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Optimizing Manhour Productivity in Automotive Component Packing Process Using the ECRS Approach

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Abstract
This study aims to improve manhour productivity in the packing process of an Indonesian automotive component company by applying the ECRS method (Eliminate, Combine, Rearrange, Simplify). The problem was identified from low labor productivity caused by non-value-added activities, inefficient work layout, non-ergonomic material placement, and the absence of proper work aids. A quantitative approach was used through direct observation, time study, motion analysis, fishbone diagram, and operation process chart to identify waste and determine improvement actions. The implementation of ECRS reduced the cycle time from 60 seconds to 46 seconds per unit, representing a 23.3% improvement, and increased output from 60 units/hour to 78 units/hour, equivalent to a 30% productivity increase. In addition, the improvement eliminated unnecessary movements, simplified work procedures, and enhanced ergonomic conditions for operators. The findings indicate that the ECRS approach provides a practical contribution to improving efficiency in manual packing processes without adding labor or major production equipment. Therefore, this method can be used as an effective and low-cost improvement strategy for productivity enhancement in manufacturing operations.

Keywords: ECRS, labor productivity, manhour productivity, lean manufacturing, packing process, work efficiency

Introduction

The manufacturing industry is currently under increasing competitive pressure due to globalization and the demands of continuous operational efficiency. Companies are required to be able to increase productivity consistently to maintain competitiveness, especially in the automotive component industry which has high quality standards and strict delivery timeliness. In this context, labor productivity is the main indicator in measuring the effectiveness of the use of production resources, especially in processes that are still dominated by manual activities (Sutalaksana et al., 2006). The packing process as the final part of the production flow has an important role in determining the smooth distribution of products, so inefficiencies in this process will have a direct impact on the overall throughput of the production system.

However, the manual and repetitive packing process often stores various forms of waste that are not realized. Based on the concept of lean manufacturing, waste is defined as any activity that does not add value to the product, which includes motion, waiting, overprocessing, and defects (Ohno, 1988; Womack & Jones, 2003). In practice in the field, the waste of motion types is the most dominant, especially due to suboptimal work layouts, unstandardized working methods, and unergonomic material placement. The accumulation of these non-value-added activities significantly increases cycle time and decreases labor productivity (Sari & Nugroho, 2021).

The results of initial observations on the packing process at Indonesian Automotive Companies show that there are various problems that indicate low work efficiency. Operators still perform unnecessary movements such as walking to pick up materials, bending over repeatedly due to unergonomic material positions, and performing activities separately that should be combined. In addition, the absence of work aids such as jig fixtures causes the product fixation process to be carried out manually, thereby increasing the workload and cycle time. This condition is exacerbated by the absence of standard working methods, resulting in variations in working methods between operators that have an impact on inconsistency in production output.

These problems indicate that the packing process still has significant potential for improvement through a systematic work method analysis. One approach that can be used is the ECRS method, which consists of Eliminate, Combine, Rearrange, and Simplify. This method enables companies to eliminate unnecessary activities, combine related work elements, rearrange inefficient work sequences, and simplify activities through better work methods and supporting tools (Barnes, 1997). In the context of manual packing, ECRS is relevant because most productivity problems are related to operator movement, material placement, work sequence, and the absence of practical work aids.

Although previous studies have shown that ECRS can improve production efficiency, many of them still focus on general manufacturing processes and have not specifically examined its application in automotive component packing activities. In addition, limited studies integrate ECRS with time study, motion analysis, waste classification, and ergonomic layout improvement in one practical improvement framework. This gap is important because packing activities are often considered simple, even though they can contain substantial non-value-added activities that directly affect cycle time and manhour productivity.

Therefore, the novelty of this study lies in the practical integration of ECRS, time study, motion analysis, fishbone diagram, operation process chart, and ergonomic improvement to reduce non-value-added activities in the manual packing process. This study does not only focus on increasing output, but also emphasizes the redesign of work methods, material placement, and the use of simple work aids to create a more efficient and ergonomic work system.

Method

This study employed a descriptive quantitative approach to analyze and improve manhour productivity in the packing process at an Indonesian automotive company. The research object focused on operator activities during the packing process, from material handling to the completion of ready-to-pack products. Data were collected through direct observation, time study, interviews, and documentation to identify work sequences, cycle time, operator movements, work constraints, and supporting production data. Time measurement was conducted using a stopwatch by first decomposing the packing cycle into measurable work elements, followed by preliminary measurements and 30 main measurement cycles under normal working conditions. The collected data were then tested for uniformity and sufficiency before calculating cycle time, normal time, standard time, output per hour, and manhour

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productivity. Waste identification was carried out using a fishbone diagram and operation process chart (OPC) to classify activities into value-added, necessary non-value-added, and non-value-added activities. Based on these findings, improvement actions were formulated using the ECRS method, namely Eliminate, Combine, Rearrange, and Simplify, to remove unnecessary movements, combine related activities, rearrange work sequences, and simplify the process through layout improvement and the use of jig fixtures. The effectiveness of the improvement was evaluated by comparing conditions before and after implementation in terms of cycle time, output, productivity, and reduction of non-value-added activities.

Results and Discussion

Initial Time Measurement Results (Before Repair)

Initial measurements were made on 30 working cycles of the packing line under normal conditions. The data were first tested using uniformity tests and sufficiency tests, with results showing that all data were valid, stable, and the number of measurements was statistically sufficient. From the measurement results, an average cycle time of 60 seconds per unit was obtained. After adjusting the rating and allowance by 15%, a standard time of 60 seconds per unit is obtained with a standard output of 60 units per hour as a baseline of productivity before repair.

Identification and Classification of Work Activities

The decomposition of one packing cycle in Indonesian Automotive Companies resulted in the identification of eleven elements of work activities that can be classified based on their contribution to product value. The following table 1 presents the results of the classification of activities and the proportion of time to the total cycle.

Table 1. Classification of Work Activities Before Repair

Yes	Activity Elements	Time (sec)	Classification	% Cycle
1	Walk takes material from the rack	4	NVA	6,7%
2	Reversing the orientation of the product on the conveyor	2	NVA	3,3%
3	Picking up products from the conveyor	3	VA	5,0%
4	Fixation of the product with two hands	3	NNVA	5,0%
5	Putting the product in the box	5	VA	8,3%
6	Visual inspection (separate)	3	NNVA	5,0%
7	Visually calculating the number of units	2	NNVA	3,3%
8	Closing and sealing the box	8	VA	13,3%
9	Weighing the box of the packing	5	VA	8,3%
10	Attach labels and stamps	6	VA	10,0%
11	Moving the box to the staging area	19	NNVA	31,7%
	Total	60		100%

Description: VA = Value-Added; NNVA = Necessary Non-Value-Added; NVA = Non-Value-Added

The classification results showed that of the total cycle time of 60 seconds, only 39.9% (±24 seconds) were direct value-added activities, while 48.3% (±29 seconds) were necessary but not value-added activities, and 10% (±6 seconds) were purely wasteful that could be eliminated. The proportion of non-value-added activities that reached more than 58% of the total cycle confirms that there is significant room for improvement and justifies the application of the ECRS method as the main intervention instrument.

Fishbone Diagram Analysis Results

1. ManOperators often bend over due to the position of materials on the floor and the absence of standard SOPs, resulting in variations in work methods between operators.
2. MethodWork sequence is not efficient because several activities that can be done at the same time are still carried out separately, causing idle time.
3. The machine's absence of a jig fixture makes the operator have to use both hands during the packing process, thus limiting parallel work.
4. MaterialThe material position is too far away and the product orientation is not standard, adding unnecessary movement.
5. EnvironmentThe layout of the work area is not yet ergonomic so that operators make a lot of moves that do not add value to the production process.

Results of ECRS Analysis and Implementation

Based on the findings of the identification of waste, the ECRS analysis was carried out hierarchically on all elements of the identified activity. Table 2 below summarizes the proposed corrective actions and their estimated impact on cycle time.

Table 2. ECRS Analysis Results and Impact Estimates

Yes	Categories	Previous Activities	Corrective Action	Saving (det)	Contributions
1	Eliminate	Walk-grab material from rack (±2 m)	Material relocated to the operator's normal range zone (≤50 cm)	4	28,6%
2	Eliminate	Reversing the orientation of the product on the conveyor	Standardization of product orientation at the upstream stage of the conveyor	2	14,3%
3	Combine	Visual inspection is done separately after packing	Visual inspection combined simultaneously with the process of putting the product into the box	3	21,4%
4	Combine	The recording of the number of units is done	Recording is integrated with the sealing process using an automatic counter	1	7,1%

		manually separately			
5	Rearrange	Material box is laid on the floor (operator bends)	The material box is relocated to the operator's elbow-height workbench (±90 cm)	2	14,3%
6	Rearrange	Order: take → check → insert → weigh → seal	Optimized order: take → enter+check → seal → weigh	1	7,1%
7	Simplify.	Manual fixation of the product using two hands	Procurement of jig fixtures for one-handed automatic fixation	1	7,1%
8	Simplify.	Visual counting of units per box	Fixed capacity jig slot of 12 units per box replaces manual counting	0*	—
		Total Savings		14 det	100%

It does not have a direct impact on cycle time but eliminates the risk of miscounting and potential rework

The implementation of the improvements was carried out in three phases that lasted for two weeks. The first phase includes changes in the working method and sequence of activities, which can be implemented without additional investment costs. The second phase includes the rearrangement of the layout of the work area and the relocation of materials to ergonomic zones. The third phase includes the procurement and installation of jig fixtures that are specifically designed according to product dimensions in Indonesian Automotive Companies. Operators are given an adaptation period of three working days before post-implementation refinement, to ensure that the data obtained reflects stable working conditions.

Post-Implementation Time Measurement Results

Post-implementation time measurements were performed using an identical procedure to the initial measurement of 30 iteration cycles with the same instrument and observer to ensure data comparability. The results of the post-implementation data uniformity and sufficiency test showed that all data was within valid control limits, confirming that the new working conditions were running stably.

The average cycle time after ECRS implementation was recorded at 46 seconds per unit, down from 60 seconds in the initial condition. This decrease equates to a time efficiency of 23.3% or a saving of 14 seconds per cycle — a figure that can be fully traced to the specific corrective actions in Table 2. The following table 3 presents a comprehensive comparison of conditions before and after implementation.

Table 3. Comparison of Results Before and After ECRS Implementation

Parameters	Before	After	Changes	% Change
Cycle time	60 seconds	46 seconds	−14 seconds	−23.3%
Output per hour	60 units	78 units	+18 units	+30,0%

Manhour productivity	100%	130%	+30%	+30,0%
Proportion of NVA activity	10,0%	0,0%	−10.0%	−100%
Proportion of NNVA activity	48,3%	31,5%	−16.8%	−34.8%
Proportion of VA activity	41,7%	68,5%	+26,8%	+64,3%

The increase in output from 60 to 78 units per hour is achieved solely through the optimization of working methods, without increasing the number of workers or investing in new production machines. This has significant economic implications: assuming effective working hours of 8 hours per shift and 22 working days per month, the resulting increase in production capacity amounted to an additional 3,168 units per month per operator — an increase achieved through minimal investment in jig fixtures and layout rearrangements.

The findings indicate that the implementation of the ECRS approach significantly improved the efficiency of the packing process. The reduction in cycle time from 60 seconds to 46 seconds shows that most delays in the initial condition were caused by non-value-added activities, particularly unnecessary movement, inefficient work sequence, and the absence of adequate work aids. This result is consistent with the lean manufacturing principle, which emphasizes the elimination of waste to improve process flow and operational productivity (Ohno, 1988; Womack & Jones, 2003). In this study, eliminating unnecessary walking and product reorientation directly reduced motion waste, while combining inspection and packing activities shortened the work sequence without reducing product quality.

The improvement in output from 60 units/hour to 78 units/hour also confirms that productivity can be increased without adding labor or major production equipment. This supports previous studies stating that work simplification through ECRS can improve manufacturing efficiency by eliminating unnecessary activities, combining related tasks, rearranging work sequences, and simplifying operator movements (Barnes, 1997; Rahman et al., 2020). The results are also in line with time and motion study theory, which explains that standardizing work elements and reducing ineffective movements can produce a more stable and efficient work cycle. Therefore, the increase in manhour productivity by 30% demonstrates that ECRS is not only applicable as a technical improvement tool, but also as a practical lean-based approach for optimizing manual packing operations.

From an ergonomic perspective, the relocation of materials to the operator's normal reach zone and the adjustment of the material box to elbow height contributed to reducing excessive bending and repetitive movements. This finding strengthens the argument that productivity improvement should not only focus on time reduction, but also on improving operator comfort and work sustainability. The use of jig fixtures further simplified the fixation process and reduced dependence on manual handling. Thus, the improvement achieved in this study reflects the integration of lean manufacturing, work study, and ergonomic principles in creating a more efficient, standardized, and operator-friendly packing process.

Impact Analysis by ECRS Category

1. Impact Eliminate
   The Eliminate category provides the largest savings, which is 6 seconds (42.9%) of the total saving of 14 seconds. Savings are gained from the elimination of walking

movements, picking up materials and reversing product orientation. In addition to speeding up the process, these improvements also reduce the risk of product misorientation and improve quality consistency.

2. Impact Combine
   The Combine category resulted in a saving of 4 seconds (28.6%). The combination of visual inspection with the process of putting the product into the box and the use of an automatic counter during sealing reduces processing time and minimizes manual recording errors.
3. Impact of Rearrange
   The Rearrange category provides a saving of 3 seconds (21.4%). Relocating the box to an ergonomic position reduces the operator's bending motion and improves working comfort. In addition, changing the order of activities makes the workflow more efficient and reduces unnecessary movement loads.
4. Impact of Simplify
   The Simplify category provides a saving of 1 second (7.1%) through the use of an automatic fixture jig. While the time savings are small, these improvements improve process consistency, reduce cycle time variations, and minimize product count errors.

Ergonomics Impact Analysis

The implementation of ECRS not only increases productivity, but also improves operator ergonomics on the production line. This improvement includes three main aspects. First, the elimination of repetitive bending posture through the relocation of the material box to the height of the operator's elbow thereby reducing the risk of musculoskeletal injury based on the principles of REBA ergonomic evaluation (Sari & Nugroho, 2021). Second, optimize the work zone by placing materials within the normal range of the operator so that work movements are more efficient and do not burden the shoulders or arms according to the principle of economy of motion (Barnes, 1997). Third, reducing cognitive burden through standardization of SOPs and the use of jig fixtures that simplify the work process, thereby reducing mental fatigue and maintaining the consistency of operators' work throughout shifts (Prasetyo & Hidayat, 2019).

Conclusion

Based on the research findings, the application of the ECRS method has proven effective in improving manhour productivity in the packing process at an Indonesian automotive company. The improvement reduced cycle time from 60 seconds to 46 seconds per unit and increased output from 60 units/hour to 78 units/hour. These results indicate that eliminating non-value-added activities, improving work layout, standardizing work methods, and using simple work aids can significantly improve operational efficiency and operator performance. Therefore, companies are encouraged to consistently apply standardized work procedures, conduct periodic evaluations of work methods, and consider further integration of lean manufacturing and ergonomic analysis to sustain productivity improvement.

References

Antony, J. (2020). Lean and Six Sigma methodologies in manufacturing: A review. International Journal of Quality & Reliability Management, 37(1), 79–94. https://doi.org/10.1108/IJQRM-07-2019-0210

Antony, J. (2020). Lean manufacturing and productivity improvement in industry. Journal of Manufacturing Systems, 54, 123–130.

Barnes, R. M. (1997). Motion and time study: Design and measurement of work (7th ed.). John Wiley & Sons.

Bhamu, J., & Singh Sangwan, K. (2019). Lean manufacturing: Literature review and research issues. International Journal of Operations & Production Management, 39(1), 2–25. https://doi.org/10.1108/IJOPM-08-2012-0315

Bimasakti, S. L., Wahyudi, A., Simanjuntak, A. R., Marjuni, & Prastyo, Y. (2025). Lean manufacturing strategy to improve efficiency of goods preparation and delivery with PDCA method. International Journal of Research and Innovation in Social Science. https://doi.org/10.47772/IJRISS.2024.8120393

Budiman, A., Santoso, D., & Wibowo, R. (2021). Application of the work sampling method for measuring labor productivity in the manufacturing industry. Journal of Industrial Systems and Management, 5(1), 12–21. https://doi.org/10.30656/jsmi.v5i1.2891

Cusiatado, A. M., Farfan, N. Y., & Rada, L. (2024). Systematic review on lean manufacturing in productivity improvement. LACCEI Conference Proceedings. https://doi.org/10.18687/LEIRD2024.1.1.325

Dul, J., & Neumann, W. P. (2019). Ergonomics contributions to company strategies. Applied Ergonomics, 80, 10–18. https://doi.org/10.1016/j.apergo.2019.05.008

Gaspersz, V. (2007). Lean six sigma for manufacturing and service industries. Gramedia Pustaka Utama.

Ghelani, H. (2021). Advances in lean manufacturing: Improving quality and efficiency in modern production systems. International Journal of Scientific Research and Management, 9(6), 611–625. https://doi.org/10.18535/ijsrm/v9i06.ec02

Groover, M. P. (2007). Work systems and the methods, measurement, and management of work. Pearson Prentice Hall.

Hasibuan, M. S. P. (2016). Human resource management (revised edition). The Earth of Scripts.

Heizer, J., Render, B., & Munson, C. (2017). Operations management: Sustainability and supply chain management (12th ed.). Pearson.

Imai, M. (1986). Kaizen: The key to Japan's competitive success. McGraw-Hill Education.

Liker, J. K. (2004). The Toyota way: 14 management principles from the world's greatest manufacturer. McGraw-Hill.

Martínez, J., & Gómez, L. (2025). Lean manufacturing and Industry 4.0 integration for operational performance. International Journal of Production Economics, 279, 109475. https://doi.org/10.1016/j.ijpe.2024.109475

Niebel, B. W., & Freivalds, A. (2003). Methods, standards, and work design (11th ed.). McGraw-Hill.

Nurhasanah, N., & Simanjuntak, R. A. (2013). Ergonomic working system design to reduce operator fatigue levels. Al-Azhar Indonesia Journal of Science and Technology Series, 2(1), 43–52.

Ohno, T. (1988). Toyota production system: Beyond large-scale production. Productivity Press.

Panigrahi, S., Al Ghafri, K. K., Al Alyani, W. R., Khan, M. W. A., Al Madhagy, T., & Khan, A. (2023). Lean manufacturing practices for operational and business performance. International Journal of Engineering Business Management, 15. https://doi.org/10.1177/18479790221147864

Prasetyo, E., & Hidayat, T. (2019). Analysis of productivity increase using time study and ECRS methods. Journal of Industrial Engineering, 13(2), 87–95.

Rahman, M., Kurniawan, B., & Putra, D. (2020). Implementation of ECRS method to improve work efficiency in manufacturing. International Journal of Industrial Engineering, 27(2), 115–123.

Rahman, A., Putra, D., & Wijaya, R. (2020). Implementation of ECRS method to improve production efficiency. International Journal of Industrial Engineering, 12(2), 45–53.

Sari, D. P., & Nugroho, A. (2021). The application of lean manufacturing to reduce waste in the production process. Journal of Industrial Engineering, 22(1), 45–52.

Singh, R., & Sharma, P. (2021). Lean manufacturing as a tool for productivity improvement in manufacturing industries. Materials Today: Proceedings, 46, 729–736. https://doi.org/10.1016/j.matpr.2020.12.193

Singh, R., & Sharma, P. (2021). Time study analysis for labor productivity improvement in manufacturing industries. Journal of Operations Management, 18(1), 67–75.

Sumi, T. (2024). Evaluation of work improvement methods in manufacturing productivity enhancement. International Journal of Production Research, 62(4), 210–219.

Sumi, S. S. (2024). Innovative paths to productivity: Advancing lean manufacturing in industrial engineering. World Journal of Advanced Research and Reviews, 22(3), 176–184. https://doi.org/10.30574/wjarr.2024.22.3.1685

Sutalaksana, I. Z., Anggawisastra, R., & Tjakraatmadja, J. H. (2006). Work system design techniques (second edition). Bandung Institute of Technology.

Sutalaksana, I. Z. (2006). Technique of Working. Bandung Institute of Technology.

Tarwaka, Bakri, S. H. A., & Sudiajeng, L. (2004). Ergonomics for safety, occupational health and productivity. UNIBA Press.

Utami, E. Y., Rijal, S., & Iwang, B. (2023). Application of lean manufacturing principles in increasing factory productivity. West Science Journal Economic and Entrepreneurship, 1(10), 264–270. https://doi.org/10.58812/wsjee.v1i10.290

Utami, R., Prasetyo, H., & Nugroho, A. (2023). Work measurement and productivity analysis using standard time approach. Journal of Industrial Engineering and Management, 15(3), 88–97.

Wignjosoebroto, S. (2008). Ergonomics, the study of motion and time: Analytical techniques for improving work productivity (first edition, fourth edition). Use Science.

Womack, J. P., & Jones, D. T. (2003). Lean thinking: Banish waste and create wealth in your corporation (revised and updated ed.). Free Press.

Womack, J. P., Jones, D. T., & Roos, D. (1990). The machine that changed the world: The story of lean production. Free Press.

Judith, W. (2018). Productivity analysis using the objective matrix (OMAX) method on the production line. Journal of Engineering and Computer Science, 7(27), 233–242.

Zhang, Y., Liu, X., & Wang, H. (2025). Effects of lean tools and Industry 4.0 technology on productivity. Journal of Industrial Information Integration, 44, 100787. https://doi.org/10.1016/j.jii.2025.100787