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Advances in Global Innovation & Technology

Challenge for the reduction of NVA in automakers

Desafio para a redução do NVA nas montadoras

Desafío para la reducción de NVA en los fabricantes de automóviles

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Abstract:

The elimination of Non-Value-Added (NVA) activities is one of the main challenges facing the contemporary automotive industry, especially in highly competitive environments that demand productive efficiency. According to Ohno (1988) and Shah and Ward (2007), NVA activities are actions that consume resources without contributing to the value perceived by the customer, such as unnecessary movements, waiting times, rework, and excessive inspections. The literature highlights methodologies such as Value Stream Mapping (VSM), Statistical Process Control (SPC), SMED, and Time and Motion Studies as effective tools for identifying and reducing these losses. Case studies show that the integrated application of these practices can reduce waste by up to 50%, improving productivity and final quality. Industry 4.0, through digitalization, the Internet of Things (IoT), and Artificial Intelligence, expands the possibilities for real-time monitoring and decision-making, enhancing the outcomes of lean manufacturing. An empirical analysis conducted in a logistics sector demonstrated a 50% reduction in operator movement and a 21.7% decrease in cycle time, confirming the impact of Lean practices and ergonomics on process optimization. Therefore, effective management of NVA is essential for the competitiveness and sustainability of automotive operations.

Keywords: *Non-Value-Added; Automotive Industry; General Assembly; Lean Manufacturing.*

Resumo:

A eliminação de atividades que não agregam valor (Non-Value-Added – NVA) constitui um dos principais desafios da indústria automotiva contemporânea, especialmente em contextos de alta competitividade e exigência por eficiência produtiva. Segundo Ohno (1988) e Shah e Ward (2007), as atividades NVA correspondem a ações que consomem recursos sem contribuir para o valor percebido pelo cliente, como movimentações desnecessárias, esperas, retrabalhos e inspeções excessivas. A literatura destaca metodologias como o Mapeamento do Fluxo de Valor (VSM), o Controle Estatístico de Processos (CEP), o SMED e a Medição de Tempos e Movimentos como ferramentas eficazes para identificação e redução dessas perdas. Estudos de caso evidenciam que a aplicação integrada dessas práticas

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pode reduzir desperdícios em até 50%, melhorando a produtividade e a qualidade final. A Indústria 4.0, por meio da digitalização, Internet das Coisas (IoT) e Inteligência Artificial, amplia as possibilidades de monitoramento e tomada de decisão em tempo real, potencializando os resultados da manufatura enxuta. A análise empírica realizada em um setor logístico demonstrou reduções de 50% na movimentação de operadores e 21,7% no tempo de ciclo, comprovando o impacto das práticas Lean e da ergonomia na otimização dos processos. Assim, a gestão eficaz do NVA é essencial para a competitividade e sustentabilidade das operações automotivas.

Palavras-chave: Non-Value-Added; Indústria Automotiva; Montagem Geral; Manufatura Enxuta.

Resumen:

La eliminación de actividades que no agregan valor (Non-Value-Added – NVA) constituye uno de los principales desafíos de la industria automotriz contemporánea, especialmente en contextos de alta competitividad y exigencia de eficiencia productiva. Según Ohno (1988) y Shah y Ward (2007), las actividades NVA corresponden a acciones que consumen recursos sin contribuir al valor percibido por el cliente, como movimientos innecesarios, esperas, retrabajos e inspecciones excesivas. La literatura destaca metodologías como el Mapeo del Flujo de Valor (VSM), el Control Estadístico de Procesos (CEP), el SMED y la Medición de Tiempos y Movimientos como herramientas eficaces para la identificación y reducción de estas pérdidas. Estudios de caso evidencian que la aplicación integrada de estas prácticas puede reducir desperdicios hasta en un 50%, mejorando la productividad y la calidad final. La Industria 4.0, mediante la digitalización, el Internet de las Cosas (IoT) y la Inteligencia Artificial, amplía las posibilidades de monitoreo y toma de decisiones en tiempo real, potenciando los resultados de la manufactura esbelta. El análisis empírico realizado en un sector logístico demostró reducciones del 50% en el movimiento de los operarios y del 21,7% en el tiempo de ciclo, comprobando el impacto de las prácticas Lean y de la ergonomía en la optimización de los procesos. Así, la gestión eficaz del NVA es esencial para la competitividad y sostenibilidad de las operaciones automotrices.

Palabras clave: *Non-Value-Added; Industria Automotriz; Ensamblaje General; Manufactura Esbelta.*

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1. Introduction

The pursuit of operational efficiency and the elimination of waste have become pillars of contemporary industrial competitiveness. In a global landscape marked by intense competition, shrinking profit margins, and rising demands for quality, innovation, and sustainability, optimizing production processes has become a strategic necessity for organizations. In this context, the automotive industry stands out for its high complexity, the continuous adoption of advanced technologies, and the constant pressure to reduce costs and increase productivity.

The concept of non-value-added (NVA) activities is central to continuous improvement practices and the philosophy of Lean Manufacturing. According to Ohno (1988) and Shah and Ward (2007), NVA activities are actions that consume resources without effectively contributing to customer-perceived value. Identifying and eliminating these activities are essential steps towards increasing production efficiency, reducing costs, and improving product quality.

Value Stream Mapping. Stream Mapping (VSM), Time and Motion Measurement, Statistical Process Control (SPC), and Quick Tool Change System (SMED). These tools enable systematic analysis of operations, allowing the identification of bottlenecks and waste throughout the production chain. In parallel, technological advancements driven by Industry 4.0, such as the Internet of Things (IoT), Big Data, and Artificial Intelligence, have expanded the possibilities for real-time monitoring and data-driven decision-making, promoting more precise and proactive management of NVA (Kagermann et al., 2013).

Beyond operational aspects, the growing demand for sustainability and socio-environmental responsibility also drives companies to adopt more efficient practices. As maintained to Geissdoerfer et al. (2018), integrating sustainable strategies can simultaneously reduce waste and increase operational efficiency, as many of these initiatives aim to eliminate activities that do not add value and to reduce the environmental impact of industrial operations.

Given this context, reducing NVA (Net Value Added) in the automotive industry is not only a technical challenge but also a strategic one, involving issues of productivity, innovation, and sustainability. The choice of the theme "Challenges for the reduction and elimination of NVA in the general assembly of the automotive industry" is justified by the need to comprehensively understand the barriers to eliminating waste at assembly stages, which directly impact the competitiveness and sustainability of automakers.

Thus, this study aims to analyze the concept of NVA (Non-Value Added) and its implications for the automotive industry's production processes, with an emphasis on the assembly stage. It seeks to identify the fundamental challenges faced by automakers, the applicable methodologies for mitigating non-value-adding activities, and the opportunities provided by digitalization and sustainable practices. In this way, it aims to advance production practices and strengthen the sector's competitiveness in modern manufacturing.

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2. THEORETICAL FRAMEWORK

2.1 *Non-Value-Added (NVA)*

In accordance with Ohno (1988), the concept of NVA (Net Value Added) refers to any activity that consumes resources, such as time and rework, does not add value to the product, and does not directly impact the end customer's perception of value (Shah; Ward, 2007). NVAs are waste streams that should be eliminated to improve the efficiency and quality of production processes. Montgomery (2012) highlights activities that generate NVA, such as unnecessary operator and material movements; waiting and queues in production processes; excessive inspections and rework; high intermediate inventories; and inefficient internal transport.

Value Stream Mapping (VSM) is one of the most widely used methods for visualizing the flow of materials and information on an assembly line. This tool allows for the identification of non-value-added (NVA) activities throughout the process, quantifying lost time and proposing solutions to eliminate or reduce them (Abdulmalek and Rajgopal, 2007).

2.1.1 NVA Calculation

Quantifying NVA is fundamental to understanding the impact of these activities on productive performance. The most used metric is the percentage of NVA time in relation to total production time, according to the equation:

VA = VP – CI$VA = VP - CI$

Where:

- VA stands for Added Value;
- VP stands for Value of Production;
- CI CI are the Intermediate Costs (inputs).

For the specific calculation of NVA, the value added in a given period is considered, with the formula adjusted to reflect changes or increases in value added over time.

Cycle time is calculated by summing the VA and NVA times. The application of time-and-motion studies is essential for collecting accurate data on the activities performed on the assembly line (Maynard, 1948; Niebel; Freivalds, 2013).

Statistical analysis is also widely used to identify patterns of waste. Statistical Process Control (SPC) helps identify variability and bottlenecks, enabling data-driven decision-making (Montgomery, 2012; Antony, 2006).

2.2 The relevance of reducing NVA (Non- Value Added) Added) in the automotive industry

The concept of NVA (Non-Value Added) is deeply rooted in the Lean Manufacturing philosophy of minimizing waste and maximizing customer value (LIKER, 2004). The automotive industry, one of the most advanced in production

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processes, continually faces challenges in keeping its assembly lines agile and efficient. The most critical point in identifying and eliminating NVA in the automotive industry is assembly, which generally encompasses integrating the various vehicle modules (chassis, engine, electrical systems, etc.). As noted by Womack and Jones (1996), vehicle assembly is a highly wasteful area, making it a point of great interest for studies on the elimination of NVA. Despite significant advances in automation and digitalization, many companies still struggle to eliminate non-value-adding activities owing to process complexity, cultural resistance, and technological limitations (Bortolotti et al., 2015). Therefore, studying the barriers to reducing NVA in vehicle assembly is essential, as it can yield valuable insights into how the industry can improve its processes and make its operations more sustainable and efficient.

2.2.1 The economic impact of eliminating NVA

The impact of reducing NVA is not only operational, but also economic. As stated by a study by Kato and Tanaka (2013), eliminating waste is a key factor in reducing costs in vehicle production.

Since car assembly is one of the most expensive steps in the manufacturing process, any improvement in this area can result in substantial savings for companies. The high cost of production, coupled with pressure to reduce delivery times and increase quality, makes the elimination of NVA (New Vehicle Assets) a strategic issue for the automotive industry.

Shah and Ward's (2007) analysis of Lean system adoption highlights that eliminating NVA (New Value Added) can reduce production cycle time, improve resource utilization, and ultimately increase companies' competitiveness in the global market. Furthermore, reducing unnecessary activities allows companies to focus their efforts on improving the value added to the product, which directly affects consumer perception and product quality.

2.2.2 Process complexity and product variability

The principal difficulty in eliminating NVA in the general assembly stems from the high complexity of assembly processes and product variability. The automotive industry operates with a wide range of vehicle models and variants, making the assembly process flexible yet prone to inefficiencies.

As Liker (2004) claims, the diversity of models and configurations requires frequent adjustments to assembly lines, which can increase setup time and generate NVA activities, such as tool adjustments and part replacements. In addition, variability in component specifications can lead to errors, rework, and wasted time, all of which compromise process efficiency.

2.2.3 Resistance to change and organizational culture

Resistance to change within organizations is a major factor in the automotive industry. Due to the complexity of the processes involved, automakers face difficulties implementing new practices to reduce NVA (Net Value Added). Studies, such as that of Shah & Ward (2007), demonstrate that although the Lean

DOI: https://doi.org/10.5281/zenodo.20171736

approach is recognized for its benefits, its full adoption faces cultural and structural barriers within companies.

Fear of process changes, lack of worker qualifications, and insistence on maintaining traditional production methods are factors that compromise the agility needed to eliminate waste and to apply NVA (New Value Added) efficiently.

2.2.4 Lack of integration and communication between the stages of the process

Automobile assembly involves interdependent steps, including subcomponent assembly, systems integration, and product finalization. A lack of integration and efficient liaison between the different areas of the production process can lead to significant losses.

In accordance with Taylor's research (1999), failures in coordination and exchanging information among production teams result in delays, rework, and longer production cycles.

2.2.5 Challenges in automation and digitalization

Automation and digitalization have been identified as essential solutions for reducing NVA in the automotive industry (Bortolotti et al., 2015). Implementing these technologies presents significant challenges, including their complexity, the high cost of investments in technology, infrastructure, and personnel training, and the need for an adaptation period during the transition from manual to automated processes.

Studies by Kato & Tanaka (2013) demonstrate that adopting advanced technologies, such as robots and real-time monitoring systems, can significantly reduce NVA activities. The challenge is to integrate new technologies with the processes already in place.

2.2.6 Supply chain management and supplier quality

Supply chain management in the automotive industry is crucial for mitigating non-value-adding (NVA) activities during the assembly process. The heavy reliance on an extensive supplier network, coupled with the complexity of coordinating received components, can lead to delays, compromised quality, and operational inefficiencies (Christopher, 2005). As Choi et al. (2015) point out, failures in supply chain management and instability in supplier performance contribute to increased lead times for parts, production line interruptions, and rework—factors that intensify NVA activities and negatively impact production efficiency.

2.2.7 Workforce training and development

Continuous worker training is essential to reducing non-value-added (NVA) activities in automotive assembly. As Eger et al. (2017) state, the absence of adequate qualifications can lead to operational failures, recurring errors, and inefficiencies in production processes. The adoption of effective training systems—such as technical training programs and learning management platforms—significantly mitigates these deficiencies, promotes greater operational precision, and consequently reduces the incidence of NVA activities.

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2.3 Tools to reduce Non- Value - Added actions in the process

Reducing non-value-adding (NVA) activities across the automotive industry's overall assembly requires a structured, methodological approach grounded in scientific principles and best manufacturing practices. This study is based on methodologies widely recognized in the academic literature, including Lean Manufacturing, Value Stream Mapping (VSM), time-and-motion studies, and Statistical Process Control (SPC).

2.3.1 Lean Manufacturing

Lean Manufacturing is one of the most widely used methods for eliminating waste and continuously improving materials in the automotive industry (Womack; Jones, 1996). This system, derived from the Toyota Production System (TPS), focuses on identifying and eliminating activities that do not add value to the final product. Tools such as Just-in-Time (JIT) and Kanban are widely applied to reduce unnecessary inventory and optimize material flow (SHAH; WARD, 2007). Studies show that implementing lean practices can reduce waste by up to 30% and increase assembly line efficiency (HOLWEG, 2007).

2.3.2. Value Stream Mapping - VSM

Value Stream Mapping is an essential technique for visualizing and analyzing the flow of materials and information in the production process (ROTHER; SHOOK, 1999). This approach allows the identification of activities that do not add value and the design of a more efficient future state. In a study by Abdulmalek and Rajgopal (2007), the application of VSM in an automotive assembly line reduced cycle time by 40%, demonstrating its effectiveness in eliminating waste.

2.3.3. Time and Motion Measurement

Time-and-motion analysis is widely used to optimize assembly processes. Techniques such as Methods -Time Measurement (MTM) allow for the identification of unnecessary movements and the proposal of ergonomic improvements (MAYNARD, 1948). As claimed by Niebel and Freivalds (2013), the proper application of MTM can reduce total assembly time by up to 25%, hence eliminating excessive effort and improving operator productivity.

2.3.4. Single Minute Exchange of Die - SMED

The SMED methodology is used to reduce setup times in automotive assembly. Developed by Shingo (1985), SMED allows converting internal operations into external ones, significantly reducing machine setup time. Research by Moreira et al. (2018) demonstrates that applying SMED to a production line reduced tool changeover time by 50%, thereby increasing manufacturing flexibility and efficiency.

2.3.5. Statistical Process Control (SPC)

Statistical Process Control (SPC) is an approach to continuous monitoring of production processes using statistical techniques. As maintained to Montgomery (2012), SPC enables early identification of variations, enabling corrective actions before problems affect final product quality. The application of SPC in the

DOI: https://doi.org/10.5281/zenodo.20171736

automotive industry has demonstrated effectiveness in reducing defects and improving operational efficiency (Antony, 2006).

2.3.6. Kaizen and Continuous Improvement

Kaizen, a Japanese term meaning "continuous improvement," is an essential strategic approach for reducing non-value-adding activities (NVA) in automotive assembly. According to Imai (1986), its application involves all hierarchical levels of the institution, promoting the systematic elimination of waste via small incremental improvements. Empirical evidence indicates that conducting Kaizen events can yield significant improvements in operational efficiency, with waste reductions of 20% to 40%.

2.4 Ergonomics and Planned Supply

Ergonomics and proper parts supply planning play a key role in reducing NVA (New Vehicle Arrivals). The application of ergonomic methodologies based on NIOSH (National Institute for Occupational Safety and Health) standards is crucial. Institute for Occupational Safety (and Health) can minimize fatigue and improve operator productivity (KARWOWSKI; MARRAS, 2003). Moreover, planned supply, with the adoption of techniques such as Milk Run, reduces waiting times and optimizes the production flow (Simchi-Levi; Kaminsky; Simchi-Levi, 2008).

2.5 Industry 4.0 and Digitalization

Industry 4.0 has introduced new tools for optimizing automotive assembly. The digitalization of processes using the Internet of Things (IoT) and Artificial Intelligence (AI) permits real-time monitoring of production activities (Schuh et al., 2017). Studies indicate that implementing these technologies can increase production efficiency by up to 25% (Kagermann; Wahlster; Helbig, 2013).

2.6 Integrated Application of Methodologies

The combination of the aforementioned approaches yields a robust strategy for reducing NVA across the automotive industry's overall assembly. Case studies in global manufacturers demonstrate that the integrated application of these methodologies can increase efficiency by up to 50%, reducing waste and improving the quality of finished products (Pereira;Oliveira;Silva, 2020).

2.7 Applicability and Case Studies

Studies indicate that the precise identification of NVA activities can reduce waste by up to 40% and significantly increase productivity (HOLWEG, 2007). Companies that have applied VSM to their automotive assembly lines have achieved significant improvements, reducing cycle time and operating costs (Abdulmalek; Rajgopal, 2007).

The integration of advanced Industry 4.0 techniques, such as real-time monitoring via IoT and big data analysis, has enabled automotive manufacturers to further improve the identification and elimination of NVA (Schuh et al., 2017; Kagermann; Wahlster; Helbig, 2013).

2.7.1 Example 1: Instrument Panel Mounting Station

DOI: https://doi.org/10.5281/zenodo.20171736

The installation of the instrument panel represents a critical step in the overall vehicle assembly process. In accordance with Shah and Ward (2007), this phase is particularly susceptible to non-value-adding activities (NVAs), such as excessive operator movement, frequent tool searches, and unnecessary manual adjustments. Such practices compromise the efficiency of the production process, extending cycle time and increasing the risk of operational failures.

NVA Analysis:

- **Excessive operator movement:** As claimed by Niebel and Freivalds (2013), inadequate ergonomics and inefficient layouts require the operator to move repeatedly to retrieve tools and components, increasing cycle time.
- **Searching for tools and parts:** The inefficient supply system forces operators to spend time searching for parts and tools, thereby impacting productivity.
- **Unnecessary manual adjustments:** Inaccurate initial fastening can require rework, increase assembly time and reduce process efficiency (HOLWEG, 2007).

Possible Improvements:

- **Application of the Just-in-Time (JIT) system:** The application of the JIT system directly contributes to the reduction of non-value-adding activities (NVA) by ensuring that tools and components are available precisely at the time and place of their use. As stated by Womack and Jones (1996), this approach eliminates unnecessary waiting and movement, promoting greater synchronization between production stages and increasing operational efficiency.

- **Improved ergonomics and standardization of work:** The use of ergonomic devices and the application of the Methods-Time Measurement (MTM) methodology contribute to reducing fatigue and eliminating unnecessary movements (MAYNARD, 1948).

- **Partial automation of the process:** The use of screwdrivers equipped with intelligent sensors is an effective technological solution to reduce non-value-adding activities (NVAs) in automotive assembly. As claimed by Kagermann, Wahlster, and Helbig (2013), these devices enable greater precision in component fastening, reducing the need for manual adjustments and, consequently, minimizing rework and associated waste.

2.7.2 Example 2: Bank Installation Station

Installing seats in vehicles requires precision and efficiency to ensure a proper and secure fit. However, this step often involves waste related to component transportation, waiting time, and unnecessary adjustments (Pereira; Oliveira; Silva, 2020).

NVA Analysis:

DOI: https://doi.org/10.5281/zenodo.20171736

- **Waiting time due to inadequate supply:** a lack of synchronization between the production line and bench supply can cause delays, affecting the production flow.
- **Excessive operator movement:** Studies indicate that inefficient workstation layouts can lead operators to frequently move around in search of benches, tools, and other resources necessary to perform tasks. This inadequate configuration results in wasted time and effort, consequently increasing non-value-adding activities (NVAs) in the production process (Lillrank; Liukko, 2004).
- **Adjustments and rework:** unevenness in the mounting rails may require additional adjustments, increasing installation time and compromising final quality (Montgomery, 2012).

Possible Improvements:

- **Milk system implementation Run:** Adopting this system for continuous, synchronized supply can reduce waiting times (Simchi-Levi; Kaminsky; Simchi-Levi, 2008).
- **Use of ergonomic devices and positioning guides:** installation aid tools, such as mechanical arms and positioning jigs, reduce repetitive physical effort and improve fastening accuracy (Karwowski; Marras, 2003).
- **Application of Statistical Process Control (SPC):** statistical analysis of measurements enables the detection of variations in bench fit, preventing rework and ensuring the accuracy and efficiency of the installation (Antony, 2006).

3. Method

The study focused on analyzing the material receiving process in the company's warehouse sector, with an emphasis on measuring execution times and employee movement during these activities. This approach enabled the identification of operational patterns, potential sources of waste, and opportunities for improvement related to non-value-adding activities (NVAs).

The case study was developed using a non-probabilistic convenience sampling methodology and is characterized as both qualitative and quantitative. Qualitative research involves interpretive stages and procedures that allow the researcher to examine phenomena in their natural contexts, with the aim of understanding them in depth or decoding them (Denzin, Lincoln, Giardina & Cannella, 2024).

The quantitative approach to research is based on well-defined theoretical concepts, from which hypotheses are developed to investigate phenomena. In this study, a mixed-methods approach was adopted, which, as stated by Creswell and Creswell (2021), allows the researcher to combine qualitative and quantitative strategies, provided that the integrity and essence of the data are preserved throughout the analysis.

DOI: https://doi.org/10.5281/zenodo.20171736

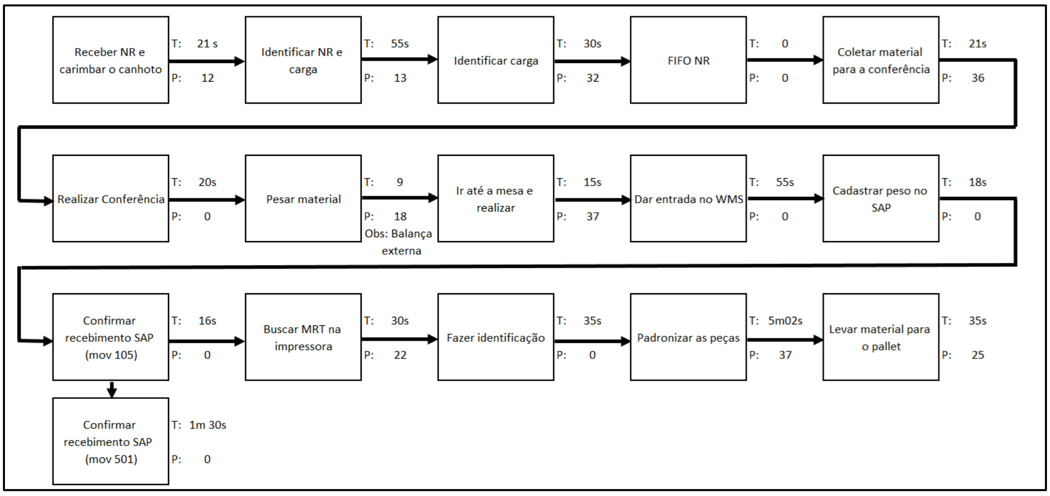
To prepare this article, a systematic literature review was conducted, encompassing publications in both Portuguese and English. The collection of materials was conducted through academic platforms such as Google Scholar and the Scientific Journal. The Electronic Library Online (SciELO), Scopus, and Web of Science databases were consulted, as well as master's theses. Furthermore, books and specialized electronic journals were consulted to ensure the study's consistency and theoretical depth.

4. Results and Discussion

For this work, field research was conducted in the logistics area of a large company, focusing on material receiving processes in the warehouse. The investigation involved measuring execution times and counting the number of steps employees take, along with the current operational flow, to identify bottlenecks and propose continuous improvements via the application of management tools. This approach aimed to minimize the impact of non-value-adding activities (NVAs), promoting greater efficiency and rationalizing the resources involved.

4.1 *Value Stream Mapping - VSM*

Table 1- Material receiving flow



Source: the authors (2025)

The application of Value Stream Mapping (Value Stream Mapping - VSM) allowed for the detailed identification of the steps involved in the physical receipt of materials and their respective registration in the Warehouse Management System - WMS). The cycle analysis revealed a total execution time of 12 minutes and 33 seconds, with the operator performing 232 steps to complete the entire process.

4.2 Time and Motion Measurement

For each stage of the process, the time and steps for its execution were identified. Figure 1 shows the mapping, where T represents the process time (measured in

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seconds), and P represents the number of steps the operator takes to perform the activity.

Fig. 1 – Activity detail

Source: the authors (2025)

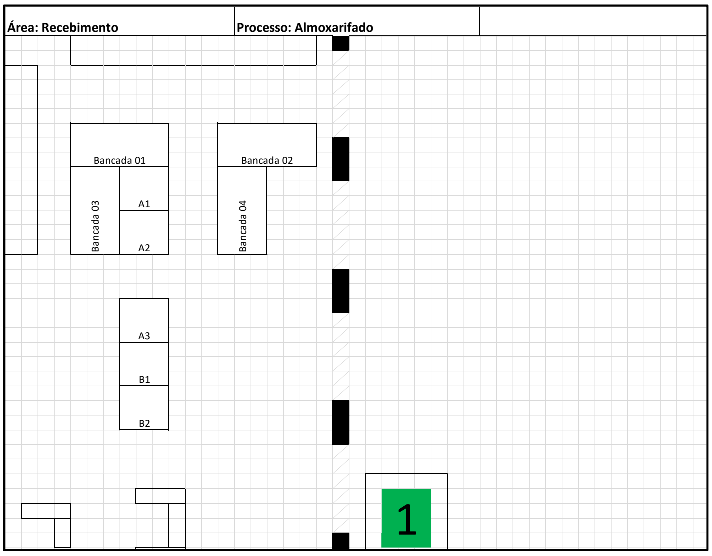
Based on the detailed activities, Figure 2 shows the route taken by the operator, with the receiving bench identified in the plant as number 1, the starting point of the process.

For each step, the operator's processes and stops were marked on the warehouse receiving plan to identify the flow based on the operator's movements, as detailed in Figure 2.

The operator's workflow within the receiving area was mapped, covering all process stages as identified in the VSM (Value Stream Mapping).

In the detailed activity, Figure 2 shows the route taken by the operator, starting from the receiving bench, identified on the plan as number 1. Each step of the process, as well as the operator's stops, was recorded on the warehouse receiving area plan, allowing visualization of the flow through physical movement.

Fig. 2 – Receiving area plan

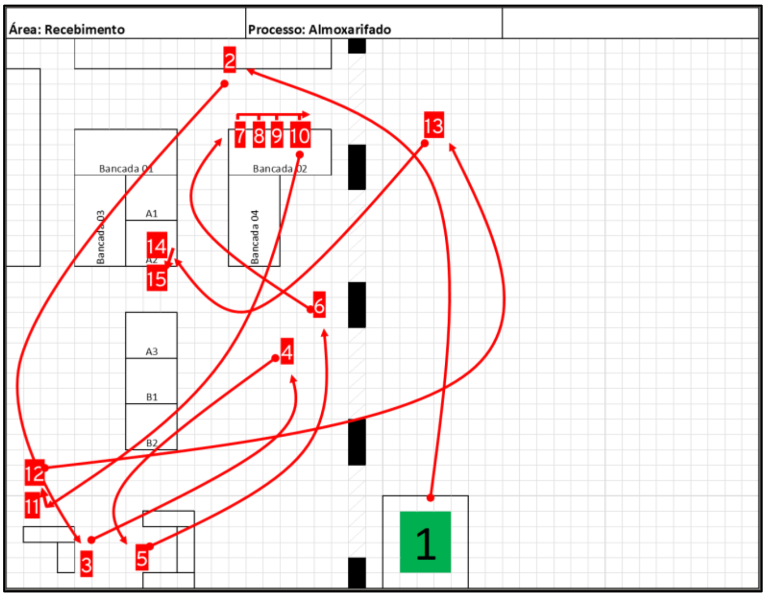


Source: the authors (2025)

The operator flow mapping, based on the steps identified by Value Stream Mapping (VSM), enabled the identification of problems in the flow, as detailed in Figure 3, and supported the suggestion of process improvements by eliminating non-value-adding activities (NVAs).

DOI: https://doi.org/10.5281/zenodo.20171736

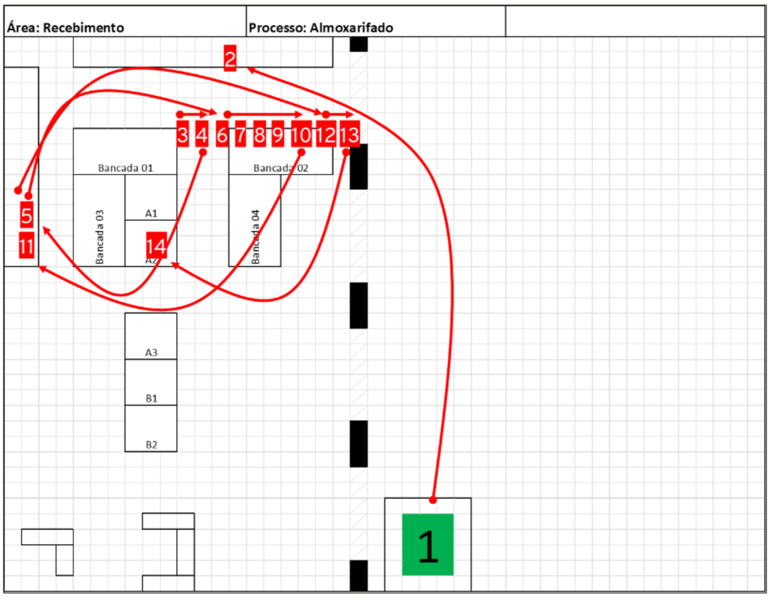
Figure 3 – Operator displacement mapping



Source: the authors (2025)

In Figure 4, the study suggests improvements to the tool layout, leading to a new workflow arrangement.

Figure 4 – New proposed flow



Source: the authors (2025)

The flow measurement was reapplied to the suggested processes, with time and step measurements shown in Table 2.

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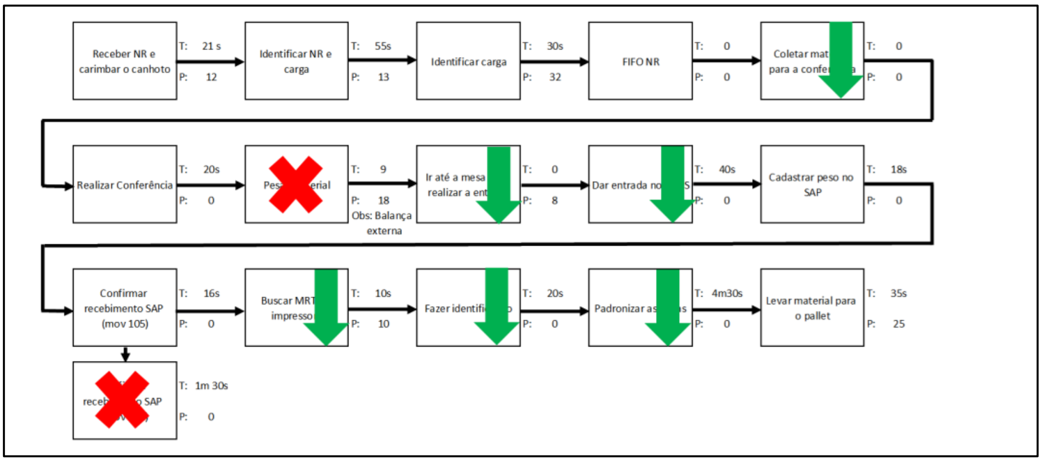
Table 2 – Optimized material receiving flow



Source: The authors (2025)

For the new process suggested, the following results were obtained:

Table 1 – Steps and Cycle Times

Pre- study		**Post-study**	
Steps	Cycle time	Steps	Cycle time
232	12min32s	118	9min55s

Source: Authors 2025

Table 2 – Results obtained

Steps	**Cycle time**	
118 50%	2min42s	21.70%

Source: Authors 2025

The results obtained after implementing the improvements show a 50% reduction in operator movement and a 21.7% decrease in cycle time for each material receiving process. These advances underscore the importance of studying non-value-added (NVA) activities, positioning them as a strategic opportunity to drive continuous improvement and reduce operational costs. In the analyzed context, the data indicate that reducing the number of team members can achieve the same activity volume, especially given the optimization potential of parallel task execution.

5. Conclusion

Given the challenges facing the automotive industry, eliminating non-value-added (NVA) activities is a strategic imperative to ensure operational competitiveness and sustainability. Adopting methodologies such as Lean Manufacturing, Value Stream Mapping (VSM), SMED, Statistical Process Control, and digitalization initiatives provides an integrated and effective approach to identifying, measuring, and mitigating waste throughout the production chain. Additionally, the application of advanced ergonomics and proper supply planning

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helps create safer, more efficient work environments, reduces adverse ergonomic impacts, and increases operator productivity.

The studies analyzed demonstrate that the synergy between these approaches can yield substantial improvements in operational efficiency, resulting in significant reductions in cycle times, defect rates, and waste levels. In this context, digitalization and the principles of Industry 4.0 play a fundamental role in enabling real-time, data-driven decisions and enhancing productivity.

The integration of these strategies is thus an urgent necessity for automakers seeking operational excellence and competitiveness in the global arena. In-depth research and the continuous adaptation of best practices to the specificities of each industrial plant will be crucial for consolidating the automotive manufacturing of the future.

In the presented case study, the reduction in operator movement and cycle time demonstrated the effectiveness of NVA activity analysis and its potential to significantly reduce waste, including the possibility of reducing the number of shift workers by 1. Other tools can be applied depending on the nature of the activity analyzed; however, in a production context, assessments of movement and the number of actions prior to operation execution have proven particularly effective in identifying opportunities for improvement.

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