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Implementation of QCC method to reduce defects in rear combination lamp gaps on MPV vehicles in the automotive industry

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ABSTRACT

The appearance of four-wheeled vehicles is the first aspect observed by customers. Defects in appearance, such as gaps defect in the rear combination lamps, can reduce the competitiveness of Multi-Purpose Vehicle (MPV) products. Such defects affect product quality and customer satisfaction, making it essential for companies to minimize gaps defect to enhance market competitiveness. This study applies the QCC (Quality Control Circle) method with a PDCA (Plan-Do-Check-Action) approach, supported by the 8-step problem-solving process and 7 QC tools. The method aims to identify the root causes of defects and implement appropriate corrective actions. In its implementation, the Plan phase involves identifying the problem and analyzing root causes using QC tools such as Pareto charts and fishbone diagrams. In the Do phase, corrective actions are carried out by adjusting processes or materials. The Check phase includes evaluating the results of the corrective actions, while the Action phase ensures the changes are sustained over time. Using the QCC method, defect rates per unit decreased from 0.130 to 0.004.

1. Introduction

The automotive industry in Indonesia has experienced significant growth over the past few decades. As one of the largest markets in Southeast Asia, Indonesia has become an attractive destination for global automotive manufacturers to invest and expand their market share (S. Setiawan et al., 2021). Factors such as economic growth, urbanization, and increased purchasing power among the population have driven the demand for motor vehicles, particularly in the four-wheeler segment. Multi-Purpose Vehicles (MPVs) remain a favourite among Indonesian consumers due to their larger carrying capacity and relatively affordable prices (Puspita et al., 2024). The automotive industry continues to experience rapid development, accompanied by increasing competition among manufacturers (Cioca et al., 2019). In this context, quality becomes a decisive factor for competitiveness in the market (Sütöová & Segiňáková, 2018). Consumers today expect high-quality products that are not only reliable in terms of performance but also excel in appearance (Fonseca & Domingues, 2017). For Multi-Purpose Vehicles (MPVs), aesthetic quality plays a significant role in attracting buyer interest and loyalty. However, appearance defects, such as gaps in the rear combination lamp, can lead to consumer dissatisfaction (Putri et al., 2016). These defects not only reduce the product's appeal but also affect perceived quality, ultimately diminishing the company's competitiveness in the automotive market (Suzana Ariffin & Lutfi Iskandar, 2017).

The gap issue in the rear combination light of MPV vehicles often occurs during the production process. Based on the Pareto analysis of appearance defects, the rear combination lamp gap defect is the highest and requires serious attention from management. This highlights the need for a systematic approach to address the problem and achieve sustainable improvements (Kardas, 2018; S. Setiawan

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et al., 2021). An effective quality control method is required to identify the root cause of the defects and establish corrective actions that can reduce appearance defects to zero (Stylidis et al., 2022).

Efforts to reduce appearance defects in the rear combination lamp gaps of MPV models in the automotive industry can be effectively carried out using the QCC (Quality Control Circle) method (Sicoe et al., 2017). This method employs the PDCA (Plan-Do-Check-Act) cycle as a foundational framework within an eight-step problem-solving process (Tejaningrum & Suryanto, 2021), Of all the improvement methods, QCC is the method that is easy to apply and understand for employees in industry through along with the use of 7 Quality Control tools (7QC tools) for identifying, analyzing, and resolving defects to prevent recurrence (Serang, 2024; Sulaeman et al., 2024).

2. Methods

This study falls under applied research, focusing on improving production systems and restructuring production lines. It emphasizes the importance of reducing defect levels using the QCC (Quality Control Circle) method (Gu et al., 2022; Yuan et al., 2024). The study employs two data collection techniques: observation and Focus Group Discussion (FGD) (Handayani & Pendrian, 2023).

The initial step involves identifying the problem specifically by defining the appearance defect in the rear combination lamp gap. Subsequently, data related to the defect is collected using quality tools such as Pareto diagrams to determine the frequency and significance of each defect (Islam et al., 2017). The collected data is then analyzed using fishbone (Ishikawa) diagrams to identify the root causes, which may include factors such as human resources, machines, materials, methods, environment, and measurements (Sumasto et al., 2023). The selected solutions are implemented in the production process, ensuring that all personnel understand and execute the required changes (Zahra & Aslami, 2024). The results of the implementation are evaluated using check sheets to confirm a reduction in defects (Jou et al., 2022; I. Setiawan & Setiawan, 2020). If the solutions prove effective, the new processes are standardized into the company's Standard Operating Procedures (SOPs) (Sisay et al., 2021). Regular reviews are conducted to ensure the defects do not reoccur, with the PDCA cycle applied continuously for necessary improvements (Zhu et al., 2021). The QCC method not only aims to reduce defects but also empowers employees by actively involving them in problem-solving processes (Fajriah & Simanjuntak, 2020). This approach enhances overall product quality and fosters continuous improvement in the automotive industry (Fikri Baisalim et al., 2022; Syahrullah et al., 2021; Tang et al., 2020; Yuan et al., 2024). An explanation of each step is illustrated in Fig 1.

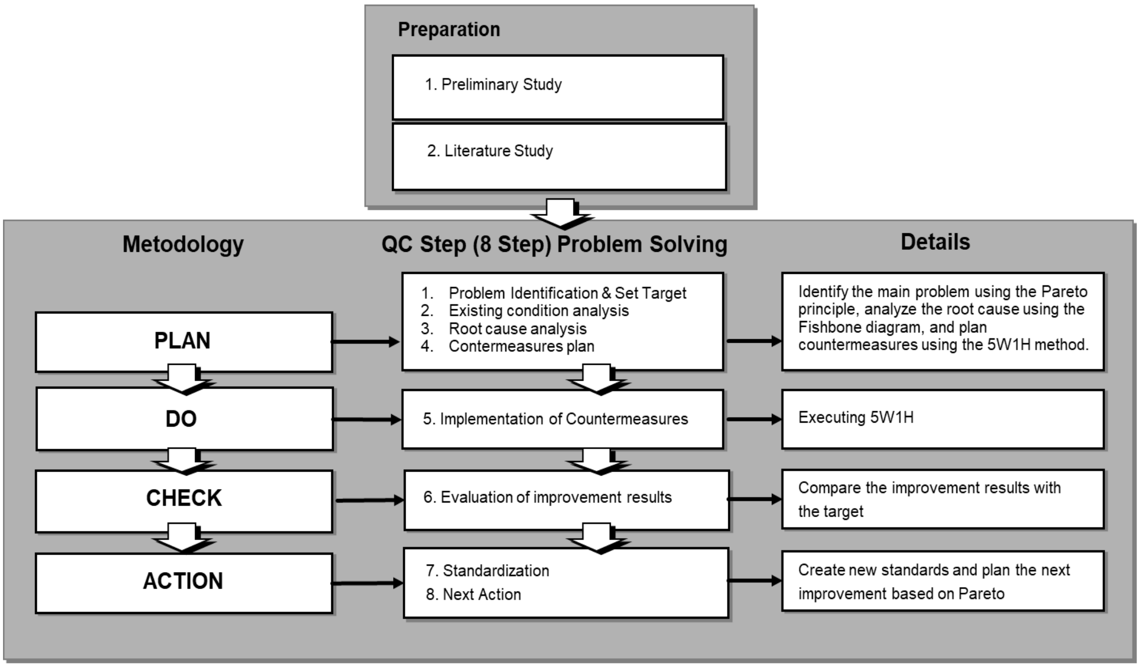

Fig. 1 Research step.

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3. Results and Discussion

In this study, we applied the PDCA systematization to ensure that the resolution process is clear and step-by-step. The PDCA cycle, consisting of Plan, Do, Check, and Act phases, was utilized to systematically identify problems, implement corrective actions, evaluate outcomes, and standardize effective solutions (Wiharjo & Wulandari, 2023). This structured approach allows for continuous improvement by addressing root causes and ensuring sustainable results. (Taufik, 2020).

Plan Stage

In the planning stage, it begins with problem identification, followed by setting targets based on an analysis of the current conditions. The final step involves analysing the conditions to identify the root cause of the problem. From the problem identification results, it was found that the defect per unit on May 2024, the rear combination lamp gap was the largest among vehicle appearance defects at Fig 2.

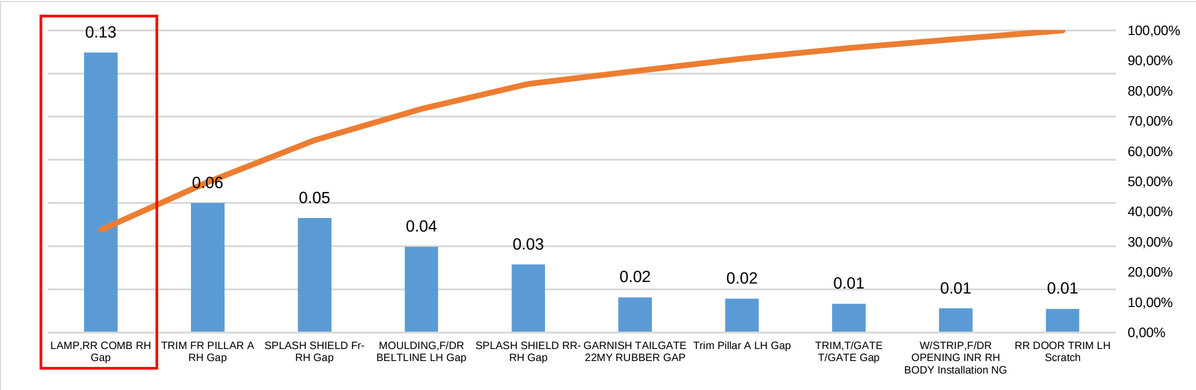

Fig. 2 DPU Pareto chart.

The management target is to reduce appearance defects to zero. Achieving this requires an in-depth analysis of the current conditions by checking the accuracy of the vehicle body condition, as illustrated in Fig. 3.

Fig. 3 Body accuracy data.

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The results of the current condition check indicate significant variations in body accuracy, which can lead to defects in the rear combination lamp gap. From this point, the root cause of the problem must be identified using a fishbone diagram at Fig. 4.

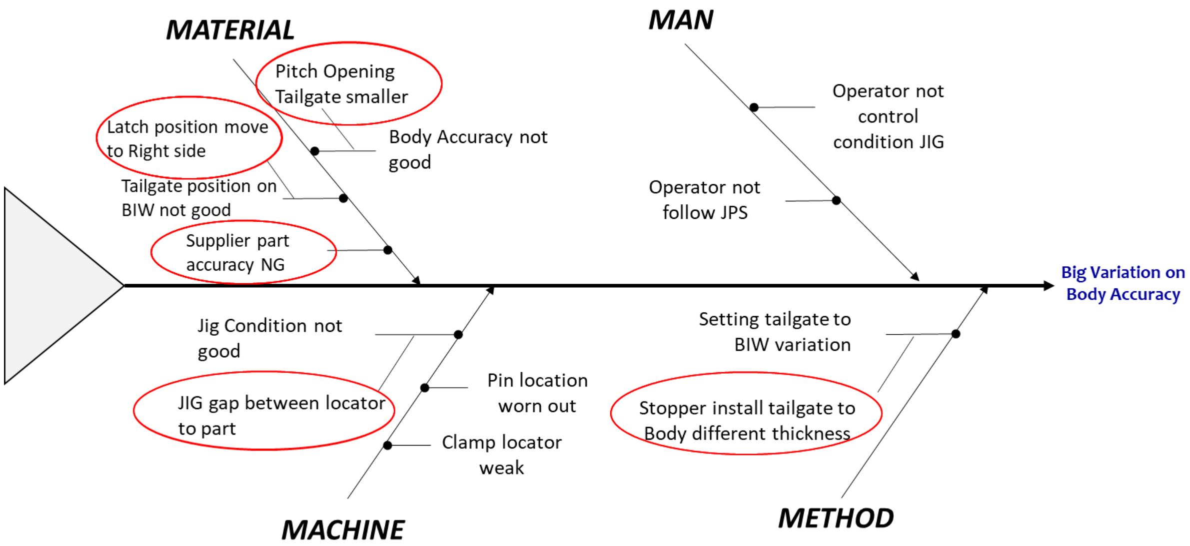

Fig. 4 Fishbone diagram

The fishbone diagram indicates that the problem originates from machine (jig), material, and method factors. Improvement plans for these three factors will be developed using the 5W1H approach.

Table 1 5W1H

No	Factor	Problem (What)	Reason (Why)	Action (How)	PIC (Who)	Dept, (Where)	Due Date (When)
1	Method	Stopper install tailgate to Body different thickness	Many time use without monitoring (Life time)	> Modify stopper installation tailgate at MS Line setting > Set periodically monitoring	MFG-Body, QC-BI	Welding Shop	June 2024
2	Material	Tailgate Latch position move to Right side	Side effect of shim at stopper has gap / worn out	Adjust center Jig latch tailgate assy at MS 104 move to LH side 0.8 mm	MFG-Body PE- Body	Welding shop	July 2024
3	Material	Pitch Opening Tailgate smaller	Side effect of shim at stopper has gap / worn out	Adjust JIG MJ 102 BL position move to Outside 1.0 mm	MFG-Body PE- Body	Welding Shop	Aug 2024
4	Material	Supplier part accuracy NG	Jig worn out	> Conduct joint check with supplier to check actual condition fitting part on JIG. > supplier will Improve JIG condition	Supplier	Supplier	Sept 2024
5	Machine	JIG gap between locator to part	Many time use without monitoring (Life time)	Change new pin and additional shim on JIG related to RCL	MFG Body PE Body QC-BI	Welding Shop	Sept 2024

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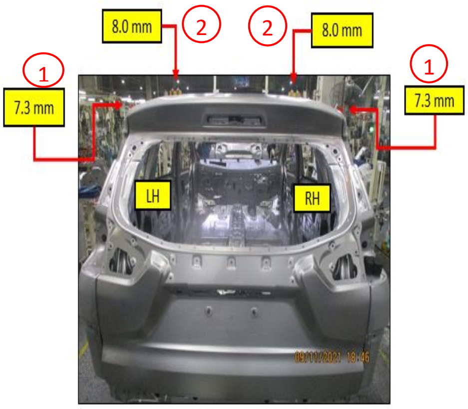
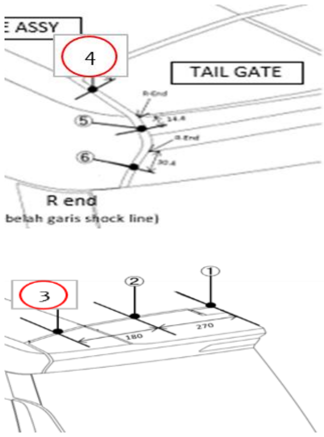
Do Stage

The *Do* stage involves executing improvements based on the plans developed during the *Plan* stage using the 5W1H approach. Countermeasure results can be seen Table 2.

Table 2 Countermeasure results for method factor

Root Cause	Countermeasure (action)	Results
Stopper install Tailgate to BIW different Thickness	Modify stopper installation tailgate at MS Line setting make same thickness between RH-LH	Gap between LH & RH are stable





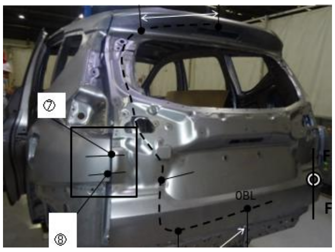
		GAP						
		LH				RH		
	POINT	①	②	③	④	②	③	④
	STH DARD	8.0	8.0	8.0	-6.9	8.0	8.0	-6.9
	TOLE RANCE	7.0 – 9.0	7.0 – 9.0	7.0 – 9.0	5.9 – 7.9	7.0 – 9.0	7.0 – 9.0	5.9 – 7.9
BEFORE	1	8.9	9.0	7.9	7.0	8.8	9.0	7.6
	2	8.3	8.3	7.8	6.6	8.5	8.7	8.0
	3	8.2	8.9	7.9	6.3	8.6	8.2	8.4
AFTER	4	7.8	8.1	7.9	7.5	7.7	7.9	7.4
	5	7.9	8.1	7.5	7.4	8.2	7.2	7.9
	6	7.5	7.8	7.6	7.5	7.6	7.6	7.7

Table 2 shows that after the improvement, no.1,2,3,4 the vehicle body exhibits consistent thickness along the area where the rear combination lamp is installed, meeting the required standards and tolerances. As a result, the rear combination lamp can be fitted properly according to customer specifications, and this improvement can be deemed acceptable.

For the material factor (vehicle body), the lower part still requires significant adjustments. Based on the root cause analysis using the fishbone diagram, it was identified that the tailgate latch position has shifted too far to the right. To address this, the centre jig for the tailgate assembly latch (MS 104) needs to be adjusted by moving it 0.8 mm to the left-hand side. This ensures that the rear combination lamp fits properly without gaps. Additionally, the pitch opening of the tailgate is smaller, requiring an adjustment to Jig MJ 102 by moving it 1.0 mm to the outside. Lastly, regarding supplier components, part accuracy issues were identified due to gaps in the child parts. Improvements were made at the supplier by stabilizing their jig setup. Detailed information is provided in Table 3.

Table 3 Countermeasure results for material factor

Root Cause	Countermeasure (action)	Results
Tailgate latch position move too Right side	Adjust center Jig Latch Tailgate Assy at MS 104 move to LH side 0.8 mm	Gap between LH & RH are stable
Pitch Opening Tailgate smaller	Adjust JIG MJ 102 BL position move to Outside 1.0 mm	Pitch Opening Tailgate getting better



		Gap	
	Point	7	8
	Standard	8.4 mm	8.4 mm
	Tolerance	7.4 - 9.4 mm	7.4 - 9.4 mm
Before Improvement	Unit#1	7.2 mm	6.9 mm
	Unit#2	7.2 mm	7.0 mm
	Unit#3	7.2 mm	6.9 mm
After Improvement	Unit#4	8.2 mm	8.0 mm
	Unit#5	8.4 mm	8.0 mm
	Unit#6	7.5 mm	7.5 mm

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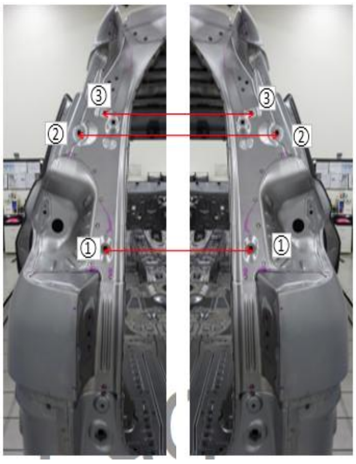
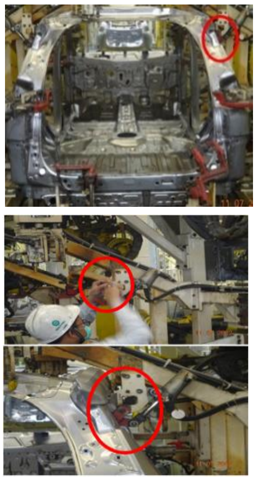


Supplier part accuracy NG due to some gap found in child part



Improve JIG supplier – additional and eliminate shim

	DATE	TIME	UNIT	RESULT					
				① Extension		② Side Outer		③ Extension	
				STDI :	1175.5	STDI :	1292.0	STD:	1164.4
				Measured	Deviation	Measured	Deviation	Measured	Deviation
BEFORE IMPROVE MENT	26-10-22 (NS)		1	1174.6	-0.9	1291.8	-0.2	1162.3	-2.1
			2	1174.8	-0.7	1291.3	-0.7	1162.9	-1.5
			3	1174.7	-0.8	1291.4	-0.6	1162.2	-2.2
	27-10-22 (DS)		1	1174.5	-1.0	1291.4	-0.6	1162.3	-2.1
			2	1174.6	-0.9	1291.6	-0.4	1162.4	-2.0
			3	1174.9	-0.6	1291.9	-0.1	1162.1	-2.2
AFTER IMPROVE MENT	07-11-22 (DS)		1	1175.7	+0.2	1292.8	+0.8	1164.3	-0.1
			2	1175.9	+0.4	1292.6	+0.6	1164.0	-0.4
			3	1176.2	+0.7	1292.9	+0.9	1163.9	-0.5
	07-11-22 (NS)		1	1174.5	-1.0	1292.0		1163.8	-0.6
			2	1174.8	-0.7	1291.0	-1.0	1164.3	-0.1
			3	1175.0	-0.5	1292.0	0	1163.6	-0.8

Part accuracy, especially on datum hole getting better

Before Improvement

Item Check	Sample Check		
	Unit#1	Unit#2	Unit#3
Standard 0 - 0.7 mm			
Gap A	1.1 mm	0.9 mm	0.9 mm
Gap B	1.0 mm	1.2 mm	1.2 mm

After Improvement

Item Check	Sample Check		
	Unit#1	Unit#2	Unit#3
Standard 0 - 0.7 mm			
Gap A	0.5	0.3	0.5
Gap B	0.1	0.1	0.1

For the machine factor, this relates to the jig that needs to be reset and the addition of shim because, during the welding process, the jig wobbles, which can lead to inaccurate body alignment and dents in certain areas. This can result in gaps during the installation of the rear combination lamp in the assembly process. For details, please see Table 4.

Table 4 Countermeasure results for method factor

Root Cause	Countermeasure (action)	Results
JIG gap between locator to part	Change new pin and additional shim on JIG related to Rear Combination Lamp	Jig stable

Before Improvement

After Improvement

Check Stage

The check stage in the PDCA (Plan, Do, Check, Act) cycle is an evaluation step to assess the results achieved from the implementation of the plan. In this stage, data collected during the do phase is

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analyzed to compare actual outcomes with planned targets. The evaluation includes identifying successes, deviations, and areas requiring improvement. This process ensures that the actions taken align with the company's objectives, providing a strong foundation for corrective measures or further development in the act stage. The results of the improvement implementation can be seen in Fig. 5.

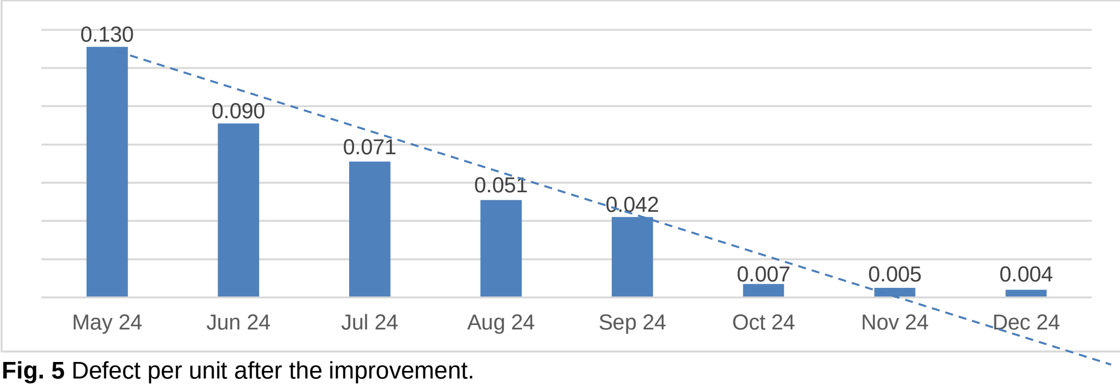

Fig. 5 Defect per unit after the improvement.

Based on Fig. 5, there was a decrease in defects per unit from 0.13 to 0.004, indicating a 69% reduction. The reduction occurred gradually, starting with the first improvement in June by fixing the stopper installation on the tailgate. In July, adjustments were made to move the tailgate latch position to the right side. In August, improvements were made to the pitch opening of the tailgate. A significant decrease occurred in October, attributed to supplier improvements in September, which focused on enhancing part accuracy and eliminating the jig gap between the locator and parts. As a result, defects dropped drastically in October, November, and December.

Action Stage

The Action stage is the final step that focuses on follow-up and implementing changes based on the evaluation results from the Check stage. At this stage, the organization or team takes actions to address identified issues or adopts successful processes as new standards. If the tested plan proves effective, the steps are integrated into routine operations. However, if the results are unsatisfactory, additional improvements or modifications to the initial plan are carried out.

Moreover, this stage includes documenting the processes, results, and lessons learned throughout the cycle. This documentation is essential to ensure the sustainability of future improvements and to help other teams learn and apply similar methods. Communication with all organizational members is also a crucial part of this stage, ensuring everyone understands the implemented changes and their roles in supporting the sustainability of improvements.

To keep the PDCA cycle running at the Action stage, the next improvements will be identified. Based on the defect per unit Pareto analysis in the Plan stage, the next step is to reduce Trim Front Pillar A RH Gap defects as shown in Fig. 6.

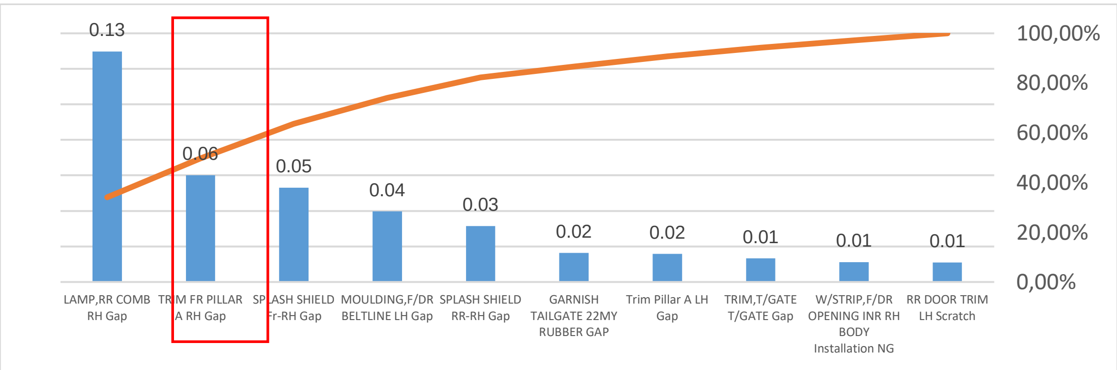

Fig. 6 The second highest defect for the next improvement project.

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Research Implication

The resolution of appearance and aesthetic defects in the automotive industry has rarely been addressed in previous studies, especially concerning the accuracy of the rear combination lamp gap. However, in similar studies, many have used the same methods to solve issues, such as QCC and the use of 7 QC tools. The implementation of the Quality Control Circle (QCC) combined with the Plan-Do-Check-Act (PDCA) method to reduce defects in rear combination lamp gaps on MPV vehicles has significant implications for quality management in the automotive industry. This research demonstrates the effectiveness of integrating team-based problem-solving frameworks with systematic methodologies to identify and address production challenges. By applying the PDCA cycle within QCC activities, the study provides a structured approach for continuous improvement, ensuring sustainable and measurable results.

The findings emphasize the importance of focusing on specific defects to achieve tangible outcomes. In this case, reducing gaps in rear combination lamps enhances both aesthetic and functional quality, leading to improved customer satisfaction. Additionally, the integration of QCC and PDCA fosters cross-functional collaboration, enabling employees to contribute insights and solutions, thus promoting a culture of teamwork and accountability.

4. Conclusion

This study demonstrates the effectiveness of implementing the Quality Control Circle (QCC) method with the Plan-Do-Check-Action (PDCA) approach to address defects in rear combination lamp gaps on MPV vehicles. By systematically identifying root causes using tools such as Pareto charts and fishbone diagrams and implementing targeted corrective actions, the defect rate was significantly reduced from 0.130 to 0.004 defects per unit. The research highlights the importance of structured problem-solving methods in improving product quality and meeting customer expectations. The integration of the 8-step problem-solving process and 7 QC tools provided a comprehensive framework for achieving sustainable results. The PDCA approach ensured continuous improvement through iterative evaluation and implementation of corrective actions.

Furthermore, the findings underscore the impact of defect reduction on enhancing market competitiveness and customer satisfaction. By addressing aesthetic and functional quality issues, the company successfully improved product reliability and strengthened its brand reputation. This study provides a valuable model for other organizations in the automotive industry to adopt similar quality improvement methodologies. The long-term sustainability of these improvements demonstrates the potential for organizations to achieve operational excellence and maintain competitiveness in a demanding market environment.

References

Cioca, L. I., Ivascu, L., Turi, A., Artene, A., & Gaman, G. A. (2019). Sustainable development model for the automotive industry. *Sustainability (Switzerland)*, *11*(22), 1–22. https://doi.org/10.3390/su11226447

Fajriah, M. A., & Simanjuntak, M. R. A. (2020). The study of quality control management that influence the implementation of technical standards for class C hospital buildings in Tangerang districs. *IOP Conference Series: Materials Science and Engineering*, *852*(1), 0–7. https://doi.org/10.1088/1757-899X/852/1/012017

Fikri Baisalim, M., Soediantono, D., & Staf dan Komando TNI Angkatan Laut, S. (2022). Literature Review of Quality Control Circle (QCC) and Implementation Recommendation to the Defense Industries. *Journal of Industrial Engineering & Management Research*, *3*(2), 2722–8878. http://www.jiemar.org

Fonseca, L. M., & Domingues, J. P. (2017). Reliable and Flexible Quality Management Systems in the Automotive Industry: Monitor the Context and Change Effectively. *Procedia Manufacturing*, *11*(June), 1200–1206. https://doi.org/10.1016/j.promfg.2017.07.245

Gu, C., Xu, Y., Li, Z., Xu, Y., & Zhou, Y. (2022). *Application of quality control circle (QCC) activity in improving the qualification rate of small dental instruments cleaning*. *1*(3). https://doi.org/10.11910/j.issn.2791-2043.2022.3.08

Handayani, W., & Pendrian, O. (2023). Evaluation of the Impact of Implementing Organizational

Please cite this article as: Setiawan, S., Hibarkah Kurnia, H., Nasihardani, D., & Putri, H.S.D. (2025). Implementation of QCC method to reduce defects in rear combination lamp gaps on MPV vehicles in the automotive industry. *Operations Excellence: Journal of Applied Industrial Engineering*, 17(1), 69-78. https://doi.org/10.22219/oe.2025.v17.i1.131

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Culture on Employee Innovative Behavior. *International Journal of Law, Policy, and Governance*, *2*(2), 49–64. https://doi.org/10.54099/ijlpg.v2i2.700

Islam, T., Khan, S. A., Sakib, M. H., Sakib, A., & Siddiquee, A. B. (2017). Analysis of major defects position and percentage in sewing lines of a garments factory with the help of pareto chart, cause effect diagram and sigma level. *International Journal of Scientific & Engineering Research*, *8*(7), 1885–1890. http://www.ijser.org

Jou, Y. T., Silitonga, R. M., Lin, M. C., Sukwadi, R., & Rivaldo, J. (2022). Application of Six Sigma Methodology in an Automotive Manufacturing Company: A Case Study. *Sustainability (Switzerland)*, *14*(21), 1–27. https://doi.org/10.3390/su142114497

Kardas, E. (2018). *the Analysis and Improvement of Product Quality Using Selected Methods and Tools in Automotive Industry Enterprise*. *21*(3), 18–25. https://doi.org/10.25961/ent.manag.21.03.03

Puspita, A. C., Setiawan, B., Ayu, C., & Heikal, J. (2024). Analisis Preferensi Konsumen dan Profil Pembeli di Industri Otomotif: Studi Kasus Pembelian Kendaraan di Wilayah Jabodetabek. *AKADEMIK: Jurnal Mahasiswa Ekonomi & Bisnis*, *4*(3), 1036–1050. https://doi.org/10.37481/jmeb.v4i3.870

Putri, N. T., Sha’Ri Mohd, Y., & Irianto, D. (2016). Comparison of Quality Engineering Practices in Malaysian and Indonesian Automotive Related Companies. *IOP Conference Series: Materials Science and Engineering*, *114*(1). https://doi.org/10.1088/1757-899X/114/1/012056

Serang, S. (2024). *Analyzing the Impact of Quality Control Circle and*. *12*, 223–227.

Setiawan, I., & Setiawan, S. (2020). Defect reduction of roof panel part in the export delivery process using the DMAIC method: a case study. *Jurnal Sistem Dan Manajemen Industri*, *4*(2), 108–116. https://doi.org/10.30656/jsmi.v4i2.2775

Setiawan, S., Setiawan, I., Jaqin, C., Prabowo, H. A., & Purba, H. H. (2021). Integration of waste assessment model and lean automation to improve process cycle efficiency in the automotive industry. *Quality Innovation Prosperity*, *25*(3), 48–64. https://doi.org/10.12776/qip.v25i3.1613

Sicoe, G. M., Belu, N., Rachieru, N., & Nicolae, E. V. (2017). Improvement of the customer satisfaction through Quality Assurance Matrix and QC-Story methods: A case study from automotive industry. *IOP Conference Series: Materials Science and Engineering*, *252*(1). https://doi.org/10.1088/1757-899X/252/1/012045

Sisay, G., Kitaw, D., Ebinger, F., & Jilcha, K. (2021). Developing Integrated Continuous Improvement Model for Competitiveness of Ethiopian Automotive Industry. *European Online Journal of Natural and Social Sciences*, *10*(2), 223–247. http://www.european-science.com

Stylidis, K., Quattelbaum, B., Bergsjö, D., Hellberg, E., Lundström, O., Siljefalk, L., Heimersson, E., & Söderberg, R. (2022). Perceived Quality Attributes Importance Ranking Methodology in the Automotive Industry: A Case Study on Geometry Appearance Attributes at CEVT. *Procedia CIRP*, *107*(March), 1559–1564. https://doi.org/10.1016/j.procir.2022.05.191

Sulaeman, S., Misaran, M. S., Farm, Y. Y., & Chua, B. L. (2024). Quality Control Circles Technique for Reducing Fine Bored Parts Rejects After Tool Change. *Proceeding of the International Conference on Multidisciplinary Research for Sustainable Innovation*, *1*(1), 239–248. https://doi.org/10.31098/icmrsi.v1i.804

Sumasto, F., Maharani, C. P., Purwojatmiko, B. H., Imansuri, F., & Aisyah, S. (2023). PDCA Method Implementation to Reduce the Potential Product Defects in the Automotive Components Industry. *IJIEM - Indonesian Journal of Industrial Engineering and Management*, *4*(2), 87. https://doi.org/10.22441/ijiem.v4i2.19527

Sütöová, A., & Segiňáková, S. (2018). Improving information flow for decision making on product quality in the automotive industry. *Quality Innovation Prosperity*, *22*(1), 71–78. https://doi.org/10.12776/QIP.V22I1.1082

Suzana Ariffin, A., & Lutfi Iskandar, M. (2017). Competitiveness Analysis of ASEAN Automotive Industry: A Comparison between Malaysia and Thailand Adoption of Innovation Culture Among Malaysian Youth Entrepreneurs Towards Creating Global Players View project Malaysia Automotive Policy View project. *Perdana School of Science, Technology and Innovation Policy, 3*(February 2019), 11–20.

Syahrullah, Y., Imran, R. A., Adhiana, T. P., & Krisnawati, M. (2021). Improvement of Education Quality Using Quality Control Circle Methods Based on Fulfillment of ISO 21001 : 2018 Requirements. *Proceedings of the Second Asia Pacific International Conference on Industrial Engineering and Operations Management Surakarta, Indonesia 2021*, 2540–2548.

Tang, N. H., Tsai, S. F., Liou, J. H., Lai, Y. H., Liu, S. A., Sheu, W. H. H., & Wu, C. L. (2020). The association between the participation of quality control circle and patient safety culture. *International Journal of Environmental Research and Public Health*, *17*(23), 1–14. https://doi.org/10.3390/ijerph17238872

Taufik, D. A. (2020). PDCA Cycle Method implementation in Industries: A Systematic Literature Review. *IJIEM - Indonesian Journal of Industrial Engineering and Management*, *1*(3), 157. https://doi.org/10.22441/ijiem.v1i3.10244

Tejaningrum, N., & Suryanto, S. (2021). Competency development of quality control in automotive companies to improve service quality. *STRADA Jurnal Ilmiah Kesehatan*, *10*(1), 385–391. https://doi.org/10.30994/sjik.v10i1.643

Wiharjo, S. M., & Wulandari, D. (2023). The Plan-Do-Check-Action Approach Model for Quality Management in Community Learning Activity Centers. *Journal of Multi-Disciplines Science (Icecomb)*, *1*(2), 92–96. https://doi.org/10.59921/icecomb.v2i1.5

Yuan, B., Song, S., Tang, X., & Ma, Z. (2024). Application of Multidimensional Quality Management Tools in the Management of Medical Adverse Events. *Risk Management and Healthcare Policy*, *17*, 91–99. https://doi.org/10.2147/RMHP.S436083

Zahra, A., & Aslami, N. (2024). *Quality Control Analysis of Bath Soap Products With QCC (Quality Control Circle) Method at Alliance Consumer Products Indonesia Uses to Minimize Failed Products*. *5*(5).

Zhu, H., Zhou, W., Li, Z., Li, L., & Huang, T. (2021). Requirements-Driven Automotive Electrical/Electronic Architecture: A Survey and Prospective Trends. *IEEE Access*, *9*, 100096–100112. https://doi.org/10.1109/ACCESS.2021.3093077