IJMECIE International Journal of Mechanical, Electrical and Civil Engineering
E-ISSN: 3047-4531
P-ISSN: 3047-4523

Research Article

Improvement of the Early, Middle and Final Patrol Check Process From Manual to Digital with the PDCA Method, Fishbone Diagram, and Why-Why Analysis at PT. Automotive Components Company

Chairul Alfatory[1]*, Bintang Rafly Aryansyah[2], Mahendra[3], Andhika Danisvara[4], Yudi Prastyo[5]

[1] Universitas Pelita Bangsa, Indonesia; e-mail: chairulalfatory@gmail.com
[2] Universitas Pelita Bangsa, Indonesia; e-mail: baryansyah30@gmail.com
[3] Universitas Pelita Bangsa, Indonesia; e-mail: mahendrrrrraaaa@gmail.com
[4] Universitas Pelita Bangsa, Indonesia; e-mail: andhikadenis07@gmail.com
[5] Universitas Pelita Bangsa, Indonesia; e-mail: Yudi.prastyo@pelitabangsa.ac.id
* Corresponding Author: Chairul Alfatory

Abstract: The Checksheet process at PT. Automotive component companies are an important activity to maintain quality consistency in the production of automotive components, especially brackets. However, the inspection method that is still carried out manually causes waste of time, high use of paper, and increased operational costs. This study aims to reduce the cycle time of Patrol Check A-T-A, implement a digital (paperless) recording system, and improve process efficiency through the PDCA (Plan-Do-Check-Act) approach, Fishbone Diagram, and Why-Why Analysis. The results of the identification of the root of the problem show that the absence of a standardized digital system and the lack of management initiatives are the main causes of the long inspection process and high paper consumption. The implementation of E-Checksheet as a digital solution resulted in a significant reduction in cycle time, from 50 minutes to 10 minutes, as well as eliminating paper use by up to 100%. In addition, workflows become simpler, data is easier to monitor, and processes become more efficient. This study concludes that the digitization of Checksheet is able to increase operational effectiveness, reduce waste, and support continuous improvement in the manufacturing environment.

Keywords: Checksheet; Cycle Time; Fishbone; PDCA; Why-Why Analysis.

Received: July 16, 2025;
Revised: September 30, 2025;
Accepted: November 29, 2025;
Published: January 26, 2026;
Curr. Ver.: January 26, 2026.

Copyright: © 2025 by the authors. Submitted for possible open access publication under the terms and conditions of the Creative Commons Attribution (CC BY SA) license (https://creativecommons.org/licenses/by-sa/4.0/)

1. Introduction

The automotive component manufacturing sector, especially *the manufacture of stamped parts*, is an important part of the global supply chain. PT. Automotive component companies are one of the vendors that play an important role in supplying these high-precision components. In an industrial world of strict competition, good quality, and competitive prices, companies are required to maintain operational efficiency which is the main determinant of business continuity and competitiveness (Wibowo, 2023).

In the manufacturing industry, efficiency is not only seen from the production volume, but also from companies that are able to reduce waste around the work process. Any non-value-added activity, such as unnecessary *waiting*, excessive motion, and material waste, indirectly affects production costs and production time. Therefore, efforts for continuous *improvement* are one of the ways that must be implemented (Kartika, 2020a).

The Early, Middle, and Final Patrol Check *process activities* are very important activities to ensure quality consistency. However, the facts in the field show that the use of time for these activities is not running optimally. In addition to the problem of paper usage time for *Checksheets*, it is also a trigger for increased costs. The use of paper for *daily use of Checksheets*

requires approximately 100 sheets, with a price per sheet of Rp.500 (Kesuma & Muhimatul Khoiroh, 2024).

The purpose of this study is to reduce the cycle time *of Patrol Check A-T-A*, ensuring that *Patrol Check A-T-A* can be carried out in accordance with the planning process of production. Change the way A-T-A check data records are recorded to paperless and less waste. Therefore, the PDCA method was chosen with FishBone diagrams and Why-Why Analysis to solve this problem.

The automotive component manufacturing industry, particularly the production of stamped parts, occupies a strategic position within the global supply chain that demands high precision, reliability, and consistency. PT. Automotive Components Company operates as a key vendor supplying critical components, where operational efficiency directly influences product quality, delivery performance, and long-term competitiveness (Wibowo, 2023). In an industrial environment characterized by intense competition, companies are required to continuously optimize their internal processes to maintain cost effectiveness without compromising quality standards. Operational efficiency has therefore emerged as a central determinant of business sustainability and market positioning in the manufacturing sector.

Manufacturing efficiency is no longer assessed solely through output volume, but through the organization's ability to systematically identify and eliminate process-related waste. Activities that do not add value, including unnecessary waiting time, redundant movements, excessive documentation, and inefficient information flows, contribute to increased production costs and extended cycle times (Kartika, 2020a). Contemporary operational excellence frameworks emphasize continuous improvement as a disciplined approach to reducing such inefficiencies. Digital transformation has increasingly been recognized as a viable pathway for enhancing transparency, responsiveness, and control within industrial processes (Allinson, 2004).

Within this context, the Early, Middle, and Final Patrol Check processes play a critical role in maintaining quality consistency throughout the production line. These patrol checks ensure that deviations are detected early, corrective actions are implemented promptly, and product conformity is maintained across production stages. Field observations, however, indicate that the existing manual inspection and documentation practices consume excessive time and generate significant non-productive activities. Manual Checksheets require approximately 100 sheets of paper per day at a cost of Rp.500 per sheet, resulting in avoidable operational expenses and administrative burdens (Kesuma & Muhimatul Khoiroh, 2024).

The reliance on manual patrol and inspection systems also limits data accessibility, traceability, and real-time monitoring capabilities. Studies on patrol digitization across various sectors demonstrate that digital patrol systems enhance efficiency, data accuracy, and supervisory control while reducing administrative overhead (Wain & Ariel, 2014; Gannapathy et al., 2023). Recent developments in digital patrol and inspection systems further highlight the role of integrated platforms in supporting preventive control and operational stability (Wu et al., 2024; Huang et al., 2024). These findings underscore the growing relevance of transitioning from paper-based inspections to digital solutions within industrial environments.

This study is designed to improve the Early, Middle, and Final Patrol Check (A-T-A) process by reducing cycle time, minimizing paper usage, and strengthening process efficiency through structured problem-solving methods. The PDCA approach is employed as a continuous improvement framework, supported by Fishbone Diagram and Why-Why Analysis to systematically identify root causes and design effective interventions. By transforming manual Checksheets into a digital E-Checksheet system, the research aims to align inspection activities with production planning requirements while reducing waste and non-productive time. The contribution of this study lies in demonstrating a measurable and practical improvement model that integrates digitalization with established quality management tools in a real manufacturing setting (Buker et al., 2024).

2. Literature Review

The PDCA method stands for (Plan-Check-Do-Act). In Indonesian, these four aspects mean the stages of planning, processing, checking, and action. The meaning of PDCA is a management method that describes the process of continuous and continuous improvement of a problem (Rosikin & Rahayu, 2024).

The PDCA (Plant-Do-Check-Act) method serves as a quality management and continuous improvement framework (Contiuous Improvement) to implement digital solutions. The data obtained will be carried out by PDCA analysis to find out the causes of Loss Time in Patrol Check A-T-A and paper waste, so that it can provide suggestions for improvements to reduce these problems. This method is a management model developed by W. Edwards Deming based on Walter Shewhart's idea for continuous process and individual improvement (Kesuma & Muhimatul Khoiroh, 2024).

According to PDCA, it is a cycle that emphasizes continuous quality improvement and is applied to increase production. Describe this cycle as a tool for solving problems and improving quality continuously through four repeating stages (Kesuma & Muhimatul Khoiroh, 2024).

The foundation of operational excellence is centered on the identification and elimination of waste (*Youth)* which is the core principle of *the Lean* (Kesuma & Muhimatul Khoiroh, 2024) philosophy. Waste is defined as any process or activity that consumes resources without providing added value from the customer's perspective. The inability to distinguish between processes that provide added value and those that do not add value remains a critical obstacle in achieving organizational efficiency.

The contemporary organizational context necessitates a focus on more subtle forms of waste, especially those in administrative and documentation processes . The study focuses on two categories, namely Non-productive time and material consumption.

3. Materials and Method

This study uses the PDCA (Plan-Do-Check-Act) approach and for problem mapping is carried out using Fish Bone Diagram and Why-Why Analysis to find the root cause.

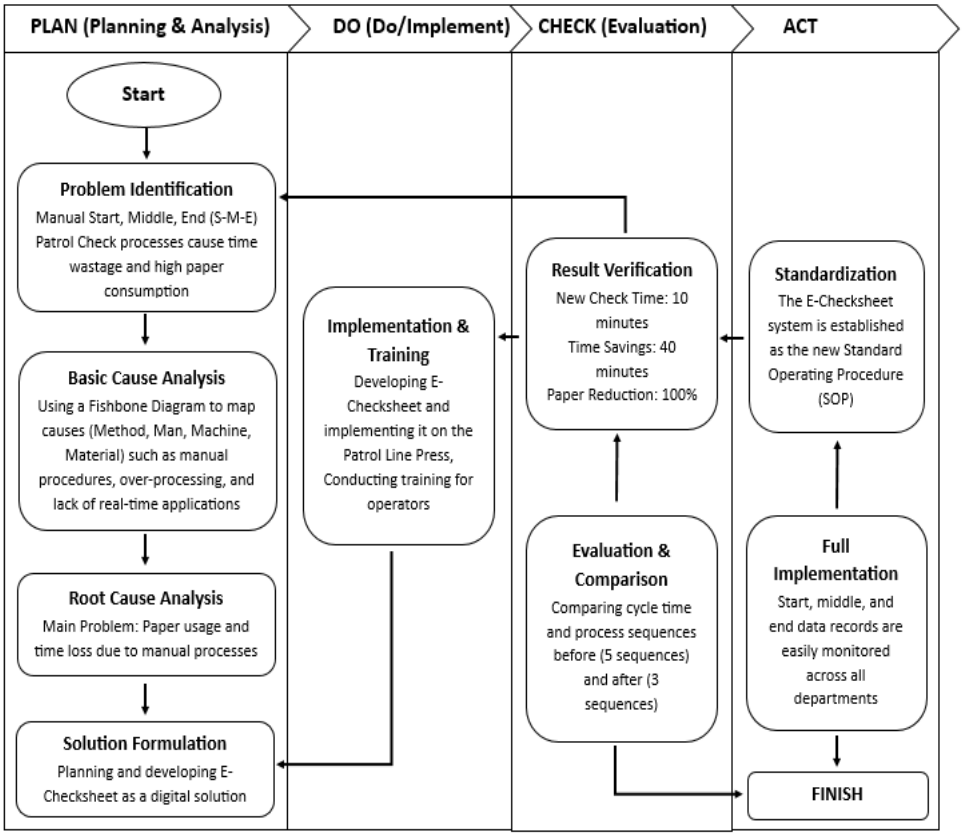

Figure 1. Flowchart PDCA.

PDCA (Plant-Do-Check-Act) Stages

Plan Phase, a plan is the first step to identifying problems, defining measurable goals, and crafting a plan for improvement. In this plan, there is a Fish Bone Diagram and Why-Why Analysis to find out the root of the problem. Do Phase, this phase aims to implement the plan after the experimental design and learning. Check Phase, in this phase, the aim is to compare the results before and after the implementation, and the results are evaluated whether there has been improvement or not. Phase Act (Follow-up), this phase begins to develop methods that aim to standardize improvements once the goals have been achieved.

Fish Bone Diagram

Fish Bone diagram is a management tool used to identify and organize the possible causes of a particular problem or effect. This diagram is shaped like a fish's bone, with the main problem or effect being on the fish's head, and the various categories of causes spreading towards the fish's spine.

The Fish Bone method was first introduced by Kaoru Ishikawa, a Japanese scientist who is also an alumnus of the University of Tokyo's chemical engineering, in 1943 (Perera & Navaratne, 2016). Along with scientific development, there are currently 8 categories in the Fish Bone diagram, namely Man, Management, Method, Machine, Environment, Material, Maintenance and Measure (Wibowo, 2023).

Why-Why Analysis

The Why-Why Analysis method is a root cause analysis tool for problem solving. This tool helps identify the root of the problem or the cause of a disagreement in a process or product. The Why-Why Analysis method serves to identify the real cause and trace the chain of cause and effect by asking the question "Why?" repeatedly on each problem that arises (Naughton et al., 2024; Kartika, 2020).

4. Results and Discussion

The outline of the problem in this study is the waste of time and the use of paper which has an effect on non-productive time and material costs. Archiving Checksheets in physical form is very time-consuming. When conducting (Naughton et al., 2024) the Patrol Check A-T-A process, it can take about 40 minutes which consists of: printing Checksheet paper, collecting data manually, measuring and writing on the Checksheet forum, and archiving Checksheet.

Plan

The Plan stage starts from identifying the problem to find the factors that are causing the loss of time of Patrol Check A-T-A and the cost of paper materials. The method used is the Fish Bone diagram as follows:

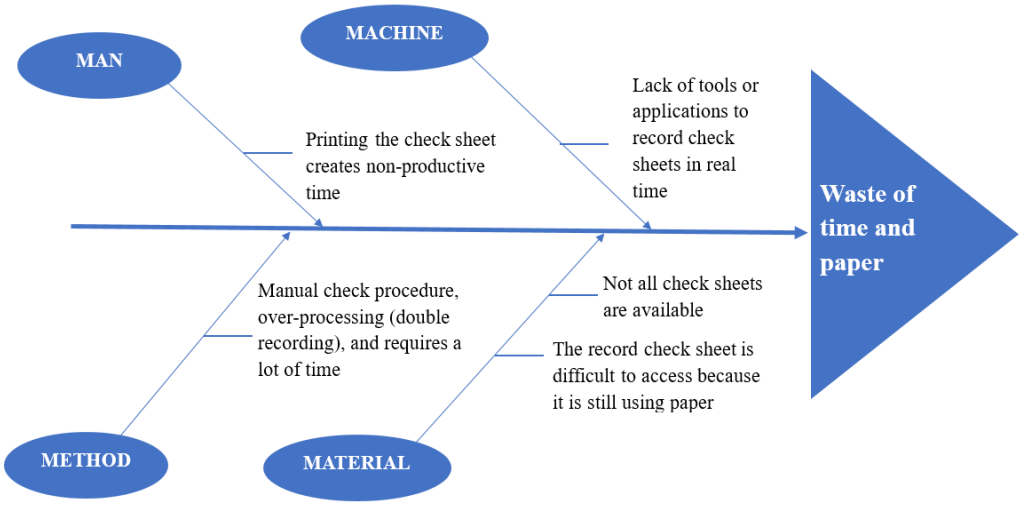

Figure 2. Fishbone Diagram.

Fishbone diagrams are analytical tools that aim to find out the main and supporting causes of a problem. In the diagram there are several causes, including the following:

a. *Method*: Manual check procedure, over-processing (double logging), and takes a lot of time.
b. *Man*: Print *Checksheet* makes time non-productive.
c. *Material*: Not all *Checksheets* are available, Record *Checksheets* are difficult to access because they are still paper-based.
d. *Machine*: Lack of tools or applications to record *Checksheets* in real-time.

Using the Why-Why Analysis method, it can find out why the loss time of Patrol Check A-T-A can have an effect on the loss of production time and waste of paper use.

a. Why does there be a loss of time? Because *the Patrol Check A-T-A* process still uses manuals.
b. Why is there a manual process? Because the procedure requires filling out a physical *Checksheet* on paper.
c. Why paper? Because there is no standardized digital system.
d. Why is there no digital system yet? Because there is no strong management initiative for the investment of the documentation system (root of the problem).

The Plan phase was initiated through a systematic identification of operational problems related to excessive cycle time and material consumption within the Early, Middle, and Final Patrol Check (A-T-A) process. This stage focused on understanding how manual inspection practices contributed to non-productive time and recurring operational costs, particularly those associated with paper-based documentation. Consistent with continuous improvement principles, problem identification was structured to ensure that observable inefficiencies were linked to measurable performance gaps (Gandhi & Singh, 2023; Kesuma & Muhimatul Khoiroh, 2024). The analytical foundation of this phase aligns with established PDCA-based improvement models applied in manufacturing environments (Kartika, 2020a; Rosikin & Rahayu, 2024).

To support structured diagnosis, a Fishbone Diagram was employed as the primary analytical tool for mapping potential causes of inefficiency. The Fishbone framework enabled a comprehensive visualization of causal factors across multiple dimensions, ensuring that both direct and indirect contributors to time loss and paper waste were examined. This approach reflects best practices in lean manufacturing and quality management, where multidimensional cause identification strengthens the reliability of improvement planning (Sugiarto et al., 2024; Contreras et al., 2020). The use of Fishbone analysis also supports organizational learning by clarifying complex cause–effect relationships in operational processes (Wibowo, 2023).

From the method perspective, the analysis revealed that the patrol check procedure relied heavily on manual documentation, which resulted in over-processing and redundant activities. Double logging, handwritten recording, and subsequent data transfer created unnecessary extensions in inspection time and increased the risk of transcription errors. Similar findings have been reported in manufacturing case studies where manual inspection systems hinder process responsiveness and operational transparency (Kartika, 2020b; Lokaputra et al., 2024). These method-related inefficiencies directly contributed to prolonged cycle times and reduced overall process effectiveness.

The human factor, categorized under the "Man" dimension, further exacerbated time inefficiencies in the patrol check process. Operators were required to print Checksheets prior to inspection, an activity that did not contribute to value creation and interrupted workflow continuity. This non-productive time reduced the effective utilization of human resources and distracted operators from core quality assurance tasks. Previous studies on lean implementation emphasize that administrative burdens imposed on operators significantly undermine productivity and process discipline (Nurhasanah et al., 2025; Revica Tauriza Alfiane & Rusindiyanto, 2024).

Material-related issues were also identified as a significant contributor to inefficiency, particularly the dependence on paper-based Checksheets. Not all required Checksheets were consistently available, and archived records were difficult to retrieve, limiting traceability and slowing decision-making processes. The daily consumption of approximately 100 sheets of paper at a cost of Rp.500 per sheet translated into recurring material expenses with no added

operational value. This condition reflects broader findings in process improvement literature, where excessive material usage is recognized as a form of waste that inflates operational costs (Kesuma & Muhimatul Khoiroh, 2024; Wibowo, 2023).

From the machine and technology perspective, the absence of real-time digital tools emerged as a critical constraint. The lack of applications or systems capable of recording patrol check data instantaneously prevented seamless data flow and delayed performance monitoring. Research on digital patrol and inspection systems consistently demonstrates that real-time data capture enhances responsiveness, accuracy, and managerial oversight (Wu et al., 2024; Huang et al., 2024). The technological gap identified in this study therefore represented a structural limitation rather than an isolated operational issue.

To deepen causal understanding, the Fishbone analysis was complemented by a structured Why-Why Analysis aimed at tracing inefficiencies to their fundamental origins. The initial question addressed why significant time loss occurred during Patrol Check A-T-A activities, which was attributed to the continued reliance on manual inspection processes. Further questioning revealed that manual practices persisted due to procedural requirements mandating physical Checksheets, reinforcing dependency on paper-based documentation. This analytical sequence reflects established root cause analysis practices used in safety, quality, and operational improvement studies (Naughton et al., 2024; Ardiansyah et al., 2025).

The final stage of the Why-Why Analysis identified the absence of a standardized digital system as the core issue underlying time loss and paper waste. This absence was directly linked to insufficient management initiative in prioritizing investment in digital documentation infrastructure. Comparable studies in patrol systems and inspection management indicate that leadership commitment is a decisive factor in successful digital transformation initiatives (Allinson, 2004; Wain & Ariel, 2014; Gannapathy et al., 2023; Buker et al., 2024). Consequently, the Plan phase established a clear, evidence-based justification for transitioning from manual Checksheets to a digital E-Checksheet system as a strategic improvement intervention.

Do

The first step in the Do stage is to develop *the E-Checksheet* and apply it to *the Patrol Line Press*. And conducted training for operators related to the use of *digital Checksheets* . In the process, it must invest training time and the use of *paper checksheets* is stopped during the trial.

The Do stage represents the practical execution of the improvement plan formulated in the previous phase, where conceptual solutions are translated into operational actions within the production environment. At PT. Automotive Components Company, this stage began with the development of a digital E-Checksheet system specifically designed to support the Early, Middle, and Final Patrol Check activities on the Press Patrol Line. The system architecture was structured to replicate existing inspection standards while improving data accessibility, accuracy, and traceability in real time, aligning with best practices in continuous improvement deployment (Gandhi & Singh, 2023; Naughton et al., 2024). This approach reflects the strategic role of digital tools in strengthening operational control without disrupting established quality requirements (Wibobo, 2023; Allinson, 2004).

The design of the E-Checksheet focused on simplifying inspection workflows while maintaining compliance with existing standard operating procedures. Each inspection parameter previously recorded manually was converted into a digital input field, enabling structured data capture and minimizing the risk of incomplete or inconsistent records. This design philosophy follows lean manufacturing principles, where process clarity and waste reduction are prioritized through systematic improvement initiatives (Kartika, 2020a; Kartika, 2020b). Similar digital patrol and inspection systems have demonstrated effectiveness in improving efficiency and monitoring capability across various operational contexts (Wu et al., 2024; Huang et al., 2024).

Implementation was initially conducted through a controlled trial on the Press Patrol Line to manage operational risk and ensure system reliability. During this trial period, the use of paper-based Checksheets was intentionally suspended to allow a full assessment of the digital system's performance under real production conditions. This transition required careful coordination to ensure that inspection activities continued without interruption while operators adapted to the new digital interface. Controlled implementation phases are widely

recognized as essential in sustaining continuous improvement initiatives and reducing resistance to change (Kesuma & Muhimatul Khoiroh, 2024; Rosikin & Rahayu, 2024).

Operator training constituted a critical component of the Do stage, recognizing that technological improvement must be supported by human capability development. Training sessions were conducted to familiarize operators with system navigation, data entry procedures, and basic troubleshooting, ensuring that the E-Checksheet could be used consistently and accurately. Although this phase required a short-term investment of training time, it was considered a necessary step to secure long-term efficiency gains and process stability. Prior studies emphasize that workforce readiness significantly influences the success of PDCA-based improvements and digital transformation efforts (Sugiarto et al., 2024; Revica Tauriza Alfiane & Rusindiyanto, 2024).

The transition from manual to digital inspection also altered the information flow within the patrol check process. Data that was previously delayed due to manual recording and physical archiving became instantly available for monitoring and evaluation. This real-time visibility enhanced supervisory oversight and supported faster decision-making at the operational level. Comparable findings in patrol and inspection research indicate that digital reporting systems significantly improve responsiveness and coordination across organizational units (Wain & Ariel, 2014; Gannapathy et al., 2023).

From a lean perspective, the elimination of paper-based documentation during the trial phase directly addressed sources of non-value-added activities. Printing, manual writing, document handling, and physical storage were removed from the process, reducing both time consumption and material usage. Such reductions align with lean manufacturing objectives that prioritize waste elimination across administrative and operational functions (Contreras et al., 2020; Nurhasanah et al., 2025). The Do stage thus served not only as a technological shift but also as a structural refinement of the patrol check workflow.

The implementation process also provided an opportunity to observe behavioral and operational adjustments among operators and supervisors. Initial adaptation challenges, primarily related to familiarity with digital interfaces, were mitigated through guided practice and on-site assistance. Over time, operators demonstrated improved confidence and consistency in conducting inspections using the E-Checksheet system. This gradual stabilization mirrors findings from previous PDCA-based case studies, where iterative learning during the Do phase contributes to sustainable improvement outcomes (Putra, 2023; Lokaputra et al., 2024).

Overall, the Do stage established a critical foundation for evaluating the effectiveness of the proposed improvement. By integrating digital technology with structured continuous improvement methods, the organization created a controlled environment to test performance changes before formal standardization. This approach reflects established improvement frameworks that emphasize disciplined execution, learning-oriented implementation, and alignment between technical solutions and organizational practices (Ardiansyah et al., 2025; Buker et al., 2024). The outcomes observed during this phase provided the empirical basis for subsequent evaluation in the Check stage and informed decisions regarding long-term adoption.

Check **(Check/Evaluate)**

The next step is to compare the results of the cycle time from before and after the implementation of *the E-Checksheet*. In the comparison, it was also found that the simplification of the workflow was as follows:

Table 1. Comparison of Process Sequence And Cycle Time.

Manual process sequence	Status	Cycle time	Digital process sequence of E-Cheeksheet usage	Status	Cycle time
Print Paper Checksheet	√	15 minutes	Access apps directly	√	2 minutes
Manual note-taking (handwritten)	√	2 minutes	Logging (data input)	√	5 minutes
Physical archiving	√	3 minutes	Real-time data transmission	√	3 minutes
Signature validation	√	5 minutes	Eliminated/automatic	x	-
Data input to the PC system	√	25 minutes	Eliminated/automatic	x	-

From the data above, we can see that the Patrol Check A-T-A activity before the implementation is still about 50 minutes and after the implementation of the Patrol Check A-T-A activity is only 10 minutes. The results of the data comparison above can be concluded that *the digital Patrol Check* activity can save 40 minutes (Gandhi & Singh, 2023).

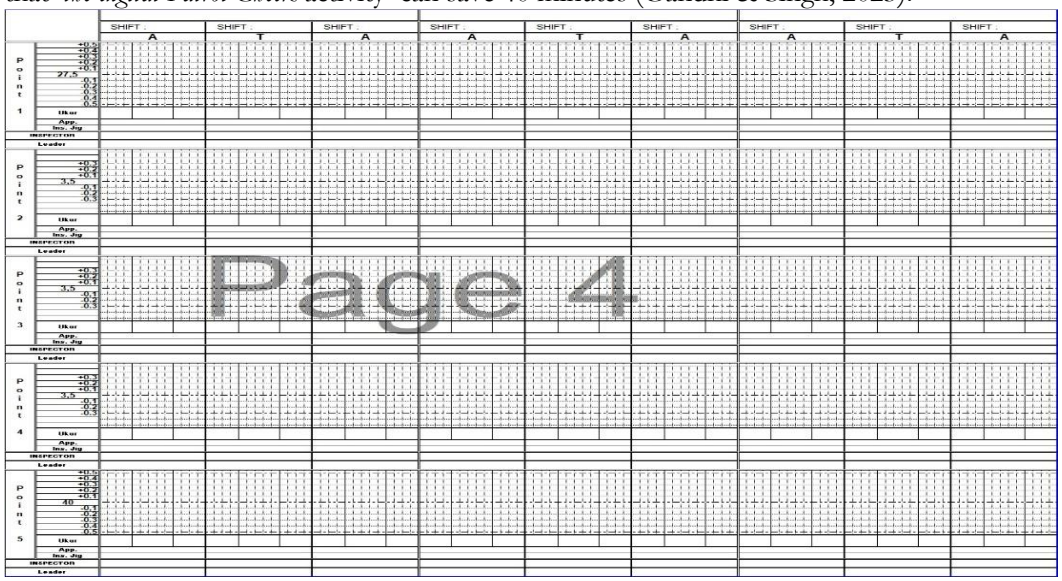

Figure 3. Cheecksheet Paper.

JamCek	PointCekNo	ItemCek	STD	TolMax	TolMin	Shift	TimeCek	1	2	3
1623	1	Ø	7	0.2	0	1	3AKHIR	0	0	0
1623	2	Ø	7	0.2	0	1	3AKHIR	0	0	0
1623	3	Ø	6	0.2	0	1	3AKHIR	0	0	0
1623	4	Dim	17	0.3	-0.3	1	3AKHIR	0	0	0
1623	5	Dim	8	0.2	0	1	3AKHIR	0	0	0
1623	6	Dim	6	0.2	0	1	3AKHIR	0	0	0
1623	7	Dim	56.5	0.3	-0.3	1	3AKHIR	0	0	0

Figure 4. Digital checksheet.

The evaluation phase focused on a systematic comparison of patrol check cycle times before and after the implementation of the E-Checksheet system, using empirical process data collected directly from production activities. This assessment aligns with continuous improvement practices that emphasize evidence-based validation of performance gains within manufacturing systems (Gandhi & Singh, 2023; Kesuma & Muhimatul Khoiroh, 2024). Cycle time was selected as the primary performance indicator due to its strong correlation with operational efficiency and non-productive time reduction in quality control activities (Kartika, 2020a; Rosikin & Rahayu, 2024). The analysis also examined changes in workflow structure to capture qualitative improvements beyond numerical time savings (Naughton et al., 2024).

Under the manual inspection system, the Patrol Check A-T-A process consisted of multiple sequential activities that collectively extended the inspection duration. Printing paper Checksheets alone required approximately 15 minutes, followed by handwritten data recording that consumed an additional 2 minutes during on-site inspections. Physical archiving of completed Checksheets added 3 minutes, while manual signature validation and subsequent data input into the PC-based system required 5 minutes and 25 minutes respectively. These fragmented steps resulted in a total cycle time of approximately 50 minutes, reflecting significant administrative and documentation inefficiencies (Wibowo, 2023; Allinson, 2004).

The introduction of the E-Checksheet fundamentally restructured the inspection workflow by eliminating several non-value-adding activities. Inspectors accessed the digital application directly, reducing preparation time to approximately 2 minutes. Data logging was conducted through structured digital input forms, requiring around 5 minutes, while real-time data transmission and centralized storage were completed within 3 minutes. Activities such as physical archiving, signature validation, and secondary data entry into separate systems were rendered unnecessary through automation, resulting in a streamlined digital process with a total cycle time of 10 minutes (Gandhi & Singh, 2023; Huang et al., 2024).

The comparative results demonstrate a net reduction of 40 minutes per Patrol Check A-T-A cycle, representing an 80 percent decrease in inspection time. This level of improvement is consistent with findings from previous PDCA-based interventions that reported substantial cycle time compression through process digitalization and waste elimination (Kartika, 2020b; Nurhasanah et al., 2025). The reduction directly contributes to lower non-productive time, allowing operators and inspectors to reallocate effort toward value-adding activities. From a lean manufacturing perspective, this outcome confirms the effectiveness of integrating PDCA with digital tools to address administrative waste (Contreras et al., 2020; Lokaputra et al., 2024).

Beyond time efficiency, the digital workflow enhanced data accuracy and accessibility across departments. Manual Checksheets, as illustrated in Figure 3, were prone to delayed retrieval, inconsistent handwriting, and storage limitations, which constrained effective monitoring and traceability. In contrast, the digital Checksheets shown in Figure 4 enabled standardized data formats, immediate availability, and centralized oversight. Such improvements align with studies highlighting the role of digital patrol systems in strengthening transparency and supervisory control (Wu et al., 2024; Wain & Ariel, 2014).

The elimination of paper-based documentation also generated measurable cost savings and supported environmentally responsible operations. Prior to digitalization, daily patrol checks required approximately 100 sheets of paper at a unit cost of Rp.500, resulting in a recurring expense of Rp.50,000 per day. The E-Checksheet system reduced paper usage by 100 percent, effectively eliminating these material costs while supporting sustainable management practices (Wibowo, 2023; Kesuma & Muhimatul Khoiroh, 2024). This outcome reflects broader evidence that digital inspection systems contribute to both economic and environmental performance improvements (Sugiarto et al., 2024).

From a control and governance perspective, the automated recording and real-time data transmission features improved auditability and process reliability. Digital records reduced the risk of data loss and enabled faster verification compared to manual documentation systems, which often rely on delayed reconciliation processes (Allinson, 2004; Putra, 2023). The structured data environment also facilitated root cause tracking and corrective action follow-up, reinforcing the sustainability of continuous improvement initiatives. These characteristics are consistent with structured improvement deployment models that emphasize data integrity and standardization (Naughton et al., 2024; Revica Tauriza Alfiane & Rusindiyanto, 2024).

The findings further demonstrate that the integration of PDCA with Fishbone and Why-Why Analysis supports robust decision-making during the evaluation stage. By linking measurable performance outcomes with identified root causes, management can validate the effectiveness of implemented solutions and justify standardization efforts (Ardiansyah et al., 2025; Rosikin & Rahayu, 2024). Comparable results have been observed in other patrol and monitoring contexts, including security and enforcement systems, where digital platforms significantly improved operational responsiveness (Gannapathy et al., 2023; Buker et al., 2024). Overall, the evaluation confirms that the E-Checksheet implementation delivers substantial efficiency gains while strengthening quality assurance and continuous improvement within the manufacturing patrol check process.

Act (Follow-up)

Once the results of the comparison show success in the Check phase, it is done to standardize the improvement: The E-checksheet *system* is set as a new standard operating procedure (SOP). The Beginning, Middle, and End data check record format becomes *paperless* and the data is well recorded, easy to see and monitor by all departments.

The Act phase represents the consolidation stage in which validated improvements are institutionalized to ensure sustainability and long-term impact within the organization. Following the successful outcomes observed during the Check phase, the E-Checksheet system was formally established as a new Standard Operating Procedure governing Early, Middle, and Final Patrol Check activities. This standardization ensures that inspection records are fully paperless, systematically stored, and readily accessible across departments, strengthening transparency and managerial control (Naughton et al., 2024; Rosikin & Rahayu, 2024). The transition reflects a strategic alignment between continuous improvement principles and sustainable operational management practices (Wibowo, 2023).

Prior to implementation, the Patrol Check A-T-A process relied entirely on manual documentation, which introduced multiple layers of non-value-added activities. The process sequence included printing paper Checksheets, handwritten data recording, physical archiving, signature validation, and subsequent data entry into a computer system, each contributing incrementally to extended cycle time. Similar inefficiencies associated with manual audit and control systems have been identified in earlier studies, particularly in relation to administrative delays and data redundancy (Allinson, 2004; Kartika, 2020a). These conditions positioned the Patrol Check process as a significant contributor to non-productive time within daily operations.

The comparative analysis presented in Table 1 illustrates a clear contrast between the manual and digital process sequences. Under the manual system, printing paper Checksheets required 15 minutes, handwritten note-taking consumed 2 minutes, physical archiving took 3 minutes, signature validation required 5 minutes, and data input into the PC system extended the process by an additional 25 minutes. Cumulatively, these activities resulted in an average cycle time of approximately 50 minutes per Patrol Check A-T-A cycle. Such extended cycle times align with findings from previous manufacturing case studies where manual documentation significantly constrained operational responsiveness (Kartika, 2020b; Lokaputra et al., 2024).

The introduction of the E-Checksheet fundamentally restructured the inspection workflow by eliminating redundant steps and automating data handling. Accessing the application directly reduced preparation time to 2 minutes, digital logging required 5 minutes, and real-time data transmission was completed within 3 minutes. Signature validation and secondary data entry were fully automated and removed from the process sequence, resulting in a total cycle time of approximately 10 minutes. This streamlined structure mirrors digital patrol and inspection systems shown to enhance efficiency and traceability across various operational contexts (Wu et al., 2024; Huang et al., 2024).

The reduction of cycle time by 40 minutes represents a substantial improvement in operational performance, equivalent to an 80 percent decrease compared to the manual process. Such outcomes are consistent with prior PDCA-based improvement initiatives that demonstrated measurable efficiency gains through process simplification and digital integration (Gandhi & Singh, 2023; Kesuma & Muhimatul Khoiroh, 2024). From a lean manufacturing perspective, this reduction directly addresses non-productive time, which is a critical form of waste affecting overall equipment and labor effectiveness (Nurhasanah et al., 2025). The results confirm that digitalization, when guided by structured improvement methodologies, produces tangible operational benefits.

Beyond time efficiency, the transition to a digital Checksheets system generated a complete elimination of paper usage in Patrol Check activities. Previously, daily operations required approximately 100 sheets of paper at a unit cost of Rp.500, resulting in a material expense of Rp.50,000 per day. The removal of paper-based documentation not only reduced direct material costs by 100 percent but also mitigated indirect costs related to storage, retrieval, and document management. Similar cost-reduction effects have been observed in PDCA-driven initiatives targeting material waste and administrative inefficiencies (Sugiarto et al., 2024; Revica Tauriza Alfiane & Rusindiyanto, 2024).

The digital Checksheets also enhanced data visibility and monitoring capabilities across organizational levels. Real-time data availability allowed supervisors and quality personnel to track inspection results without delay, supporting faster decision-making and corrective actions. Comparable advantages have been reported in digital patrol and monitoring systems, where centralized data access improves accountability and coordination (Gannapathy et al., 2023; Wain & Ariel, 2014). This shift strengthens preventive control mechanisms and reinforces quality assurance without increasing inspection workload.

From a broader methodological perspective, the integration of PDCA with Fishbone Diagram and Why-Why Analysis proved effective in identifying root causes and sustaining improvement outcomes. The structured problem-solving approach ensured that technological implementation addressed fundamental process deficiencies rather than superficial symptoms. Similar methodological combinations have been shown to enhance the robustness of continuous improvement initiatives across manufacturing and safety-critical environments (Ardiansyah et al., 2025; Putra, 2023; Contreras et al., 2020). Collectively, the

findings demonstrate that the digitalization of Patrol Check processes, when embedded within a disciplined improvement framework, contributes not only to efficiency gains but also to organizational learning and operational resilience.

Benefits of Repair

Process Sequence Becomes Shorter

The use of *E-Checksheet* only requires 3 process sequences compared to 5 process sequences if using paper *Checksheets*. This makes the use of time and paper more efficient.

Faster A-T-A Check Patrol Time

The completion time using the E-Checksheet takes only 10 minutes, which is 20% of the time required for a manual Checksheet (50 minutes). This is able to reduce non-productive time.

More Economical Paper Cost

The cost of materials in the form of paper (100 sheets x Rp.500 = Rp.50,000/day) can be reduced by up to 100% due to the elimination of the use of paper for Checksheets.

The implementation of the E-Checksheet system demonstrates a tangible improvement in process structure by significantly shortening the patrol check sequence. The conventional manual inspection required five sequential activities, including printing, handwritten recording, physical archiving, signature validation, and secondary data input, all of which contributed to prolonged cycle time and administrative burden. After digitalization, the inspection process was streamlined into three integrated steps, consisting of direct application access, real-time data input, and automatic data storage. This structural simplification reflects core principles of continuous improvement and waste elimination emphasized in PDCA-based manufacturing optimization studies (Gandhi & Singh, 2023; Kartika, 2020a).

From an operational perspective, the reduction in process steps directly influences time efficiency and workflow stability on the production floor. Shorter process sequences minimize interruptions to production activities and reduce dependency on supporting administrative tasks. Similar findings have been reported in lean manufacturing implementations where redundant documentation processes were eliminated through systematic PDCA cycles (Rosikin & Rahayu, 2024; Lokaputra et al., 2024). The present study confirms that process simplification through digital transformation strengthens operational discipline while maintaining compliance with existing quality standards (Wibowo, 2023).

A significant outcome of the improvement initiative is the substantial reduction in Patrol Check A-T-A cycle time. The manual inspection process required approximately 50 minutes to complete, whereas the E-Checksheet system reduced the completion time to 10 minutes, representing only 20% of the original duration. This 40-minute reduction per patrol cycle directly addresses non-productive time and enhances the availability of operators for value-adding activities. Comparable cycle time reductions have been documented in PDCA-driven improvement projects across manufacturing environments (Nurhasanah et al., 2025; Kesuma & Muhimatul Khoiroh, 2024).

The decrease in inspection time also contributes to improved production flow and responsiveness. Faster patrol checks enable quicker detection of deviations and more timely corrective actions, reducing the risk of defect propagation across production stages. Prior research on PDCA and lean-based inspection optimization highlights that shorter inspection cycles improve process control without compromising product quality (Putra, 2023; Revica Tauriza Alfiane & Rusindiyanto, 2024). The findings of this study align with these observations, demonstrating that digital inspection supports both efficiency and quality assurance objectives.

Another critical benefit of the E-Checksheet implementation is the complete elimination of paper usage in patrol inspections. Previously, the inspection process consumed approximately 100 sheets of paper per day at a cost of Rp.500 per sheet, resulting in a daily expense of Rp.50,000. The transition to a fully digital system reduced paper consumption by 100%, eliminating recurring material costs and associated storage requirements. This outcome reinforces the role of digitalization in supporting sustainable strategic management and environmental responsibility in industrial operations (Wibowo, 2023; Allinson, 2004).

Beyond direct cost savings, the elimination of paper-based documentation improves data accessibility, traceability, and accuracy. Digital records allow inspection data to be monitored in real time, accessed by multiple departments, and analyzed for continuous improvement initiatives. Studies on digital patrol and monitoring systems consistently report enhanced transparency and control compared to manual systems (Wu et al., 2024; Huang et al., 2024). The present results further validate that digital documentation strengthens information flow and managerial oversight within manufacturing environments.

The integration of PDCA, Fishbone Diagram, and Why-Why Analysis played a central role in ensuring that improvements were systematically designed and sustainably implemented. Root cause identification revealed that the absence of a standardized digital documentation system and limited management initiative were primary contributors to inefficiency. Similar structured problem-solving approaches have proven effective in addressing process waste, cost overruns, and operational risks across industrial case studies (Sugiarto et al., 2024; Ardiansyah et al., 2025; Naughton et al., 2024). This methodological alignment reinforces the reliability and replicability of the improvement outcomes achieved.

Finally, the results of this study resonate with broader findings on patrol digitalization across various operational contexts, including security, public services, and inspection-based activities. Research on mobile and web-based patrol systems highlights consistent gains in efficiency, monitoring capability, and reporting accuracy when manual patrol processes are replaced with digital platforms (Gannapathy et al., 2023; Wain & Ariel, 2014; Buker et al., 2024). Although conducted within a manufacturing setting, this study extends the applicability of digital patrol concepts to industrial quality control, confirming that E-Checksheet implementation offers measurable operational, economic, and managerial benefits when aligned with structured continuous improvement frameworks (Contreras et al., 2020; Kartika, 2020b).

5. Conclusion

Doing the work quickly and accurately is the goal of PT. Automotive component companies to streamline work time and accelerate employee performance productivity for smoothness and achievement of maximum targets in carrying out work.

By using the PDCA (Plant-Do-Check-Action) method, the Fishbone method and the Why-Why Analysis method, we can control the development of a root problem in the flow of our daily work process and design to improve the root of the problem, starting from the root of the problem, the cause of the problem and the shortcomings of the problem, so we must make improvements from the design results that have been arranged in such a way, We can compare the results of before and after implementation using the action phase so that we can know whether the improvement is efficient or not in the Early, Middle, and Final Patrol Check (A-T-A) process.

With the replacement of patrol data from paper to E-Chechsheet, this is the beginning of a smooth time change, which is very significant for the Company and for the operator.

With the implementation of digital Patrol Check or E-Checksheet, we are able to compress the time for 40 minutes in checking, which was initially 50 minutes in checking, to 10 minutes. And and reduce the use of paper by 100% (100 width x Rp.500 = Rp.50,000 per day), in checking this can prove that using this E-Checksheet really helps our daily work and achieves the company's expectations in streamlining operational time and costs, the results of this E-Checksheet are very precise with the existing SOPs. So that it does not interfere with or reduce the quality of the product.

References

Alfiane, R. T., & Rusindiyanto. (2024). Mengurangi cacat produk dengan implementasi PDCA (studi kasus perusahaan PT XYZ). *Jupiter: Publikasi Ilmu Keteknikan Industri, Teknik Elektro dan Informatika, 2*(1), 103–113. https://doi.org/10.61132/jupiter.v2i1.58

Allinson, C. (2004). The process of audit and control: A comparison of manual and electronic information systems. *Policing: An International Journal of Police Strategies & Management, 27*(2), 183–205.

Ardiansyah, A. R., Anindita, G., & Dhani, M. R. (2025). Penerapan metode double Ishikawa dan 5 Whys analysis dalam analisis kecelakaan loading unloading billet baja. *Journal of Safety, Health, and Environmental Engineering, 3*(1), 66–73.

Buker, N. H., Buker, I. E., & Oswalt, J. (2024). Optimizing police patrol beats: A practical framework for enhanced efficiency in determining patrol beat borders using the need for patrol presence score. *The Police Journal.*

Contreras, M., Lopez, C. A., & Solis, J. M. (2020). Process improvement techniques using lean manufacturing tools in Six Sigma methodologies as applied to electronic manufacturing services companies. *Batangas State University–JPLPC Malvar Campus.*

Gandhi, S., & Singh, J. (2023). Benefit using PDCA cycle of continuous improvement in manufacturing industry: A case study. *International Journal of Management Concepts and Philosophy, 1*(1), 1. https://doi.org/10.1504/ijmcp.2023.10054603

Gannapathy, V. R., Narayanamurthy, V., Subramaniam, S. K., Ibrahim, A. F. B. T., Isa, I. S. M., & Rajkumar, S. (2023). A mobile and web-based security guard patrolling, monitoring and reporting system to maintain a safe and secure environment at premises. *International Journal of Interactive Mobile Technologies, 17*(11).

Huang, X., Li, L., Wang, W., Liu, L., & Li, M. (2024). Intelligent patrol inspection of low-code-enabled electric power communication equipment based on digital transformation. *Cluster Computing, 27*(8), 10421–10435.

Kartika, H. (2020a). Application of lean Kaizen to increase line painting productivity in automotive production parts with the PDCA method.

Kartika, H. (2020b). Industrial engineering system analysis. *22*(1), 22–32.

Kesuma, R., & Khoiroh, S. M. (2024). Continuous improvement with PDCA on the production of bar soap at PT XYZ. *Journal of Solar Engineering, 11*(1), 118–127. https://doi.org/10.37859/jst.v11i1.7024

Lokaputra, R., Rosalina, V., & Ariyanto, D. E. (2024). Analisis pemborosan waktu kerja mesin IS-10 untuk perbaikan proses produksi dengan metode PDCA (Plan, Do, Check, Action) di PT GV. *Jurnal Sains Ilmu Teknologi Industri, 4*(1).

Naughton, E., Moran, R., Kharub, M., Sa, J. C., & McDermott, O. (2024). A structured model for continuous improvement methodology deployment and sustainment: A case study. *Heliyon, 10*(21), e40034. https://doi.org/10.1016/j.heliyon.2024.e40034

Nurhasanah, A., Rahayu, S., & Windyatri, H. (2025). Analisis penerapan lean manufacturing untuk menurunkan cycle time pada proses produksi dengan menggunakan metode PDCA di PT XYZ. *JENIUS: Jurnal Terapan Teknik Industri, 6*(1), 57–69.

Putra, R. C. M. (2023). *Defect analysis using PDCA (Plan–Do–Check–Action) and FMEA on cabinets of upright piano* (Doctoral dissertation, Universitas Islam Indonesia).

Rosikin, R., & Rahayu, S. (2024). Lean manufacturing analysis to reduce the cycle time of the assembly process using the PDCA method at PT X.

Sugiarto, A., Octavianto, A., Nugroho, S. E., & Prastyo, Y. (2024). Machine modification and material replacement to reduce production cost using PDCA method with fishbone diagram and why-why analysis. *Journal of Industrial Engineering and Management, 5*(3), 136–141.

Wain, N., & Ariel, B. (2014). Tracking of police patrol. *Policing: A Journal of Policy and Practice, 8*(3), 274–283.

Wibowo, I. (2023). Sustainable strategic management: Integration of environmental principles in business management. *Journal of Management, Accounting and Economics (MAR–Economics), 1*(2), 80–86.

Wu, Y., Wu, J., Zhang, S., Zhou, Z., & Chen, J. (2024). Research on the digital patrol and prevention system under the perspective of peaceful China. *Engineering Advances, 4*(4).