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Revolutionizing Operational Excellence: Advancing the automotive industry through Lean Principles

Siti Norida Wahab^{1*}, Norashida Othman², Md Uzir Hossain Uzir³, Ramakrishna Yanamandra³

** Corresponding Author*

¹ Department of Technology and Supply Chain Management Studies, Faculty of Business and Management, University Teknologi MARA, Selangor, Malaysia,

² Department of Economics and Financial Studies, Faculty of Business and Management, University Teknologi MARA, Selangor, Malaysia,

³ Marketing Department, Lincoln University College, Petaling Jaya, Selangor, Malaysia,

⁴ School of Business, Skyline University College, University City of Sharjah, P.O. Box 1797 - Sharjah, UAE

sitinorida23@uitm.edu.my; shidaothman@uitm.edu.my; uzir@lincoln.edu.my; ramakrishna@skylineuniversity.ac.ae
Tel: +60123976911

Abstract

This paper aims to discover the effect of lean principles and practices (LPP) on the operational excellence of the Malaysian automotive industry. A quantitative research approach was adopted focusing on 112 designated managerial-level respondents who were experts in the automotive industry. This study provides future researchers with easy access to information on the need for LPP implementation in the automobile industry toward revolutionizing operational excellence. The authors foresee this study to have a significant effect on practitioners, particularly automobile manufacturers and other key stakeholders, about the possible benefits of LPP implementation across the automotive industry, notably in emerging market economies.

Keywords: Lean Principles; Lean Manufacturing; Operational Excellence; Automotive Industry

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1.0 Introduction

Lean principles and practices (LPP) is a management philosophy that originated in manufacturing, particularly in the Toyota Production System (TPS). The main goal of LPP is to maximize customer value while minimizing waste. It emphasizes the efficient use of resources and the continuous process improvement. At its core, LPP is centred around the determination and elimination of waste. Waste, in the LPP context, refers to any process or activity that does not add value to the customer (Kaspin et al., 2021). LPP identifies eight types of waste: defects, waiting, overproduction, transportation, non-utilized talent, motion and inventory. One key principle of LPP is the concept of "Just-in-Time" (JIT), which strives to manufacture items at the precise time they are required in the manufacturing process. This reduces inventory costs and minimizes the risk of overproduction. Another crucial element is "Kaizen," which means continuous improvement. Kaizen encourages small, incremental changes to processes and operations to enhance efficiency and effectiveness continually. LPP also emphasizes respect for people. It recognizes the importance of empowering employees, involving them in decision-

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making processes, and fostering a culture of collaboration and continuous learning. This approach not only improves morale but also taps into the collective knowledge and creativity of the workforce (Bhat & Bhandarkar, 2020; Pinto et al., 2018).

The LPP philosophy has transcended its origins in manufacturing and has been successfully applied in numerous industries, including services, healthcare and software development. LPP thinking can be a powerful tool for organizations seeking to enhance productivity, reduce costs, and deliver higher value to their customers in a rapidly changing and competitive business environment. Implementing LPP requires a cultural shift, strong leadership commitment, and a systematic approach to identifying and addressing inefficiencies throughout the entire value stream (Tasdemir & Gazo, 2018). Since the LPP is a systematic approach to optimizing operations by eliminating waste, improving efficiency, and enhancing overall productivity, it plays a pivotal role in achieving operational excellence. Hence, the LPP implementation enhances operational excellence by eliminating waste, focusing on customer value, promoting continuous improvement, and empowering employees. By implementing LPP, organizations can create more efficient and responsive operations, ultimately delivering higher-quality products and services to customers while maintaining a competitive edge in the market, particularly Malaysia's automotive industry.

Malaysia's automotive industry has made great strides. The establishment of national cars, Proton and Perodua, was vital in the country's transformation from a mere motor car assembler to a car manufacturer. The Proton facility at Tanjung Malim is now fully automated, with robotic technology, and is designed for high-volume production and efficiency through the use of LPP. Furthermore, Malaysia remains an appealing site for global car manufacturers. Toyota, Honda, Mercedes-Benz, Nissan, BMW and Geely Auto Group are among the multinational automakers that have established operations in the country to capitalise on growing customer demand. The industry remains an important part of the country's manufacturing sector, accounting for 4% of Malaysia's GDP and ranking third in ASEAN. Malaysia now has 28 manufacturing and assembly plants for passenger vehicles, motorbikes and scooters, commercial vehicles as well as automotive parts and components (MIDA, 2023).

This paper is separated into multiple parts. It starts with a review of previous literature and then followed by research methods. The findings of this study are discussed in the fourth part. Finally, the paper's limitations and future research direction are discussed before closing with a broad implication for both scholars and practitioners.

2.0 Literature Review

The automotive industry is a fast-paced and globally prominent industry encompassing the design, manufacturing, marketing, and sale of motor vehicles. It plays a pivotal role in driving economic growth, technological innovation, and employment opportunities worldwide. Key components of the industry include passenger vehicles, trucks, buses, and motorcycles. Major automakers, both traditional and electric vehicle manufacturers, continually strive to meet evolving consumer demands, stringent regulatory standards, and environmental concerns (Llopis-Albert et al., 2021). Previous studies highlighted those technological advancements, such as electric and autonomous vehicles, have reshaped the landscape, prompting industry players to invest heavily in research and development (R&D). Global competition is fierce, with companies competing for market share by introducing innovative features, improving fuel efficiency, and advancing safety technologies. Emerging markets, particularly in Asia, contribute significantly to industry growth, while established markets in North America and Europe continue to be major players (Cai et al., 2019; Hertenstein & Williamson, 2018).

Similarly, the Malaysian automotive industry is a dynamic element of the country's economy, contributing significantly to industrialization, employment, and export revenue. Dominated by well-established players, including Proton and Perodua, the industry has experienced notable growth and transformation over the years. Proton, the national carmaker, has been a key player since its establishment in the 1980s, while Perodua, focused on compact cars, has become a major contributor to the market (Anazawa, 2021). The industry has also attracted international manufacturers, fostering collaborations and joint ventures. Government policies and incentives have played a pivotal role in shaping the industry's landscape. The National Automotive Policy (NAP) aims to enhance competitiveness, promote innovation, and create a sustainable ecosystem. Malaysia's strategic location in Southeast Asia positions it as a regional automotive hub with a supportive infrastructure and a skilled workforce (MIDA, 2023).

The Malaysian automotive sector faces the global challenge of transitioning towards sustainable mobility. Efforts are underway to encourage the adoption of electric and hybrid vehicles, renewable energy sources, and eco-friendly manufacturing practices. As the industry adapts to technological advancements and shifts in consumer preferences, it continues to be a key driver of economic growth and industrial development in Malaysia (Anazawa, 2021). Collaborations with technology companies and the integration of artificial intelligence (AI) are further shaping the future of mobility within this ever-evolving sector. Hence, to encounter the global trend, the majority of the automotive industry has embraced LPP as a cornerstone for achieving operational excellence. Rooted in the TPS, LPP focuses on eliminating waste, optimizing processes, and continuously improving efficiency. This approach has become integral to streamlining operations, enhancing quality, and driving innovation in the automotive sector (Czifra et al., 2019).

One key aspect of LPP in the automotive industry is the persistent pursuit of waste reduction. By systematically eliminating waste, manufacturers can reduce costs, optimize resource utilization and enhance overall operational efficiency. Another critical LPP applied in the automotive industry is JIT manufacturing. JIT minimizes inventory levels, assuring that components and materials are delivered precisely when desired in the production process. This reduces the costs associated with excess inventory and minimizes the risk of obsolete parts, enabling manufacturers to respond quickly to changing market demands (Pinto et al., 2018). Additionally, Kaizen, or continuous improvement, is a fundamental concept within LPP. It encourages employees at all levels to contribute ideas for incremental improvements in processes and systems. In the automotive industry, this means fostering a culture of continuous learning and adaptation. Workers are empowered to identify and address inefficiencies, leading to a more agile and responsive organization. Visual management is another LPP tool widely implemented in the automotive industry. It involves the use of visual cues, such as kanban

boards, to provide real-time information on production status, inventory levels, and performance metrics. This enhances communication and transparency, enabling quick decision-making and problem-solving (Kaspin et al., 2021).

On the other hand, LPP principles also extend to supplier relationships in the automotive industry. Collaborative partnerships with suppliers help create a seamless flow of materials and information, reducing lead times and ensuring high-quality inputs for production. Hence, LPPs play a pivotal role in achieving operational excellence in the automotive industry. By focusing on waste reduction, implementing JIT manufacturing, fostering a culture of continuous improvement, employing visual management tools, and optimizing supplier relationships, automotive manufacturers can enhance efficiency, reduce costs, and stay competitive in a rapidly evolving market (Vanichchinchai, 2019).

However, the implementation of LPP in the Malaysian automotive industry is not without its challenges, reflecting a complex interplay of cultural, organizational, and economic factors. One significant challenge is the prevailing traditional management mindset that emphasizes hierarchy and centralization. LPP requires a shift towards a more collaborative and decentralized approach, and convincing entrenched leadership to embrace this change can be a formidable task. Moreover, cultural factors also play a role, as the hierarchical structure may discourage open communication and the sharing of ideas among employees (Maware & Parsley, 2022). LPP rely heavily on employee involvement and empowerment, necessitating a cultural shift towards a more participatory work environment. Resistance to change, fear of job insecurity, and a lack of understanding about the benefits of LPP can hinder successful implementation. Additionally, the Malaysian automotive industry faces challenges related to workforce skills and training. LPP requires a highly skilled and adaptable workforce capable of continuous improvement. However, there may be a shortage of workers with the necessary skills, and retraining existing employees can be time-consuming and expensive (Tiwari & Tiwari, 2018).

Additionally, supply chain complexities pose another hurdle. The automotive industry relies on an extensive network of suppliers, and coordinating a lean supply chain requires close collaboration and synchronization. Overcoming the challenges of disparate supplier capabilities, varying levels of technology adoption, and differing production schedules can be a considerable barrier. Likewise, economic factors, including the initial investment required for lean implementation, can be a challenge for companies, particularly small and medium-sized enterprises (SMEs) (Tiwari & Tiwari, 2018). The automotive industry's competitive nature, coupled with thin profit margins, may make it difficult for companies to justify the upfront costs associated with restructuring processes. Hence, the challenges of LPP implementation in the Malaysian automotive industry encompass organizational, cultural, skill-related, supply chain, and economic factors. Successful implementation will require a comprehensive and strategic approach that addresses these challenges and fosters a culture of continuous improvement (Maware & Parsley, 2022).

Although the future of LPP in Malaysia's automotive industry brings some challenges, it also promises numerous new opportunities. Hence, this study intends to bridge the gap by investigating the LPP implementation benefits, challenges and how it may affect operational excellence. The key objective of this study is to understand how efficiency, waste reduction, and continuous improvement contribute to competitiveness. This knowledge is essential for practitioners, scholars, and policymakers, shaping strategies for sustainable, high-performance automotive operations in a rapidly evolving global market. This study appears to be among a few studies that attempt to investigate the need for LPP and how it affects operational excellence in Malaysia's automotive industry. Consequently, the findings of this study can be utilized as a parameter for Malaysian automotive manufacturers to implement LPP to sustain operational excellence in today's competitive business environment.

3.0 Methods

This study adopted a quantitative method to better understand the benefits and challenges of LPP implementation, as well as how it may affect operational excellence in Malaysia's automotive industry. A thorough literature research was used to develop the questionnaire. To assess the accuracy and appropriateness of the questionnaire, content validity was done. The questionnaire was evaluated by two experts. Both experts' ideas and feedback were incorporated to enhance the questionnaire. The questionnaire survey was then utilised to collect information from 112 suitable respondents. The data was collected from October to December 2023. The sample size is within the specified range of 100 or above and adequate for the analysis to proceed (Hair Jr et al., 2021). Before the actual data collection, a series of phone discussions with selected responders was done. Second, respondents were checked to ensure that they were qualified to answer the questionnaire. Respondents with managerial positions and experience in the automotive industry are among the assessed criteria. To avoid ambiguity, the questionnaire was written in both English and Malay (the local language), with back-translation to ensure meaning equivalency. Once all essential information has been gathered, the obtained data is transcribed and evaluated using Excel, and conclusions are drawn (Rajendran et al., 2020).

4.0 Findings and Discussion

4.1. Demographic Profile

The quantitative survey gathered insights from 112 respondents within the automotive industry. The majority of participants were male (100), with only 12 females. Age distribution indicated a predominantly experienced managerial position, with 72 respondents aged 55 and above. Production/Manufacturing was the most represented department (44), followed by Supply Chain and Logistics, Quality Assurance/Quality Control, Aftermarket Services, and Research and Development (R&D). In terms of years of experience, 56 respondents had over 15 years of experience in the automotive industry, while 4 respondents had less than a year. This diversity in demographics and experience levels provides a comprehensive perspective on the industry, highlighting potential areas for improvement

and identifying common themes across different departments and age groups. Table 1 summarizes the demographic of the respondents for this study.

Table 1. Demographic of Respondents (N = 112)

Category	N	%
<i>Gender</i>		
Male	100	89.3
Female	12	10.7
<i>Age</i>		
25 – 34 years old	8	7.1
35 – 44 years old	8	7.1
45 – 54 years old	24	21.4
More than 55 years old	72	64.3
<i>Department attached</i>		
Production/Manufacturing	44	39.3
Supply chain and Logistics	16	14.3
Quality Assurance/Quality Control	16	14.3
Aftermarket Services	16	14.3
Research and Development (R&D)	12	10.7
Other	8	7.1
<i>Years of experience in the automotive industry</i>		
Less than 1 year	4	3.6
1 – 5 years	12	10.7
6 – 10 years	16	14.3
11 – 15 years	24	21.4
More than 15 years	56	50.0

4.2. Familiarity with Lean Principles and Practices (LPP)

Respondents were then asked about their familiarity with LPP. As shown in Figure 1, the results revealed a notable level of familiarity, with a significant majority (64) indicating they were "Extremely Familiar," and an additional 32 respondents stating they were "Very Familiar." Another 12 respondents claimed to be "Moderately Familiar," while 4 considered themselves "Somewhat Familiar." Encouragingly, none reported being "Not Familiar at All." These findings emphasize a widespread understanding and acceptance of LPP within the automotive sector, suggesting a positive viewpoint towards the adoption of efficient and streamlined practices. The results provide valuable insights for organizations seeking to leverage LPP, indicating a solid foundation for implementing and further optimizing LPP in the industry.

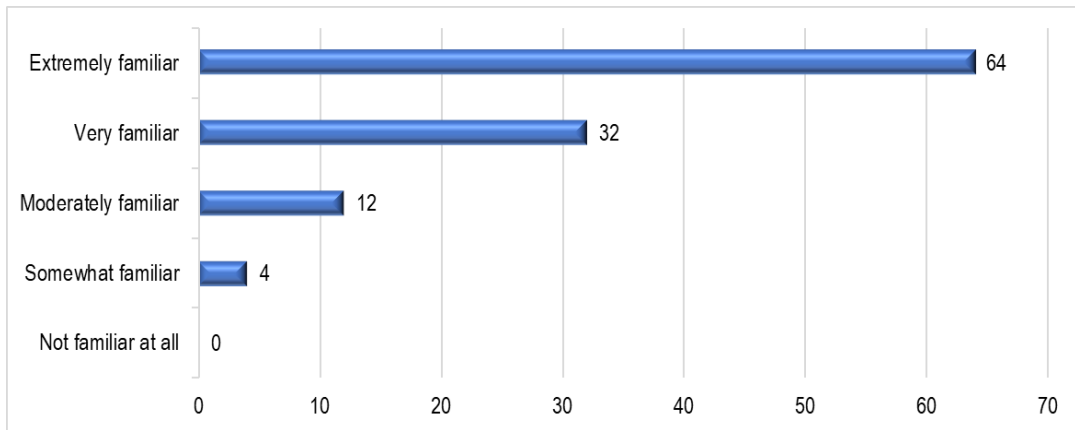


Figure 1. Familiarity with LPP

4.3. LPP Key Benefits

Among the 112 respondents in the automotive industry, opinions on the key benefits of LPP were diverse as demonstrated in Figure 2. The majority of the respondents (108) emphasized "Improved Quality" as a primary benefit, reflecting a strong focus on enhancing product standards. "Continuous Improvement" received endorsement from 104 respondents, indicating a commitment to ongoing refinement. "Cost Reduction" was highlighted by 68 respondents, emphasizing financial efficiency. Additionally, 92 respondents recognized the importance of "Waste Reduction," while 88 acknowledged "Increased Productivity." Other benefits such as "Reduced Lead Times" (76), "Enhanced Flexibility and Responsiveness" (56), and "Supplier and Customer Collaboration" (48) were also acknowledged. These findings highlight a consensus on the multifaceted benefits of LPP, providing valuable insights for organizations aiming to prioritize and tailor their lean initiatives within the automotive industry.

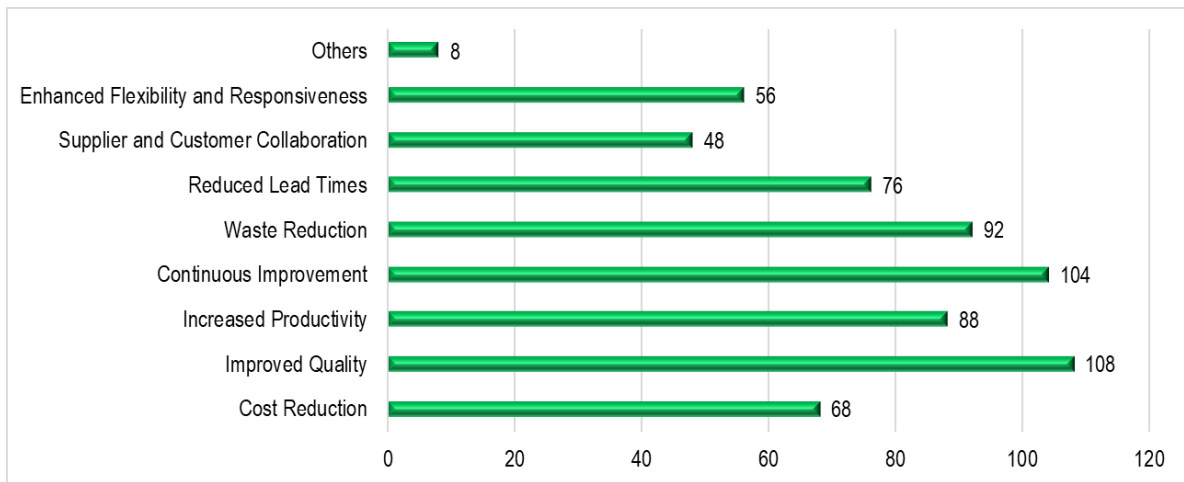


Figure 2. LPP key benefits

4.4. LPP Implementation Challenges

There are diverse perceptions concerning the main challenges of implementing LPP as highlighted in Figure 3. "Technological Barriers" emerged as a predominant concern, with 100 respondents recognizing the challenges associated with integrating technology into LPP. "Lack of Standardization" (96) and "Complex Supply Chains" (88) were identified as substantial challenges. "Cultural Resistance" (68) and "Market Volatility" (64) were acknowledged as other possible challenges, emphasizing the significance of organizational culture and market dynamics. "Lack of Leadership Commitment" (40) also surfaced as a recognized challenge. These findings emphasize the numerous challenges in implementing LPP in the automotive industry, providing insights for organizations aiming to navigate and overcome these challenges for successful implementation.

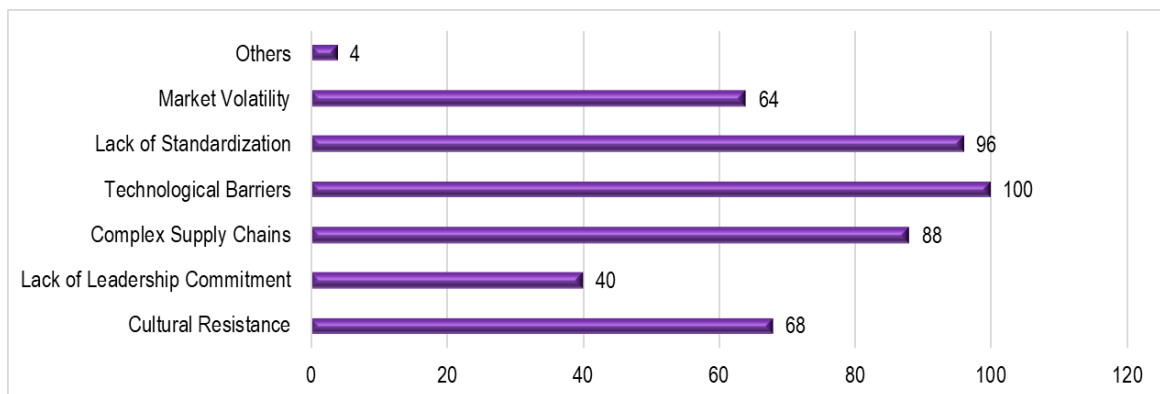


Figure 3. LPP implementation challenges

4.5. Operational Excellence Analysis Implementation and Dimension

The majority of the respondents (96) described that their organizations have implemented operational excellence analysis. This high affirmative response suggests a prevalent focus on enhancing operational efficiency within the industry. However, 16 respondents indicated that their organizations have not yet implemented such analyses, highlighting a minority that may need to explore opportunities for operational excellence initiatives. The results emphasize the widespread recognition of the importance of operational excellence in the automotive industry, with the potential for continued improvement and implementation across the industry.

Among the 96 respondents who reported implementing operational excellence analysis, a variety of strategies were employed (Figure 4). "Waste Reduction" emerged as a prominent focus, with 88 (19%) respondents prioritizing this aspect, highlighting a commitment to LPP. "Process Efficiency" was specified by 76 (17%) respondents, indicating a concentration on optimizing workflow. "Customer Satisfaction" (72) and "Continuous Improvement" (60) were also significant areas of attention, emphasizing a customer-centric approach and a commitment to ongoing enhancement. Additionally, "Employee Engagement" (64) and "Standardization" (44) were recognized as another vital dimension. Some respondents mentioned other unspecified areas (12), showcasing a diverse range of operational excellence priorities within the automotive industry. These findings provide valuable insights into the multifaceted approaches organizations employ to achieve operational excellence within the industry.

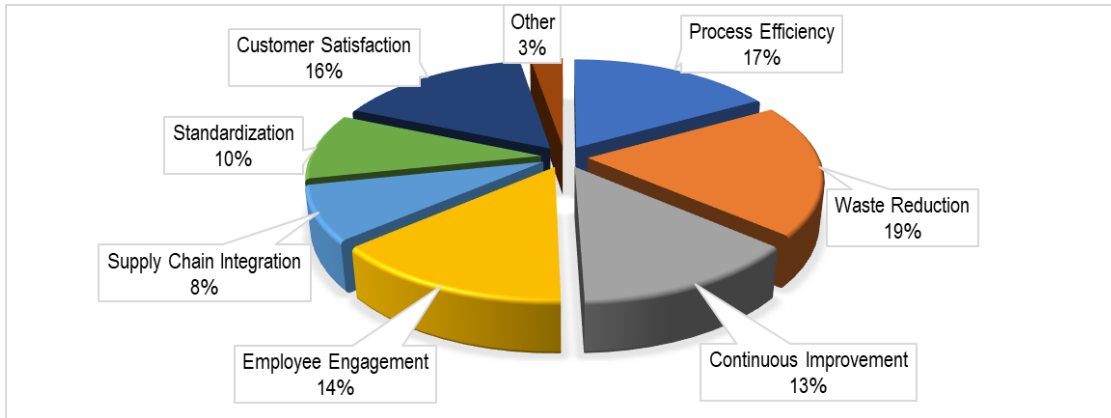


Figure 4. Operational excellence dimension

4.7. LPP and their Effects on Operational Excellence

Figure 5 emerged insights into the impact of LPP on operational excellence. Among 112 respondents, the most prevalent perception was "Increase Efficiency", with 27 (24%) respondents highlighting streamlined processes. "Waste Elimination" gathered the next significant recognition, with 29 (26%) respondents emphasizing the reduction of inefficiencies and unnecessary activities. "Quality Improvement" was acknowledged by 22 (20%) respondents, emphasizing a commitment to delivering superior products. A notable 16 (14%) respondents cited the "Process Standardization", emphasizing the importance of consistency. In terms of "Cost Reduction", 12 (11%) respondents acknowledged financial benefits through LPP implementation. However, a relatively lower emphasis on "Customer Focus" was observed, with only 6 (5%) respondents recognizing the alignment of operations with customer needs. These findings highlight a range of perceived benefits across efficiency, waste reduction, quality, standardization, cost, and customer-centric practices on the impact of LPP implementation on operational excellence within the automotive industry.

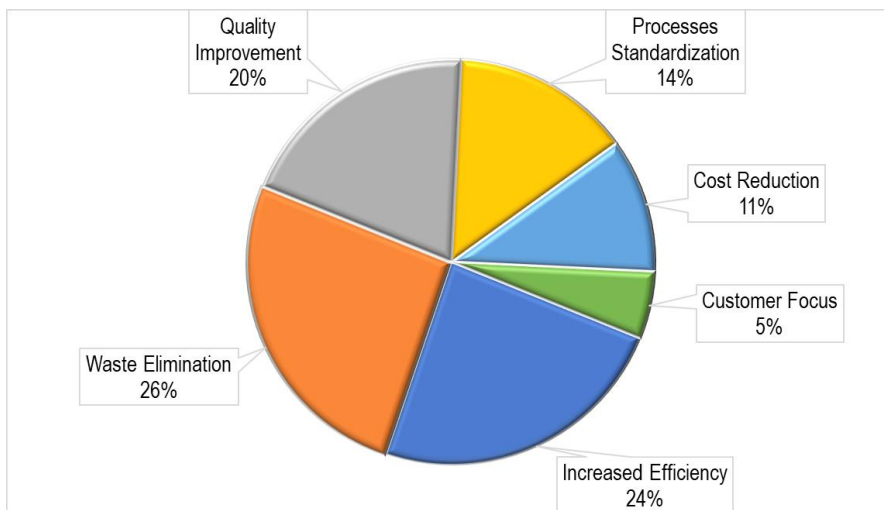


Figure 5. LPP and their effects on operational excellence

5.0 Conclusion and Recommendations

Understanding the impact of LPP on the automotive industry is crucial for achieving operational excellence. LPP drives efficiency, reduces waste, and enhances overall productivity. In the automotive sector, where precision and speed are vital, LPP leads to streamlined processes, improved quality, and cost savings. By embracing LPP, companies can adapt to changing market demands, foster continuous improvement, and build a resilient, customer-focused organization. This comprehension is fundamental for staying competitive, meeting industry challenges, and sustaining a culture of excellence in the rapidly evolving automotive landscape. This study's findings are in line with the TPS concept. TPS is a comprehensive management philosophy that emphasizes efficiency, waste reduction, and continuous improvement. It remains a benchmark for operational excellence and has been widely studied and adopted globally.

Practically, LPP implementation in the automotive industry impacts stakeholders significantly. It enables stakeholders to improve profitability through cost reduction and operational efficiency. Similarly, customers benefit from higher product quality and quicker response to market demands. Employees experience a positive work culture focused on continuous improvement, enhancing job satisfaction. Suppliers benefit from streamlined processes and better collaboration. Regulators witness adherence to industry standards

and sustainability. Hence, LPP contributes to stakeholder satisfaction by creating a more competitive, adaptive, and responsible automotive industry, aligning business goals with the needs of shareholders, customers, employees, suppliers, and regulatory bodies.

Theoretically, the study of LPP in the automotive industry provides scholars with valuable insights into operational excellence, offering a real-world application of LPP methodologies. Scholars gain a deep understanding of waste reduction, JIT manufacturing, and continuous improvement. This knowledge contributes to academic research, fostering innovation in management and manufacturing practices. It allows scholars to analyze the dynamic intersection of industry practices and theoretical frameworks, promoting a holistic perspective. Additionally, the study serves as a bridge between academia and industry, inspiring future research and facilitating the development of strategies for sustainable and efficient automotive operations, enriching scholarly discourse and advancing the field.

Despite its limitations, this study provides a fruitful ground for future researchers to work on. First, this study only focuses on the Malaysian automotive industry, hence future studies may replicate this study method in different countries and industries. Second, the respondents are primarily automotive professionals, which could lead to prejudice. Therefore, future studies may examine a larger and more significant scale of respondents. Finally, the current study only focuses on the quantitative approaches, hence, future studies should examine the relationship between LPP and operational excellence using both qualitative and quantitative research approaches. To substantiate the suggested approach, inputs from practitioners, professional bodies, and scholars are greatly encouraged.

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Paper Contribution to Related Field of Study

This study provides future scholars with easy access to information on LPP implementation in the automotive industry, which is in line with the global sustainability agenda. The authors foresee this study to have a significant effect on practitioners, particularly those in automotive manufacturing, as well as other relevant stakeholders, about the possible benefits of LPP implementation on operational excellence, particularly in Malaysia.

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