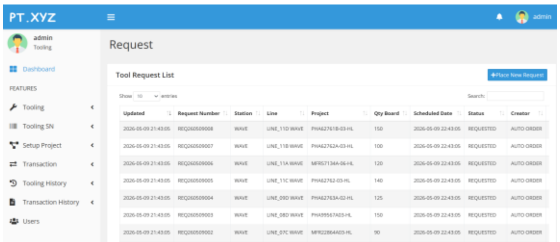

Figure 10. Tools Request Page

The Tooling dashboard displays various essential information, such as:

1) A list of automatically generated tooling requests.
2) Job priorities based on production time.
3) The request status at each stage.
4) Details of tool requirements.

This dashboard serves as an operational control center, where all tooling request activities can be monitored in a single view. With this dashboard, the tooling department no longer needs to search for information manually, thereby increasing work efficiency.

c. Status REQUESTED

This stage marks the beginning of the Auto Request phase, a procedure in which the system executes full automation to generate the necessary tool requests independently, based on data references from previously input Work Orders.

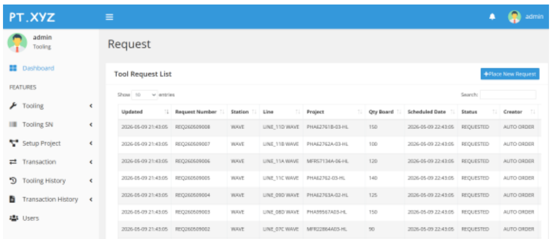

Figure 11. Requests Page Requested

1) Status: REQUESTED
2) Key characteristics:
   a) The system operates without manual input.
   b) Data is sourced directly from the Work Order.
   c) Requests appear immediately on the tooling dashboard.

This stage demonstrates a significant shift from a manual to an automated system, where the request process no longer depends on the operator.

d. Status of PREPARING TOOLS (Tool Preparation)

At this stage, the tooling department begins preparing the tools according to the system's requests.

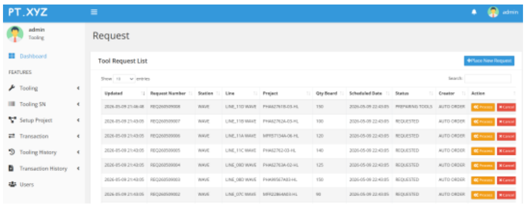

Figure 12. Tool Preparation Page

Activities include:

1) Retrieving tools from inventory.
2) Inspecting the condition of the tools.
3) Adjusting quantities as needed.

This stage is a value-added activity because it contributes directly to production readiness.

e. Scanning Tools Process

The tooling department performs a barcode scan on each tool that has been retrieved.

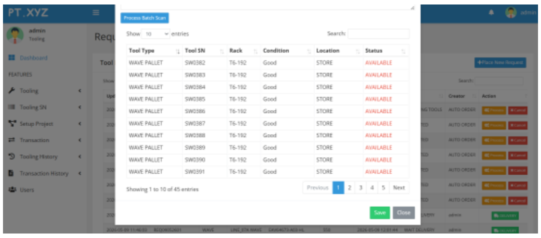

Figure 13. Scanning Tools Page Before Validation

Primary functions:

1) Validating tool compatibility with the system.
2) Preventing retrieval errors (defects).
3) Improving data accuracy.

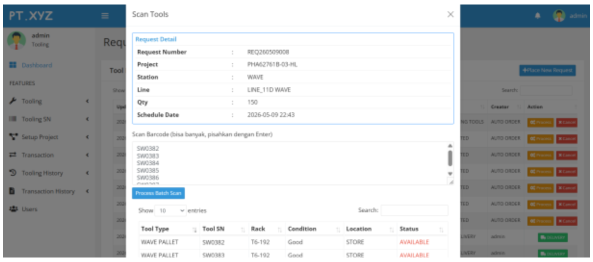

Figure 14. Scanning Tools Page After Validation

Once all tools have been validated, the status changes to: WAIT DELIVERY.

f. Status WAIT DELIVERY

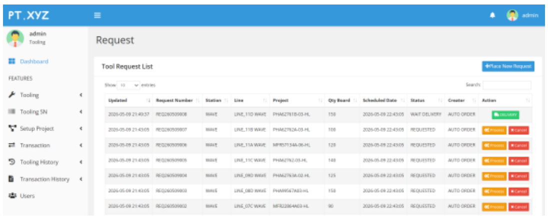

Figure 15. WAIT DELIVERY Status Page

This status indicates that:

1) All tools are ready.
2) The process is awaiting delivery to production.

This stage signifies that the preparation process is complete and the system is ready to proceed to the distribution stage.

g. Tooling Delivery to Production

The tooling department delivers the tools to the production area according to the predetermined schedule. This process is carried out by scanning the trolley used as the medium for tool delivery.

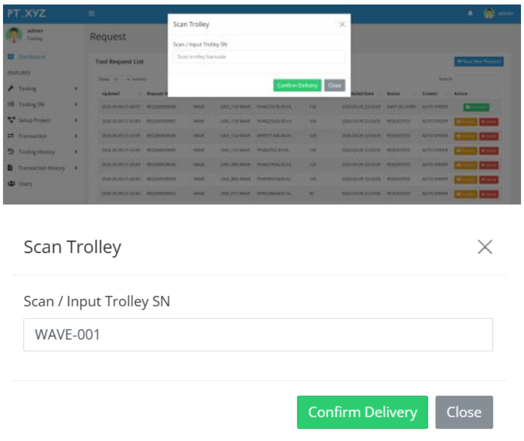

Figure 16. Trolley Scan Page for Equipment Delivery

Once the trolley scanning process is complete, the system will update the status to DELIVERY. This status indicates that the tools are in the process of being transported to the production area.

This stage represents the transition from the internal Tooling process to operational processes in the production area, ensuring that the required tools are received on time and in accordance with the request.

h. Status DELIVERY

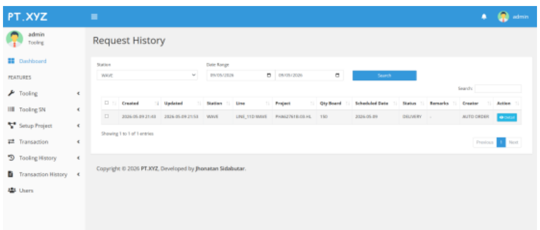

Figure 17. DELIVERY Status Page

Indicates that the tools:

1) Are in transit.
2) Have not yet been received by the operator.

This status provides visibility into the location of the tools within the process flow.

i. Status BE USED

This stage occurs when the tools have arrived at the production area and have been received by the operator.

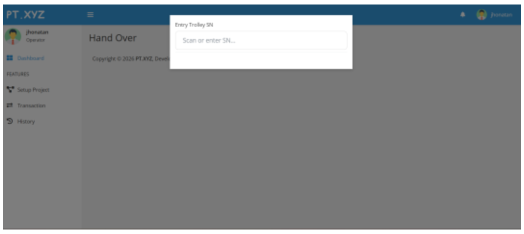

Figure 18. Trolley Scan Page for Equipment Receipt

The operator scans the trolley as proof of receipt:

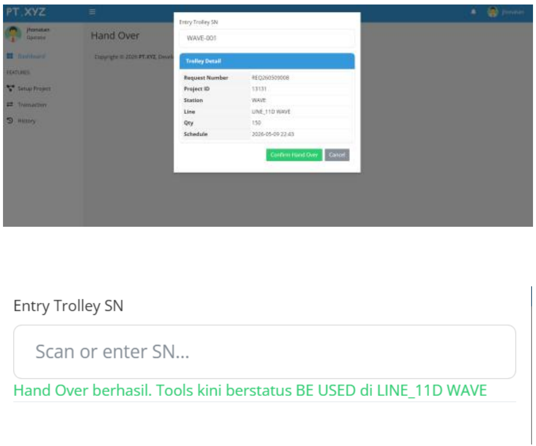

Figure 19. Tool Acceptance Validation Trolley Scan Page

Functions:

1) Confirmation that the tools have been received.
2) Final validation in the distribution process.

After this process:

1) The status changes to: **BE USED**.

j. Status FINISHED

The final stage of the process is when the tools have finished being used.

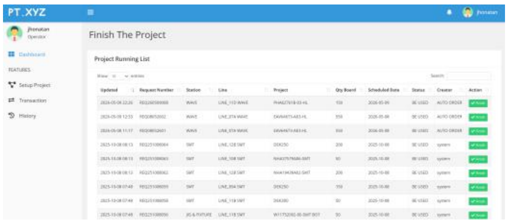

Figure 20. Tool Completion Page

Actions performed:

1) Click the "Done" button.

This signifies that:

1) The process has been fully completed.
2) The tooling has been used as required.
3) There is no further activity.

This stage is also important as historical data for future analysis.

B. Analysis Results

1. Before State Mapping

Table 3. Before State Activities

No	Activity	Category	Duration (Min)
1	Manual Request (Data input)	NVA	2
2	Waiting for response	NVA	10
3	Request confirmation	NVA	3
4	Tools preparation	VA	10
5	Tools Delivery	VA	10
Total			**35**

The before state analysis in Table 4.3 was obtained through direct field observation and real-time time measurements conducted over 20 production tool request cycles. The lead time measurement began from the moment the operator checked the production schedule in Excel and performed manual input into the TMS system, until the cycle concluded when the physical tool was received and marked as ready for use (BE USED) on the production line.

Based on these observations, the total average lead time required is 35 minutes. The accumulation of non-value added (NVA) activities reached 15 minutes due to waiting times and manual confirmation processes, while value-added (VA) activities for physical preparation accounted for 20 minutes. According to these calculations, VA activities represent 57.14% and NVA activities represent 42.86% of the total lead time. Activities such as manual communication, waiting for responses, and re-confirmation do not add value to the product, yet they significantly extend the operational process duration.

Total Value Added (VA) Time:

$$VA_{\text{before}} = \sum \text{Durasi Aktivitas VA} = 10 + 10 = 20 \text{ menit}$$

Total Non-Value Added (NVA) Time:

$$NVA_{\text{before}} = \sum \text{Durasi Aktivitas NVA} = 2 + 10 + 3 = 15 \text{ menit}$$

Total Lead Time:

$$\text{Lead Time}_{\text{before}} = VA_{\text{before}} + NVA_{\text{before}} = 20 + 15 = 35 \text{ menit}$$

In greater depth, the manual request activity (2 minutes) highlights a dependency on manual communication between departments, which leads to low process standardization. Waiting for a response is the largest contributor to delays, with a duration of 10 minutes; this occurs because, after the tools are prepared, the tooling team must wait for a manual response from the production team regarding the readiness to receive tools on the production line.

Furthermore, the request confirmation activity (3 minutes) during the wait delivery stage indicates information uncertainty (manual validation) that could potentially cause rework or delays in physical delivery. The dominance of NVA activities at 42.86% indicates that the initial system had a significantly high level of inefficiency. The average data from these 20 test trials confirms that these operational constraints occur consistently and directly impact the length of the lead time, as well as low productivity, because the flow of information is not as fast as the physical flow of the tools.

Table 4. Waste Identification

Waste Type	**Description**	**Potential Savings**
Waiting	Waiting for production response and manual validation queues after tools are ready (wait delivery).	100% (Real-time Dashboard)
Motion	Repetitive communication via Zoom to check stock.	80% (Digital data)
Overprocessing	Manual confirmation and re-inputting data from Excel.	90% (Digitized workflow)
Defect	Incorrect tool retrieval due to manual data entry errors.	Minimation Human Error

Based on the waste identification in Table 4.4, the most dominant type of waste is waiting, occurring as the tooling department waits for production administrator responses and manual validation queues for delivery. This condition is caused by a manual communication system that is not integrated, preventing the requesting party from knowing the status of ready tools in real-time. Furthermore, motion and overprocessing waste indicate the presence of additional activities that do not add value, such as manual confirmations and re-entering data from Excel, which should be automated.

Furthermore, defect waste is also identified as a result of manual information transmission errors, which have the potential to cause the use of incorrect tooling, thereby triggering rework and reducing process quality. Overall, the before state condition reflects a system that is not yet optimal because it is still dominated by non-value-added activities that can be eliminated to improve process efficiency. These findings are in line with research by Bizuneh and Omer (2024), which states that wastes such as waiting, motion, and overprocessing are the primary causes of inefficiency in production systems and can be minimized through the application of a lean approach using Value Stream Mapping.

2. After State Mapping

Table 5. After State Activities

No	Activity	Category	Duration (Mnt)
1	Auto Request	VA	0
2	Dashboard monitoring	VE	2
3	Tools preparation	VA	10
4	Tools delivery	VA	8
Total			**20**

The after-state in Table 4.5 shows a significant increase in efficiency based on the average results of 20 trials following the system implementation. Pure non-value-added (NVA) activities have been completely eliminated. The process focus has now shifted to value-added (VA) activities and Value Enabler (VE) support activities, with a total duration of 20 minutes. This indicates that the system is capable of eliminating waste such as waiting for responses and manual confirmation, which previously consistently hindered the workflow.

Total Effective Time (VA + VE):

$$VA_{\text{after}} + VE_{\text{after}} = 18 + 2 = 20 \text{ menit}$$

The implementation of the Auto Request allows the request phase to run with a duration of 0 minutes because it is automatically triggered by the system, thereby removing coordination delays. Furthermore, the use of a monitoring dashboard (2 minutes) as a Value Enabler provides real-time visibility that replaces the manual confirmation process. This change creates a more integrated and synchronous process flow. Through 20 trials, it has been proven that by eliminating manual waiting times, physical activities such as tool preparation (10 minutes) and delivery (8 minutes) have become faster, more accurate, and exhibit more stable durations compared to the previous system.

3. VSM Comparison

Table 6. Comparison Results

Aspect	Before State	After State	Improvement Percentage
Number of Processes	5 Stages	4 Stages	↓ 20% Reduction
NVA Time	15 Minutes	0 Minutes	↓ 100% Reduction
Lead Time	35 Minutes	20 Minutes	↓ 42.86% Faster
PCE (Efficiency)	57,14%	100%	↑ 42.86% Effective

The comparison between the before state and after state in Table 4.6 demonstrates a significant improvement. The number of steps has been reduced from 5 to 4, resulting in a 20% more streamlined workflow. The reduction of NVA activities from 15 minutes to 0 minutes is a key indicator of successful workflow optimization. This shows that the system has reached theoretical efficiency, where all waste caused by reliance on manual coordination has been eliminated. Operationally, the system now functions without obstacles (zero-waiting), proving that the process design has achieved an ideal lean condition.

Reduction Percentage Lead Time:

$$\text{Reduksi } LT = \left(\frac{LT_{\text{before}} - LT_{\text{after}}}{LT_{\text{before}}}\right) \times 100\% = \left(\frac{35 - 20}{35}\right) \times 100\% = 42{,}86\%$$

Reduction Percentage NVA:

$$\text{Reduksi } NVA = \left(\frac{NVA_{\text{before}} - NVA_{\text{after}}}{NVA_{\text{before}}}\right) \times 100\%$$

$$\left(\frac{15 - 0}{15}\right) \times 100\% = 100\%$$

Furthermore, the reduction of waiting time from 10 minutes to 0 minutes demonstrates that the system is capable of resolving the primary bottleneck through process automation. The elimination of this waiting activity has a direct impact on the smoothness of information flow, ensuring the process is no longer hindered by reliance on manual responses from the production team. Overall, the lead time has been successfully cut by 42.86%, which increases the Process Cycle Efficiency (PCE) to 100%, as all remaining time is allocated to Value-Added (VA) and Value-Enabling (VE) activities.

The improvement in flow—transitioning from a previously fragmented state to a more seamless one—indicates that the system has successfully created a continuous flow in accordance with lean manufacturing principles. These results align with research by Kurniawan and Wulandari (2024), which states that the application of Value Stream Mapping is capable of reducing non-value-added activities and significantly increasing efficiency.

4. Efficiency Analysis

Table 7. Total Lead Time

Component	Before (Min)	After (Min)	Difference
Non-Value Added (NVA) Activity	15	0	-15 Minutes
Value Enabler (VE) Activity	0	2	+2 Minutes
Processing (VA) Activity	20	18	-2 Minutes
Total Lead Time	35	20	-15 Minutes

Table 8. Total Efficiency

Component	Before State	After State	Description
Total VA+VE	20 Minutes	20 Minutes	Duration optimization
Total NVA	15 Minutes	0 Minutes	Total delay elimination
Lead Time	35 Minutes	20 Minutes	Total process time
PCE (%)	57,14%	100%	Efficiency increased

The comparison between the before state and after state in Table 4.8 shows a significant improvement in the process structure. The number of stages has been reduced from 5 to 4, making the workflow 20% more streamlined. The drastic reduction of NVA activities from 15 minutes to 0 minutes has a direct impact, resulting in a 100% reduction in waste.

Process Cycle Efficiency (PCE) Before:

$$PCE_{\text{before}} = \left(\frac{VA_{\text{before}}}{\text{Lead Time}_{\text{before}}}\right) \times 100\% = \left(\frac{20}{35}\right) \times 100\% = 57{,}14\%$$

Process Cycle Efficiency (PCE) After:

$$PCE_{\text{after}} = \left(\frac{VA_{\text{after}} + VE_{\text{after}}}{\text{Lead Time}_{\text{after}}}\right) \times 100\% = \left(\frac{18+2}{20}\right) \times 100\% = 100\%$$

Furthermore, the reduction of waiting time from 10 minutes to 0 minutes demonstrates that the system is capable of resolving the primary bottleneck through process automation. Overall, the lead time has been successfully cut from 35 minutes to 20 minutes, or 42.86% faster. This increases the Process Cycle Efficiency (PCE) from 57.14% to 100%.

Achieving 100% PCE in the after state represents the theoretical upper bound of the proposed system design. This optimal condition is reached because the system successfully integrates all coordination stages into the automated workflow, eliminating any idle time previously lost to manual validation queues. It is important to emphasize that this 100% figure represents the efficiency of the process flow design, indicating that the proposed model is free from administrative waste.

In practical implementation, this ideal condition serves as a performance benchmark that will be maintained through the reliability of the SQL Server infrastructure and operator discipline. Thus, the system has successfully created a continuous flow in accordance with Lean Manufacturing principles. The improvement in flow—moving from a fragmented condition to a smoother state—confirms that the system has achieved the continuous flow necessary for optimal operational efficiency.

5. Qualitative Impact Analysis

Table 9. Organizational Impact

Aspect	Impact
Operational	Faster
Communication	Standardized
Decision-making	More accurate
Workload	Lighter

The implementation of the system yields impact not only on technical aspects but also on organizational ones. Operationally, the acceleration of processes enhances the company's ability to meet production requirements on time.

Regarding communication, the use of a dashboard as a centralized information medium reduces reliance on informal communication, thereby increasing the clarity and consistency of information. This contributes to faster and more accurate decision-making.

Furthermore, the reduction of manual activities also impacts the operator's workload, allowing human resources to focus more on value-added activities.

6. Relation to Theory

Table 10. Theoretical Interrelationships

Theory	Implementation
Lean	Waste elimination
VSM	Flow improvement
Digitalization	Automation

The results of this study demonstrate strong alignment with Lean Manufacturing theory, particularly in the efforts to eliminate waste and improve process efficiency. The implementation of Value Stream Mapping (VSM) has proven effective in identifying and improving process flows.

Furthermore, the implementation of digitalization through a monitoring dashboard demonstrates how technology can act as an enabler in transforming business processes toward a more efficient and integrated system.

7. Research Findings

Table 11. Research Findings

No	Findings
1	Increased efficiency
2	Crucial Work Order (WO) data
3	Dominant waiting waste
4	Improved control and visibility

Based on the analysis results, it was found that the implementation of the Auto Request system provides a significant increase in efficiency. Work Order data serves as a key element in determining tooling requirements accurately.

Furthermore, it was discovered that waiting waste was the dominant factor affecting process performance in the initial condition. By eliminating this waste, the system is able to increase control and visibility over the process as a whole.

8. Research Implications

Table 12. Research Implications

Type	Impact
Academic	VSM contribution
Practical	Industry reference
Systemic	Digital transformation

The implications of this research span academic, practical, and systemic dimensions. Academically, this study contributes to the application of VSM methods within digital-based systems. Practically, the research findings can serve as a reference for industries implementing automation systems to enhance operational efficiency. From a systemic perspective, the research highlights the importance of data integration in supporting digital transformation.

Despite the various improvements provided by the system implementation, there are several limitations to consider. The system is highly dependent on the quality of Work Order data as its primary input. If the data used is inaccurate or incomplete, the resulting output may potentially be incorrect.

Furthermore, the system implementation also requires user readiness to adapt to changes in work processes. Therefore, training and competency development for users are necessary to ensure the system is utilized optimally.

4. Conclusions

The implementation of the Auto Request feature, directly integrated with Work Order data within the Tooling Management System at PT. XYZ, demonstrates the capability of information technology transformation to address Lean Manufacturing challenges. The system successfully transforms the workflow by shifting the internal tool supply chain paradigm from an error-prone reactive mode to an automated and proactive system. Furthermore, it achieves total waste elimination by effectively eradicating waiting times and manual confirmations (Non-Value Added activities), reducing these delays from 15 minutes per cycle to 0 minutes—a 100% reduction. This elimination drives a significant surge in efficiency, sharply cutting the overall Lead Time by 42.86% (from 35 to 20 minutes) and boosting the Process Cycle Efficiency (PCE) metric from an initial 57.14% to an optimal 100%. Consequently, sustainable integration is established, turning a previously disconnected workflow that hindered inter-departmental effectiveness into a continuous flow powered by real-time database automation. To maintain this performance stability in the future, it is crucial to ensure the high validity of Work Order input data on the SQL Server and enforce consistent barcode scanning discipline on the shop floor. Finally, future research is recommended to explore the integration of predictive algorithms for tool feasibility and asset care through predictive maintenance.

References

[1] Firdaus, R. Z., & Wahyudin. (2023). Penerapan Konsep Lean Manufacturing untuk Meminimasi Waste pada PT Anugerah Damai Mandiri (ADM). Journal of Integrated System (JIS), 6(1), 21–31.

[2] Fatma, N. F., Ponda, H., & Solehah. (2023). Penurunan Lead Time Manufacturing Dengan Pendekatan Lean Manufacturing (Studi Kasus Di PT. MKM). Journal Industrial Manufacturing, 8(2), 136–156.

[3] Nurwulan, N. R., Taghsya, A. A., Astuti, E. D., Fitri, R. A., & Nisa, S. R. K. (2021). Pengurangan Lead Time dengan Lean Manufacturing: Kajian Literatur. JIME (Journal of Industrial and Manufacture Engineering), 5(1).

[4] Nugrowibowo, S., & Muslimin, M. (2023). Smart Manufacturing: Latest Technologies And Applications In Industrial Engineering. Jurnal Minfo Polgan, 12(1).

[5] Salomon, L. L., Kosasih, W., Lam, E. C., & Putri, S. (2024). Penerapan Lean Manufacturing untuk Meningkatkan Efisiensi Produksi Kemasan Plastik. Jurnal Serina Sains, Teknik dan Kedokteran, 2(2), 147–156.

[6] Brilianto, R., & Waluyowati, N. P. (2024). Analisis Proses Produksi Dengan Value Stream Mapping Pada Industri Manufaktur. Jurnal Kewirausahaan dan Inovasi,3(4), 1095–1103.

[7] Siagian, W. T. W., & Saifudin, J. A. (2024). Analisis Penerapan Lean Manufacturing dengan Metode VSM (Value Stream Mapping) Guna Mengurangi Waste dan Cycle Time pada Proses Produksi Keramik di PT XYZ. Tekmapro.Journal of Industrial Engineering and Management, 19(2).

[8] Suwandi, N. N., & Suhada, K. (2025). Penerapan Lean Manufacturing dengan Metode Value Stream Mapping untuk Mengurangi Cycle Time pada Bagian Perakitan Spring Mattress di PT X. Journal of Integrated System (JIS), 7(2).

[9] Arunizal, S., Wardhani, D. H., & Windarta, J. (2024). Penerapan Value Stream Mapping (VSM) untuk Menurunkan Lead Time Process dan Meningkatkan Kinerja Aktivitas Pengadaan di Site Tambang. Jurnal Profesi Insinyur Indonesia, 2(3),

141–150.

[10] Kennedy, F., & Elizabeth, T. (2025). Penerapan Metode RUP dalam Pengembangan Sistem Informasi Kepegawaian pada PT CNMG. The 4th MDP Student Conference 2025, 4(1).

[11] Young, S., Nuryasin, I., & Suharso, W. (2024). Penerapan Metode SDLC RUP (Rational Unified Proses) Dalam Pembuatan Sistem Informasi E-kos Berbasis Web. Jurnal Repositor, 2(3).

[12] Bizuneh, B., & Omer, R. (2024). Lean waste prioritisation and reduction in the apparel industry: application of waste assessment model and value stream mapping. Cogent Engineering, 11(1).

[13] Kurniawan, M. A., & Wulandari, I. A. S. (2024). Integration of VSM and VALSAT in Lean Manufacturing to Reduce Waste at PT. SPLN. Jurnal Teknik Industri, 10(2).

[14] Aiko Putro, M. S., & Nursyamsiah, S. (2024). Analisis Implementasi Lean Manufacturing dengan Metode 5S pada Startup Manufaktur di Indonesia. Jurnal Ilmiah Manajemen, Ekonomi, & Akuntansi (MEA), 8(3).

[15] Erdi. (2025). Penerapan Lean Manufacturing untuk Meningkatkan Produktivitas dengan Mengurangi Waste pada Line X-Arm Regulator dengan Metode Value Stream Mapping. Jurnal Tadbir Peradaban, 5(1).

[16] Irsyad, M. N., & Hartini, S. (2024). Value Stream Mapping sebagai Alat Analisis dalam Lean Manufacturing: Analisis Bibliometrik. J@ti Undip: Jurnal Teknik Industri, 19(1), 35–45.

[17] Khalidzky, M. K., Winarno, & Maulidin, W. F. (2025). Lean Manufacturing dalam Reduksi Waste untuk Peningkatan Efisiensi Produksi Konektor Tipe X di PT XYZ. Jurnal Engine: Energi, Manufaktur, dan Material, 9(1).

[18] Moengin, P., & Ayunda, N. (2021). Lean Manufacturing untuk Meminimasi Lead Time dan Waste agar Tercapainya Target Produksi (Studi kasus: PT. Rollflex Manufacturing Indonesia). Jurnal Teknik Industri, 11(1).

[19] Rizka, A., Asbari, M., & Setiawan, R. A. (2024). Penerapan Prinsip Lean Manufacturing untuk Efisiensi Operasional dan Produktivitas: Tinjauan Literatur. Jurnal Ilmu Sosial, Manajemen, Akuntansi dan Bisnis, 1(2).

[20] Yulyani, E., Widyadhana, K. A., Moulydhea, R. I., & Sari, R. (2025). Penerapan Lean Manufacturing dalam Mengurangi Lead Time dan Meningkatkan Efisiensi. Integrative Perspectives of Social and Science Journal, 2(2).