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Driving performance: benefits of operational excellence in the automotive industry

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Abstract: The rapidly growing Moroccan automotive industry faces intense global competition, demanding cutting-edge operational excellence (OpEx). A major challenge lies in understanding and concretely applying the benefits of OpEx in this specific context, particularly concerning flow and supply chain management. This study aims to explore the impact of implementing operational excellence practices on the performance of companies operating within Morocco's automotive sector, specifically identifying the key dimensions that contribute most to this improvement and their implications for competitiveness and logistical performance. To this end, a structured questionnaire was developed and distributed to 264 firms in the industry. The pilot study yielded 246 valid responses, resulting in a response rate of 93%, thereby ensuring a high level of representativeness across the sector. The reliability and validity of the measurement instruments were rigorously assessed, and data analysis was conducted using the statistical software SPSS, version 28. The findings highlight eight core dimensions identified as the most influential drivers of operational excellence in the specific context of the Moroccan automotive industry. Results indicate that the adoption of these practices leads to notable improvements in profitability, customer satisfaction, and organizational responsiveness to market shifts, particularly within logistics operations and the overall supply chain. These insights offer practical guidance for industry stakeholders aiming to strengthen long-term competitiveness and provide a valuable empirical foundation for researchers and practitioners seeking a deeper understanding of the tangible benefits associated with operational excellence in industrial settings, especially regarding logistics management and flow optimization.

1 Introduction

The Operational excellence (OpEx) represents a strategic orientation adopted by automotive companies aiming to deliver superior value in terms of quality, pricing, purchasing convenience, and service standards within their logistics processes and competitive landscape [1]. This approach centers on the integration of lean methodologies, technological innovation, and effective management frameworks to streamline processes, increase operational efficiency, and promote long-term sustainability [2,3]. Structured methodologies such as Lean, Six Sigma, and Total Quality Management (TQM) provide foundational tools and practices that support the pursuit of these efficiency and performance goals [4], notably in logistics and production management.

The growing relevance of operational excellence is particularly evident in emerging industrial ecosystems, such as Morocco's automotive sector, which has undergone significant transformation over the past decade. Between 2017 and 2024, Morocco has experienced a notable progression in global automobile production, marked by consistent growth in both volume and international standing. Based on figures reported by the International Organization of Motor Vehicle Manufacturers (OICA) and interpreted by M. Hamoumi et al. [5], the country advanced from 30th position in 2020 to 24th in 2023 and maintained this rank in 2024, an advancement that occurred over a relatively brief period. This trend is indicative of a deliberate and dynamic industrial policy, bolstered by the presence of leading global automotive firms and the consolidation of a strong domestic supplier network. From 2023 to 2024, Morocco recorded a 4% increase in vehicle production, reaching a total of 559,645 units. This performance places the country sixth worldwide in terms of annual production growth, highlighting its rising significance within the global automotive landscape and reinforcing its role as a key industrial player in the North African region, particularly in terms of logistics and supply chain capabilities. Furthering this discussion, a study by El Affaki et al. [6] provides a roadmap for automotive firms, demonstrating the synergistic impact of implementing Lean Management tools in conjunction with the IATF 16949:2016 quality standard to drive operational excellence.

However, this industrial dynamism is accompanied by specific challenges concerning the integration of operational excellence within the Moroccan automotive sector. The optimization of logistical flows and the management of an increasingly complex supply chain represent major stakes. While previous research has examined the outcomes of OpEx in this context, it has often overlooked an in-depth analysis of the close ties between OpEx and logistical performance or has not proposed an empirically validated framework for action specifically adapted to the realities of the local market. It is precisely this gap that our study seeks to address: how can the concrete application of operational excellence practices transform the performance of Moroccan automotive companies, specifically targeting their logistical dimensions and overall competitiveness? Our primary objective is therefore to build a detailed understanding of the mechanisms by which operational excellence generates a direct and measurable impact on logistical performance and the overall competitiveness of the automotive sector in Morocco.

The scientific contribution of this work lies in its integrated approach, which enriches the operational excellence model with a deep logistical perspective, validated by a rigorous empirical methodology covering 93% of the Moroccan automotive market. From a practical standpoint, this study offers companies a concrete and proven roadmap. This guide, informed by reliable local data, aims to help them optimize their operations and strengthen their position in the global market.

This study outlines a methodological approach for developing a tailored operational excellence model, grounded in the specific characteristics of the Moroccan market and informed by the latest advancements in management practices. While previous research has largely focused on assessing the outcomes of operational excellence within Morocco's automotive industry, this study takes a more comprehensive perspective, integrating the role of logistics elements. By analyzing data representing 93% of the national automotive sector, the research highlights tangible benefits linked to operational excellence, particularly in terms of productivity, product quality, and customer satisfaction, which are inherently tied to efficient material flows and distribution logistics. It also identifies the key drivers that enable firms to streamline their operations and enhance competitiveness, especially in logistics and manufacturing. Ultimately, this study provides Moroccan automotive companies with a practical and evidence-based roadmap for strengthening their position in the global market through the implementation of a proven operational excellence framework, with a focus on optimizing logistical processes.

2 Literature review

2.1 The Operational Excellence

Excellence is widely used in research and practice, yet many organizations struggle to achieve it due to confusion among managers regarding its meaning [7]. The Operational Excellence (OpEx) is achieved through high-performance teams seeking continuous improvement in well-designed processes, using appropriate tools and technologies [8]. It is underpinned by a philosophy that combines problem-solving, teamwork, and effective leadership, focusing on customer needs and empowering employees to maintain optimal value flows, including logistics flows [8]. OpEx is often used as a desired goal, but its meaning is ill-defined, necessitating a comprehensive review to clarify its theoretical foundation [9].

A range of methodologies and frameworks are utilized to support the achievement of operational excellence, each offering distinct yet often complementary approaches. Lean Management emphasizes the elimination of waste and the enhancement of process efficiency, particularly in production and logistics processes [10], while Six Sigma provides a data-centric methodology focused on minimizing defects and reducing process variability [11,12]. Total Quality Management (TQM), on the other hand, adopts a holistic perspective by engaging all organizational levels in continuous quality improvement efforts [12,13]. Business Process Orientation (BPO) explores the impact of process-centric thinking both within and across organizational boundaries to improve overall performance [14]. Hoshin Kanri offers a strategic alignment mechanism that integrates long-term sustainability objectives with operational performance goals [15]. These approaches are not mutually exclusive and are frequently implemented in combination, such as in Lean Six Sigma, which merges Lean's process efficiency principles with Six Sigma's rigorous data analysis, to create a comprehensive and synergistic path toward operational excellence [12], particularly beneficial for supply chain management and logistics optimization.

2.2 Benefits of Operational Excellence

Operational Excellence, frequently implemented through methodologies such as Lean Six Sigma, provides significant advantages to businesses. In-depth studies, particularly within the automotive sector, have demonstrated its positive impact on the overall performance of companies. Organizations that embrace this concept derive notable benefits across various areas, including logistics performance:

Financial Performance: The research of [16] alongside that of [17] indicates that Operational Excellence significantly improves the return on assets by reducing expenditures, particularly indirect costs. Logistics cost reduction is often a key contributor. [18] corroborate these findings by highlighting the favorable impact on key performance indicators such as the rate of defects per unit produced.

Operational Performance: Operational Excellence leads to the optimization of production and logistics processes. [19-21] highlight substantial reductions in cycle times, inventory levels, and downtime, while simultaneously increasing overall production capacity and improving material flow management.

Customer Satisfaction: By diminishing imperfections and delivery lead times, Operational Excellence enhances the quality of the products or services offered, which in turn results in improved customer satisfaction, as demonstrated by the studies of [19,20]. This is directly linked to efficient distribution logistics.

Business Strategy: Operational Excellence integrates seamlessly with the overall business strategy, as emphasized by [17,22]. It contributes to strengthening the organization's competitiveness by aligning operations with defined strategic objectives, encompassing logistics strategy.

Human Resources: Operational Excellence fosters a constructive work environment. [18,23,24] underscore the importance of employee engagement, continuous training, and a culture centered on ongoing improvement, vital for managing human flows and ensuring logistics operations run smoothly.

More recent research, such as that by [25,26], broadens the scope of Operational Excellence to encompass new sectors and challenges. [25] sheds light on the positive influence of Lean Six Sigma on the performance of Indian manufacturing industries, while [26] notes the increasing interest in Operational Excellence within the energy sector. These works illustrate the evolution of practices and the continuous adaptation of improvement methodologies to address the specific issues of each field, including logistics issues.

Investigations conducted within the automotive industry consistently affirm the effectiveness of the Lean Six Sigma approach in this sector. The studies by [27] demonstrate how the combination of Lean tools and the DMAIC methodology enables improvements in quality, productivity, and customer satisfaction in the manufacturing of automotive components, optimizing logistics and production flows. [28] propose a Lean Sigma framework tailored to the specific characteristics of manufacturing companies, illustrating its benefits in terms of cost reduction and quality enhancement, particularly for manufacturing logistics. [29] offer a specific contribution by suggesting solutions to minimize the loss of electronic components during assembly, which also impacts material flow and inventory management.

In conclusion, the entirety of this research establishes that Operational Excellence is a powerful lever for optimizing the overall performance of a company, whether in terms of financial results, operational efficiency, customer satisfaction, strategic alignment, or the development of human capital. The benefits are numerous and impact all dimensions of the organization, including logistics functions and the supply chain.

3 Methodology

This research was conducted using a quantitative approach, favoring a survey methodology to collect primary data from stakeholders in the Moroccan automotive sector. The process began with the meticulous development of a structured questionnaire, designed to capture perceptions and practices related to operational excellence. This questionnaire was pre-tested with a small sample of professionals to refine its clarity and relevance. Subsequently, data collection was systematized: the questionnaire was directly distributed to the 264 identified companies, ensuring comprehensive sectoral coverage. This meticulous deployment allowed us to obtain a substantial number of 246 usable responses, reflecting an exceptional response rate of 93%, guaranteeing a high representativeness of the sample. The raw data collected was then carefully verified and prepared for statistical analysis, primarily focused on regression techniques, to uncover the relationships between operational excellence variables and performance indicators.

3.1 Research framework and data analysis

This research provides a comprehensive mapping of the Moroccan automotive sector. It establishes a complete inventory of key players, ranging from major international manufacturers such as Renault and Stellantis to the leading independent Moroccan manufacturer, Neo Motors, without omitting the entire subcontracting network. By examining the data of 264 companies identified on December 2024, this analysis offers a clear perspective on the operations, origins, and geographical distribution of each actor, thereby enriching the understanding of the organization and dynamics of this essential sector for the Moroccan economy, particularly in terms of supply chain structure and logistical network.

The Moroccan automotive sector is characterized by a vibrant interaction between international players and domestic companies. Foreign firms, mainly French, American, and Japanese, constitute 68% of the industrial fabric, bringing their expertise and advanced technologies, which often include sophisticated logistics systems. As for Moroccan companies, although fewer in number, they play a fundamental role in the diversification of the sector and in innovation. Joint ventures, such as those uniting Induver and AGC or Tuyauto and Gestamp, are catalysts for growth, encouraging the transfer of technologies and access to global markets. This mix of national and international actors contributes to the competitiveness and dynamism of the Moroccan automotive industry, affecting its logistics performance and global trade flows.

3.2 Research sample characteristics

The examination of the sample reveals a characteristic profile of actors in the Moroccan automotive industry, where a significant proportion works in technical sectors such as engineering, production, and quality control, often involved in logistics and material handling. The younger generation, particularly those aged 20-30, represents a significant part of the workforce, contributing through their energy and receptiveness to new technologies, including those used in transport and information management systems within logistics. Nevertheless, the experience of more seasoned professionals (with more than five years of seniority) remains a considerable advantage for ensuring the transmission of skills and the continuity of businesses, especially in complex logistics operations. The distribution of hierarchical levels also illustrates this dynamic: although managers and technicians are the most numerous, leaders are also present, highlighting the importance of strategic decision-making within the sector.

The survey highlights a structure where technical functions occupy a central place. This predominance aligns with the current challenges of the automotive industry, which demand specialized expertise in design, manufacturing, and quality assurance, as well as efficient logistics and distribution networks. The harmonious presence of young talent and experienced professionals fosters a stimulating and innovation-friendly work environment. The conclusions of this analysis underscore the need to maintain this balance to ensure the long-term competitiveness of the Moroccan automotive sector, particularly through improved logistics and operational efficiency.

Table 1 Demographic and professional composition of the research sample

Characteristics	***Result***	***Percentage***
Function	Engineering	26%
	Production	24%
	Quality	20%
	Maintenance	12%
	Human Resources	6%
	Method	6%
	Finance	3%
	Purchasing	3%
Hierarchical Level	Executive, Member of the Executive Committee	8%
	Supervisor	12%
	Manager	39%
	Technician	21%
	Team Leader	16%
	Operator	4%
Age	20-30	62%
	30-40	31%
	40-50	6%
	+50	2%
Professional Experience	Less than 2 years	28%
	2 to 4 years	30%
	More than 5 years	43%

3.3 Identification and selection of operational excellence attributes

The various benefits of Operational Excellence were identified through a literature review, using keywords such as "advantages of Operational Excellence", "attributes of Operational Excellence", "logistics performance", "supply chain efficiency" and by consulting databases like Google Scholar and Scopus. A total of 17 attributes were selected in collaboration with experts in the field.

3.4 Instrument reliability test

The reliability analysis was conducted using IBM SPSS Statistics 28 software. The consistency of the collected data was verified, and Cronbach's alpha coefficient was estimated at (0.727), which is considered satisfactory for the study. This proves that the research instrument used is reliable and consistent in data collection. Therefore, if a research instrument consistently assesses the desired traits, it is considered reliable. Each research instrument used in this study successfully passed the reliability tests, presenting Cronbach's alpha values greater than 0.7. This attests to the reliability of each research instrument, indicating that the questionnaire can be used. The results of the reliability tests are presented in Table 2.

Table 2 Reliability test results for the research instrument

Theme	***Variables***	***Measurement Instruments and Coding***	***Cronbach's Alpha if Item Deleted***
Attributes	Financial Performance	**AT01**_Boosting Profitability	0.717
		AT02_Cutting Costs	0.718
		AT03_Streamlining the Supply Chain	0.714
	Operational Performance	**AT04**_Upping Productivity	0.704
		AT05_Optimizing Processes	0.712
		AT06_Slashing Waste and Environmental Impact	0.711
		AT07_Trimming Downtime	0.718
	Customer	**AT08**_Elevating Customer Satisfaction	0.710
		AT09_Enhancing Product/Service Quality	0.716
		AT10_Shortening Delivery Times	0.707
		AT11_Building Customer Loyalty	0.720
	Strategic	**AT12**_Sharpening Competitiveness	0.724
		AT13_Better Navigating Market Shifts	0.714
		AT14_Developing New Offerings	0.720
	Human Resources	**AT15**_Boosting Employee Morale	0.720
		AT16_Skill Development	0.720
		AT17_Increasing Employee Engagement	0.713

3.5 Model development

The research model for this study was developed with the assistance of experts in the field. To develop the model, 17 attributes of Operational Excellence were considered as independent factors, and the benefits of Lean Six Sigma implementation were considered as a dependent factor, taking into account their impact on logistics performance. The research model for this study is presented in Figure 1.

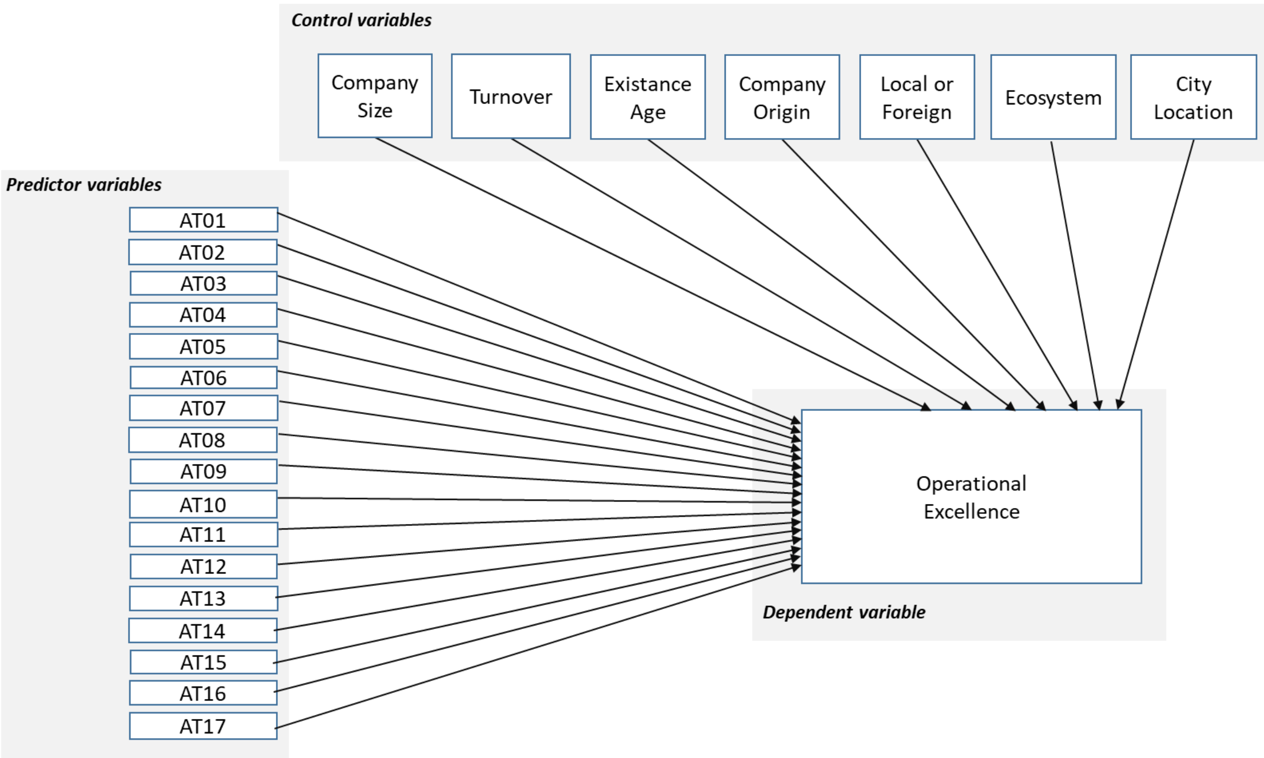

Figure 1 Developed Research Model

4 Results

4.1 Hypothesis testing

Hypothesis testing is performed using regression analysis. The analysis is conducted using IBM SPSS Statistics 28 software.

Table 3 Reliability test results for the research instrument

Independent Variables	*Std. coeff. β*	*p-value*
AT01_Increased Profitability	0.133	0.007
AT02_Cost Reduction	0.133	0.002
AT03_Supply Chain Optimization	0.175	0.000
AT04_Increased Productivity	-0.019	0.694
AT05_Process Optimization	0.106	0.017
AT06_Waste and Environmental Impact Reduction	0.005	0.902
AT07_Downtime Reduction	0.054	0.164
AT08_Increased Customer Satisfaction	0.033	0.472
AT09_Improved Product/Service Quality	0.072	0.075
AT10_Reduced Delivery Times	-0.037	0.420
AT11_Increased Customer Loyalty	0.053	0.175
AT12_Increased Competitiveness	0.085	0.030
AT13_Better Adaptation to Market Changes	0.107	0.010
AT14_Development of New Products/Services	0.102	0.008
AT15_Improved Employee Morale	0.007	0.869
AT16_Skills Development	0.053	0.193
AT17_Increased Employee Engagement	0.100	0.021

The increase in profitability, cost reduction, supply chain optimization, process optimization, increase in customer satisfaction, improvement in the quality of products/services, reduction in delivery times, increase in competitiveness, better adaptation to market changes, development of new products/services, and increase in employee engagement are all strongly associated with an improvement in the dependent variable. This indicates that these attributes significantly contribute to operational excellence, encompassing logistics performance.

The increase in productivity, reduction of waste and environmental impact, reduction in downtime, increase in customer loyalty, skills development, and improvement in employee morale do not appear to have a significant impact on the dependent variable, according to the results of this analysis.

In summary, the results highlight the importance of several classic attributes of operational excellence such as cost reduction, quality improvement, and adaptation to market changes. However, it is interesting to note that some attributes like increased productivity and waste reduction, although often associated with operational excellence, do not seem to have a significant impact in this particular context.

4.2 Control variables

The regression analysis conducted to test the influence of several control variables on Operational Excellence (OpEx) reveals a mixed set of results: while company size ($p = 0.055$) and company origin ($p = 0.460$), ecosystem ($p = 0.814$), and city location ($p = 0.147$) did not show statistically significant relationships with OpEx, turnover ($p = 0.003$), age of existence ($p < 0.001$), and whether the company is local or foreign ($p = 0.001$) did demonstrate a significant impact, suggesting that higher turnover, a longer history of operation, and being a local versus a foreign entity are associated with greater levels of Operational Excellence within the studied context, possibly due to existing logistics infrastructure or specific material flow characteristics.

Table 4 Research hypothesis testing for "Control Variables"

Research Hypothesis Test	*Statistical Result t/f*	*p-value*	*Result*
Company Size -> OpEx	1.92	0.055	Not Supported
Turnover -> OpEx	2.99	0.003	Supported
Age of Existence -> OpEx	4.24	0.000	Supported
Company Origin -> OpEx	0.74	0.460	Not Supported
Local or Foreign -> OpEx	3.37	0.001	Supported
Ecosystem -> OpEx	0.24	0.814	Not Supported
City Location -> OpEx	1.45	0.147	Not Supported

The study highlighted that company size, turnover, and age are factors significantly associated with better operational performance. Furthermore, foreign companies also appear to benefit from a slight advantage in terms of operational excellence, potentially due to their established global logistics networks and technical logistics elements. Conversely, the company's origin, its ecosystem, and its geographical location do not seem to have a significant impact on the results. Although the statistical model used explains a significant portion of the variability in operational excellence, it is important to note that other unmeasured factors could also play a role, such as specific transportation infrastructure or information flow management practices. In conclusion, the results of this analysis reveal that operational excellence is closely linked to several organizational factors. Indeed, our findings suggest that larger companies with substantial turnover and a longer history are better able to implement operational excellence practices, including advanced logistics management strategies. However, it is important to note that this study does not establish causal relationships, and other unmeasured factors could also influence the results.

5 Discussion

The findings of this study align with the broader literature on Operational Excellence (OpEx), as highlighted by [16,17], which emphasize the positive impact of OpEx on financial performance, particularly through cost reduction, a key attribute found significant in the Moroccan automotive context, notably logistics cost reduction. Similarly, the observed improvements in customer satisfaction resonate with [19,20], who linked OpEx to enhanced product/service quality and reduced delivery times, although the latter was not statistically significant in this specific study, perhaps due to factors within distribution logistics. The study's identification of supply chain and process optimization as significant drivers of OpEx echoes the focus on process efficiency found in Lean Management [10] and the defect reduction focus of Six Sigma [11,12]. Interestingly, while prior research [18,23,24] underscores the importance of human resource factors like employee engagement and skills development, these attributes did not show a significant direct impact on OpEx in this Moroccan automotive sample, suggesting a potential contextual difference or the influence of mediating factors not explored in this research, possibly related to human flows within logistics operations. Furthermore, the significant role of organizational factors like company turnover and age in facilitating OpEx implementation suggests that the capacity to invest in and sustain OpEx initiatives may be linked to the maturity and financial health of the firms, a nuance that could be further explored in future research building upon the foundational understanding provided by this study, particularly regarding their logistics capabilities.

This study advances the academic position that the effectiveness of operational excellence is not a universal constant, but is instead deeply tied to a specific industrial and organizational context. In contrast to some prior research that assumes a general impact from all OpEx attributes, the present findings indicate that, within the Moroccan setting, certain elements like improved productivity or reduced waste are not the primary drivers of performance. This observation enriches the academic body of knowledge by highlighting the need for a more nuanced, contextual approach, challenging the blind application of standard OpEx models. For practitioners, the implication is direct: efforts should be concentrated on specific dimensions, such as supply chain optimization and cost reduction, which are shown to generate a measurable impact. As for government policymakers, these conclusions suggest that support for the automotive industry should favor operational excellence strategies that are tailored to local specificities, particularly in logistics and the development of national supplier networks, in order to maximize returns and strengthen the sector's overall competitiveness.

6 Conclusion

This study has demonstrated that the adoption of operational excellence practices has a positive impact on the performance of Moroccan automotive companies. By surveying nearly 246 businesses, representing a broad cross-section of the sector, it was established that those that have implemented continuous improvement practices generally experienced more sustained growth. These companies have successfully optimized their processes, reduced their costs, and improved the quality of their products and services, which has allowed them to strengthen their competitiveness and better satisfy their customers, largely through efficient logistics and supply chain management.

While increased profitability, customer satisfaction, and agility in the face of market changes are undeniable benefits of operational excellence, our results suggest that not all aspects of this approach have the same impact. Indeed, while cost reduction and quality improvement are essential drivers, other factors such as waste reduction or increased productivity appear less decisive in the specific context of the Moroccan automotive industry, perhaps due to the existing logistics network or specific transportation challenges.

The analyses also revealed that the successful implementation of operational excellence is closely linked to certain organizational factors. Larger companies, with greater resources and a longer history, appear better equipped to carry out such initiatives, often possessing more developed logistics infrastructures and expertise in material management. Furthermore, the duration of implementation, the visibility of the results obtained, and the commitment of a dedicated team are key elements to ensure the success of these projects, including those focused on logistics process optimization.

In summary, the findings substantiate the research's core hypothesis: operational excellence serves as a significant performance driver for the Moroccan automotive sector, though its impact is shaped by the specific context of each company and its logistical capacities.

7 Limitations and future directions

This study has demonstrated the benefit of operational excellence for Moroccan automotive companies, while also highlighting the need for a personalized approach adapted to the specific context of each company, including its logistics particularities. A key challenge encountered was the cross-sectional design of the survey. While this approach ensured broad coverage, it precluded an in-depth case study, limiting the ability to analyze the internal dynamics of OpEx in detail. Furthermore, the reliance on self-reported data from companies may introduce a potential for perception bias. Though the validity and reliability of the instrument were tested, these limitations should be considered when interpreting the results. The results obtained open interesting avenues for future research, particularly by exploring the impact of operational excellence on other sectors of activity or by analyzing the cultural and organizational factors that can promote or hinder its adoption, especially concerning supply chain integration and logistics innovations. Future work could also involve conducting longitudinal studies to assess the long-term evolution of OpEx practices' impact. Alternatively, more targeted case studies could be undertaken to understand the factors driving success or failure in implementing OpEx within specific firms, thereby enabling a more detailed analysis of their logistical processes and associated infrastructure.

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