

Original Article

The Maturity of Operational Excellence and its Level of Deployment in Moroccan Automotive Companies

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Abstract - Operational Excellence (OpEx) is more of a philosophy than a set of tools; it is a fully integrated management approach. Despite the importance of the toolkit, the human element remains the most crucial asset and the key to the success of Operational Excellence. However, it has been shown that the line between the success and failure of Operational Excellence integration projects is the balance between technological efficiency and human reliability. Therefore, in this work, the research will develop an analysis of the current state of Operational Excellence integration in the automotive industry in Morocco. This exploration aims to assess the maturity of Operational Excellence in Moroccan automotive companies, the management and organizational structure of this concept, and finally, the level of deployment of its practices with an analysis of the sources of impact.

Keywords - Operational Excellence, Automotive industry, Industrial performance, Automotive ecosystem, Morocco.

1. Introduction

Operational Excellence defines an organisation's ability to generate more and more value for its customers, employees, shareholders, and partners to improve its competitiveness sustainably. It is a systematic approach that aims to optimize the overall performance of an organization by identifying and eliminating inefficiencies and waste, as well as by improving the quality of its operations [1]. At the heart of operational excellence are well-established methodologies, including Lean Manufacturing, Six Sigma, Total Quality Management (TQM), and others [2]. These methods aim to improve processes and maximize value for the customer while reducing costs and strengthening competitiveness. Operational excellence is based on several fundamental principles:

- **Continuous Improvement of Operational Performance:** Process optimization is at the heart of operational excellence. It involves continuously identifying, analyzing, and improving processes to eliminate inefficiencies and waste [3,4].
- **Customer Satisfaction:** Operational excellence puts the customer at the center of its concerns. Organizations strive to understand their customers' needs and expectations, improve the quality of their products and services, and deliver value [5].
- **Employee Satisfaction:** Employees play a crucial role in achieving operational excellence. They are encouraged to be involved in solving operational problems and

improving processes [6].

- **Measurement and Analysis:** The collection and consolidation of data, performance measurement, and analysis of results are essential for operational excellence. To evaluate the process, companies use Key Performance Indicators (KPI) [7, 8].
- **Environmental Performance:** Implementing operational excellence significantly impacts processes by making them more efficient and effective using the least resources and reducing waste in the company's value chain [9,10,11].

In this context, the Moroccan automotive industry, positioned at the intersection of global competitiveness, environmental sustainability, and technological innovation, faces many challenges today. In this rapidly changing and constantly evolving context, Operational Excellence (OpEx) emerges as a strategic imperative for automotive companies seeking to optimize their performance. It serves as the pivot on which these companies can rely to achieve essential levels of competitiveness and sustainability in a demanding business environment. Previous studies on operational excellence within Morocco's manufacturing sector have primarily concentrated on evaluating practices and results [12] [13] [14]. However, there remains a notable void in research exploring the impact of the Moroccan socio-cultural context on the adoption and maturity of such practices. This research addresses this gap by delving into the role of the Moroccan



socio-cultural context in shaping operational excellence culture and leadership perceptions. This study thoroughly explores the maturity and deployment of operational excellence practices in the Moroccan automotive industry, a sector experiencing intense competition and constant evolution. Building upon prior foundational works, our exploration primarily aims to confirm the hypothesis of the role of the Moroccan socio-cultural context in the development of the "OpEx culture," as well as its influence on the perception of OpEx and the maturity of Leadership.

2. Research Framework and Data Analysis

2.1. Sample Selection

Without official data on automotive companies in Morocco, the research team contacted AMICA, the "Moroccan Association for Automotive Industry and Construction", which provided us with an initial list of 201 companies. The first task was to update and complete this list with official information from (<https://www.mcinet.gov.ma/fr/actualites>). Through a comprehensive analysis, the research identified 264 automotive companies operating in Morocco as of December 2023. Data were collected through surveys conducted using a carefully designed questionnaire across all national and multinational automotive companies established in Morocco.

2.2. Survey Questionnaire: Design, Structure, and Content

The empirical research took place during the year 2023. The survey questionnaire was developed and adapted, considering research instruments whose reliability is verified through Cronbach's Alpha test, which measures the consistency among the questions. The questionnaire was created electronically, a more accessible and faster means, using the services of Google®, which offers an online survey service called Google Forms®.

The questionnaire developed for this survey consists of three sections:

- First Section: Aimed at collecting information about the company profile, including the company name, sector of activity, location, size of the company, and the position of the person responding to the survey within the organization.
- Second Section: This part of the questionnaire asked questions to gather data on the maturity of the Operational Excellence (OpEx) deployment implemented by the participating companies, the management and organizational structure of OpEx within the company, and the perception of the objective behind deploying such an approach. A certain logic in the sequence of questions was incorporated into the questionnaire, and an automatic error-preventer helped the respondents not to forget to answer any questions. Therefore, the questionnaire is easier to follow and requires less response time, which increases the overall response rate.

- Third Section: This section aimed to obtain data on the level of deployment of Lean tools in OpEx, the methods implemented, and the impact factors.

2.3. Data Collection

In total, 214 responses were received out of the 264 questionnaires distributed, resulting in a % response rate of 81%. Subsequently, the sample selection was complete, and the number of responses obtained can represent all national and multinational automotive companies established in Morocco. Finally, the survey provided enough data for an initial, exploratory, and general analysis of the state of adoption of the Operational Excellence (OpEx) philosophy in the Moroccan automotive sector.

Although most of the targeted companies are international, the respondents were Moroccan, thus enhancing our ability to identify the national cultural influences on our conclusions. The survey questionnaire structure was developed based on Operational Excellence's fundamentals and cultural components.

As previously mentioned, all Moroccan automotive companies were contacted. A questionnaire was developed and sent via email and LinkedIn to collect the desired information. The structure of the survey questionnaire was based on the technical and organizational background of Operational Excellence. The questionnaire was divided into 4 chapters to determine:

- The maturity of integration of Operational Excellence.
- Management of Operational Excellence within the Moroccan sociocultural context.
- The level of deployment of tools and Lean practices of Operational Excellence.
- The maturity of leadership

2.4. Results, Data Analysis, and Discussion

A primary result was expected, with 92% of respondents stating that they have deployed a continuous improvement approach such as Operational Excellence. Indeed, the automotive sector is considered a leader in integrating new continuous improvement concepts.

2.4.1 Distribution of Companies by Size

The participating companies are generally large enterprises (see Figure 1). Thus, 87% of the companies in the sample have more than 51 employees, and only 13% are small organizations with a workforce not exceeding 50 employees.

2.4.2 Distribution of Companies by Ecosystem

The automotive ecosystem is a platform that brings together level 1 and 2 enterprises and subcontractors active in the same sector of activity. The primary role of the ecosystem is to increase local integration. The existing 264 companies are distributed in Morocco, as illustrated in Figure 2.

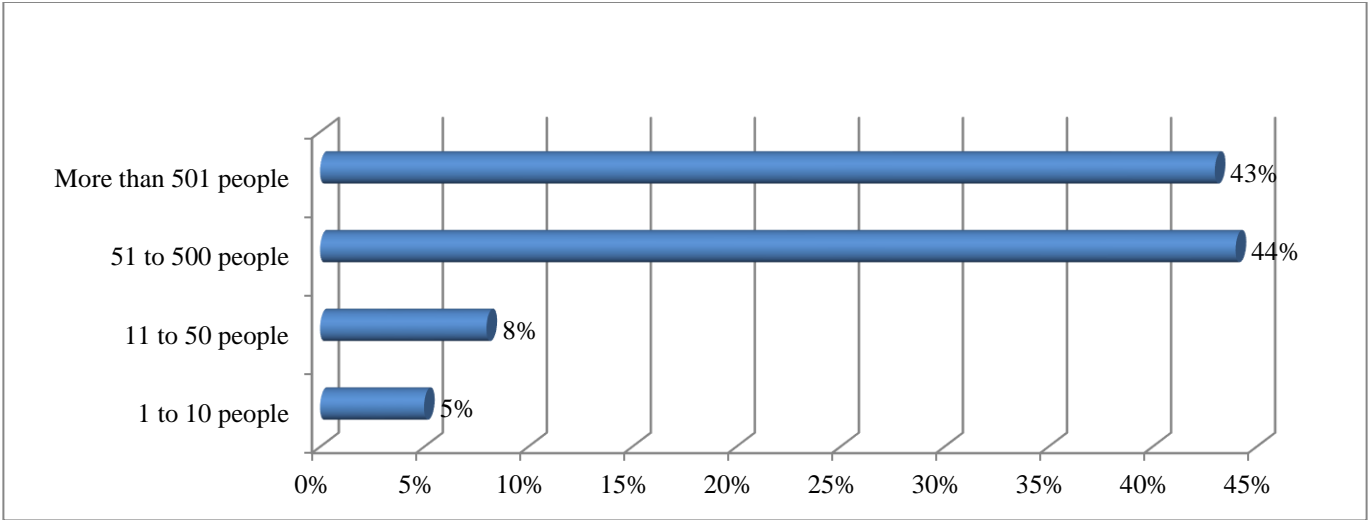


Fig. 2 Distribution of companies by size

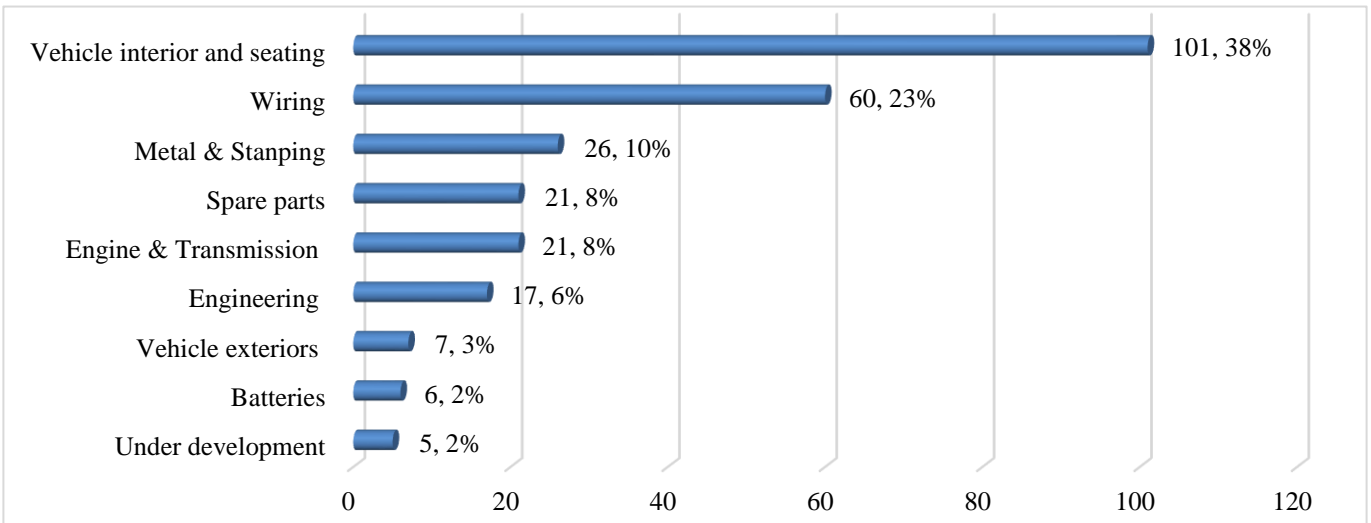


Fig. 2 Ecosystems - Number; Percentage / Ecosystem (December 2023)

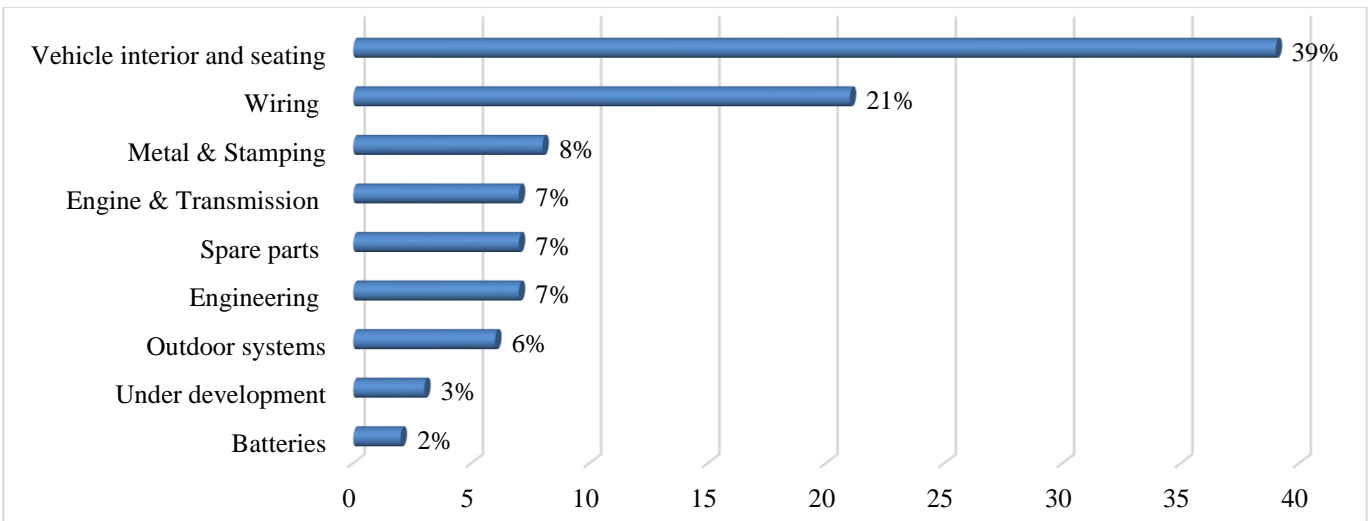


Fig. 3 Distribution of companies by ecosystem

The 214 surveyed companies are distributed across 9 different activity ecosystems (see Figure 3). The most represented ecosystems are those of the “Vehicle Interior and Seat” ecosystem (39%) and the “Wiring” ecosystem (21%), as well as those from the “Metal & Stamping” ecosystem (8%). To further analyze the representativeness of our sample and by comparing the distribution of companies in ecosystems of the 214 surveyed companies with the existing 264 companies, The research found the same order; “Vehicle Interior and Seat” ecosystem followed by the “Wiring” ecosystem and the “Metal & Stamping” ecosystem.

2.4.3 Distribution by Hierarchical Levels of Respondents

Analysing the hierarchical levels of the respondents to the survey, the study confirms the sample's representativeness, incorporating responses from strategic to operational levels, including tactical levels. Indeed, most responses came from managers and engineers (72%), followed by technicians (23%) and directors (4%), three hierarchical positions likely to reflect a reliable perception of the maturity of operational excellence practices considering their daily involvement in operational management. The limited number of director profiles can explain the analysis of hierarchical levels compared to managers and technicians in the automotive sector specifically and by understanding the concept of

operational excellence management at strategic and tactical levels compared to the operational level.

2.4.4 Distribution by Country of Origin

32% of the automotive companies targeted in the survey are purely Moroccan. Finally, 68% are multinational companies, including 22% French, 10% American, 8% Japanese, and 6% Spanish (see Figure 5).

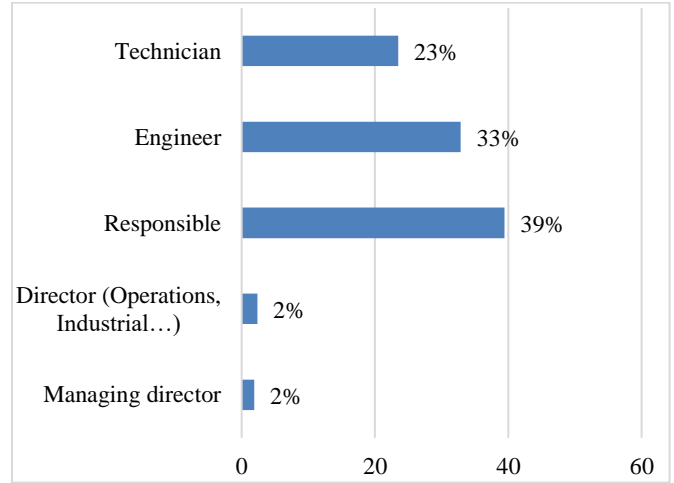


Fig. 4 Distribution by hierarchical levels of respondents

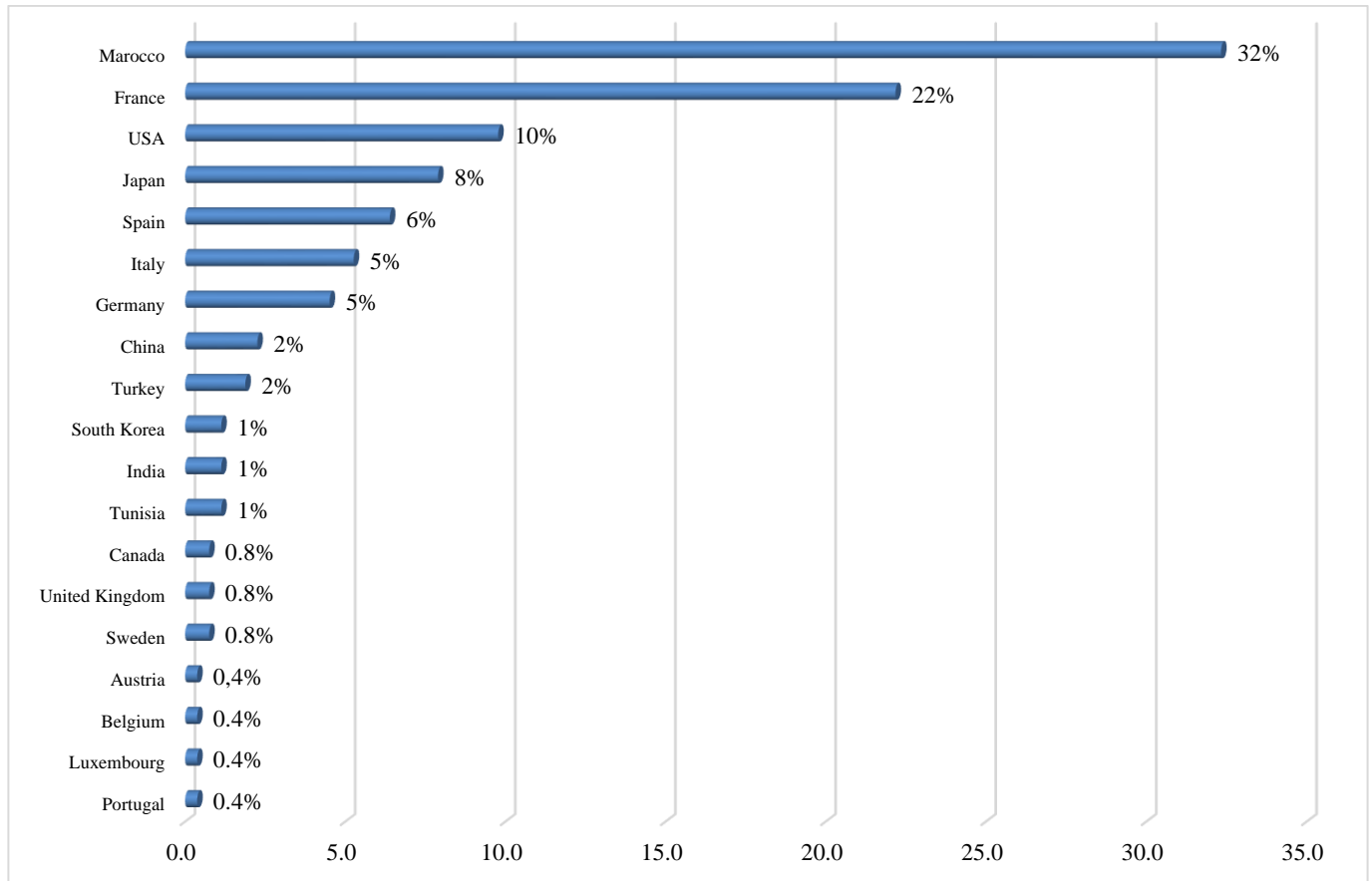


Fig. 5 Distribution by country of origin

3. Literature Review: From Lean Management to Operational Excellence

At the origin of OpEx is "Lean management": a method to achieve operational excellence. After World War II, the Japanese lacked financial resources and raw materials. This led the Japanese company Toyota to optimize its production chain and adapt to the local market. It built a car that met customer needs at a reduced price by tracking waste and engaging in continuous improvement. Following this, in 1986, Toyota outperformed General Motors (GM) in two aspects: speed and production quality: while GM took 40 hours to manufacture a car with an average of 13 defects, Toyota did it in 18 hours with 4.5 defects. Ford and GM adopted the Toyota Production System (TPS) in their factories, which they named "Lean Management". This simplified and less expensive method gave birth to operational excellence.

Nowadays, globalization and the emergence of innovative technologies have influenced companies' choice of management systems. Indeed, for companies to develop and maintain their growth and competitiveness in a changing environment, it is essential to improve their adopted managerial model [15]. To enhance their competitiveness [16], increase efficiency to boost profits, and optimize quality [17], the adoption of Lean has aroused great interest among many companies in various sectors. In other words, Lean management was initially developed for the automotive industry [18] and then integrated into other sectors. It is a management philosophy based primarily on continuous improvement, which requires the commitment and involvement of the entire organization to improve the efficiency of the three main components, "Quality-Cost-Delivery". It is an approach centered on the human factor [19] that aims to create more value-added with less time, space, and fewer defects. Ohno (1988) [32] defined 7 types of waste called "muda" in Japanese (overproduction, waiting, transportation, inventory, unnecessary activities, defects, movements). An 8th "muda" called "untapped creativity" was added later [21]. Not to mention the two other types of waste called "muri," meaning excessive means, and "mura," meaning overly variable means. Finally, lean management is a philosophy and mindset the company integrates to achieve better performance. The approach is centered around two fundamental principles: eliminating waste and generating added value.

4. Maturity of Integration of Operational Excellence

The initial phase of the research involved assessing the integration of Operational Excellence among 81% of Moroccan automotive companies by inquiring about the duration of their respective journeys. Fig. 6 illustrates the results with the posed question. It is important to note that the company's size is significant in determining whether it implements Operational Excellence.

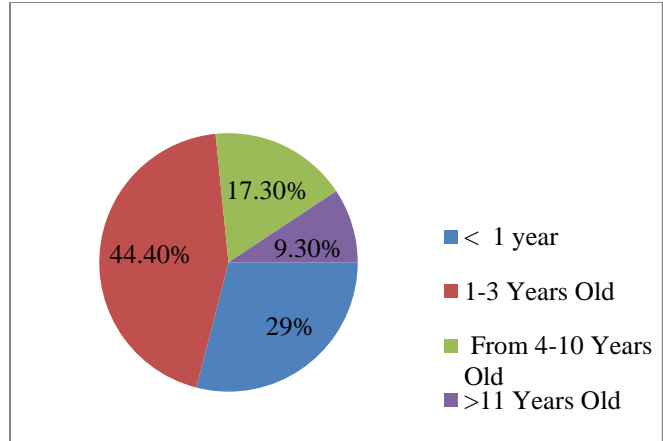


Fig. 6 Maturity of integration of Operational Excellence

Indeed, 13% of the small companies (less than 50 employees) that participated in the survey did not adopt the Operational Excellence philosophy. Most of the others have just started experimenting with the approach, largely being "Greenfield, which means new organizational structures in a newly created field", which started with the PSA factory in Kenitra on June 20, 2019.

5. Management of Operational Excellence

With more than 260 national and international automotive manufacturers established in the Kingdom, each with its model of operational excellence, a rich cultural wealth is created. This wealth is manifested through a collection of best practices. Certainly, some companies can put all their assets on their side by integrating engineers with the philosophy of OpEx to lead and support the implementation of the operations management system at their sites and ensure its sustainability, or even establish an "OpEx" department (as is the case with the two manufacturers RENAULT & PSA and most of the Moroccan equipment manufacturers).

Others are content to reinforce the requirements of IATF 16949 and the CSR of the manufacturers (similar to most national automotive manufacturers). But it is in human behaviour that the difference is made. The two automotive manufacturers in Morocco have developed their own OpEx systems over time, from which the equipment suppliers take inspiration. These two systems have a starting point in the Toyota Production System (TPS).

Analysis and Discussion: According to Fig. 7, 67% of companies have OpEx entities, explaining the importance of integrating OpEx into the organizational diagram of the companies. On the other hand, 66% of the participating companies have named OpEx "champions" in their organization to manage the system. These champions are considered experts with the appropriate behavior and attitude to establish and promote the culture of OpEx through constantly questioning processes, technologies, and preconceived ideas.

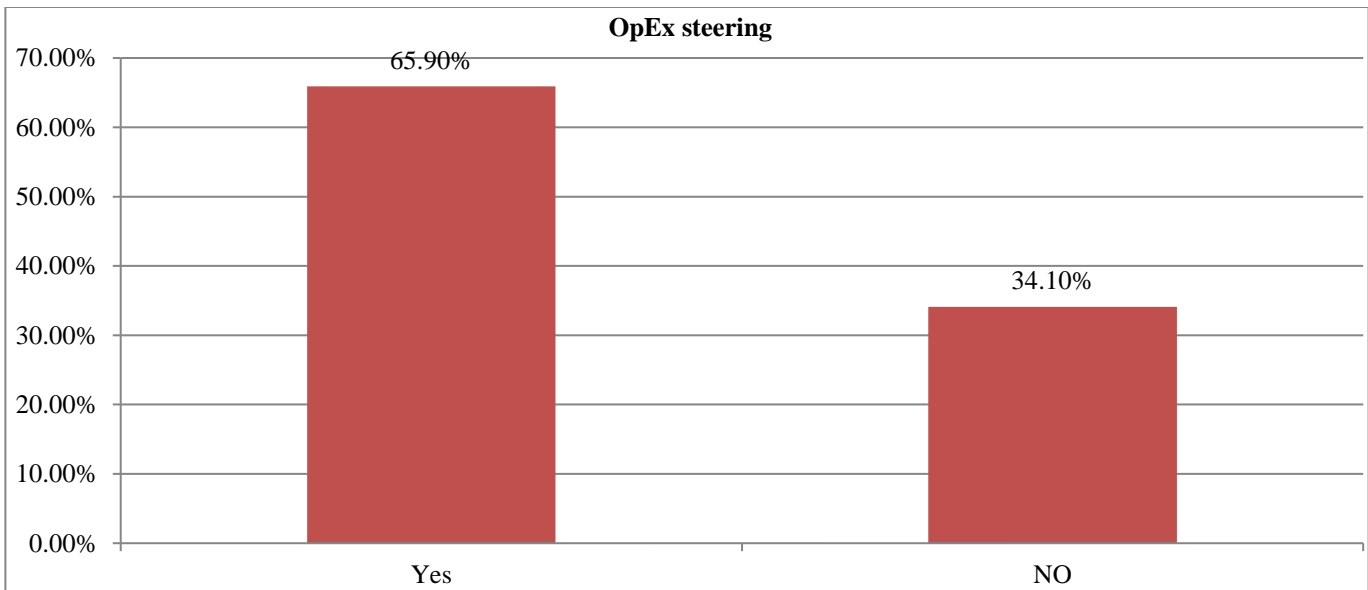
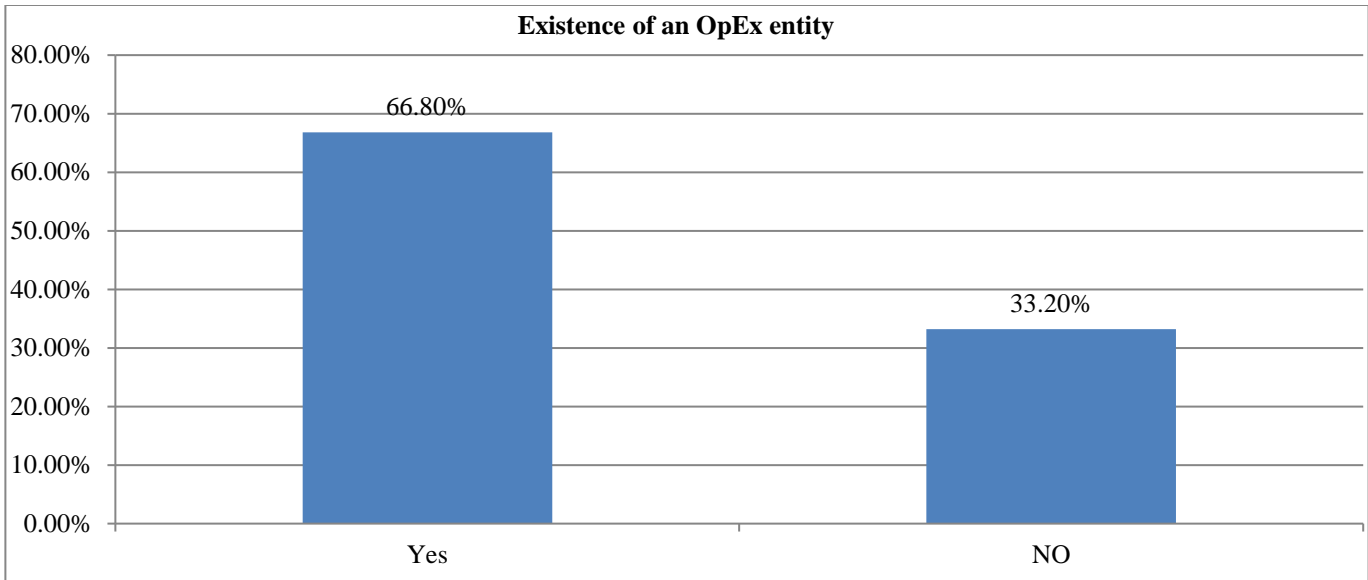


Fig. 7 Existence of an OpEx entity and OpEx steering

Table 1. Data comparison

OpEx Entity	OpEx Pilot	Number of companies	Percentage
Yes	Yes	110	51%
No	No	40	19%
No	Yes	31	14%
Yes	No	33	15%

To refine our analysis, a detailed comparison of the data between companies with an OpEx entity and those nominating an OpEx pilot, the study observed that 51% of companies have fully adopted the OpEx system by establishing both an organization and a dedicated OpEx pilot. On the other hand, 19% still struggle to adopt this system fully, and this difficulty is associated with a lack of consideration of the human

dimension throughout the adoption of OpEx and the size of the companies. Finally, these results join those previously analyzed for the maturity of the integration of OpEx; namely, 13% of participating companies are small companies (less than 50 employees). It should also be noted that several companies have set up entities equivalent to OpEx, namely, LPS Plus, Lean, Kaizen, or Monozukuri.

6. Level of Deployment of Lean Tools of Operational Excellence

The subsequent phase of the research will involve an analysis of the implementation and deployment levels of Lean tools. The comparison between numerous theoretical and empirical studies led to identifying 17 practices often cited as basic technical practices of Lean [23].

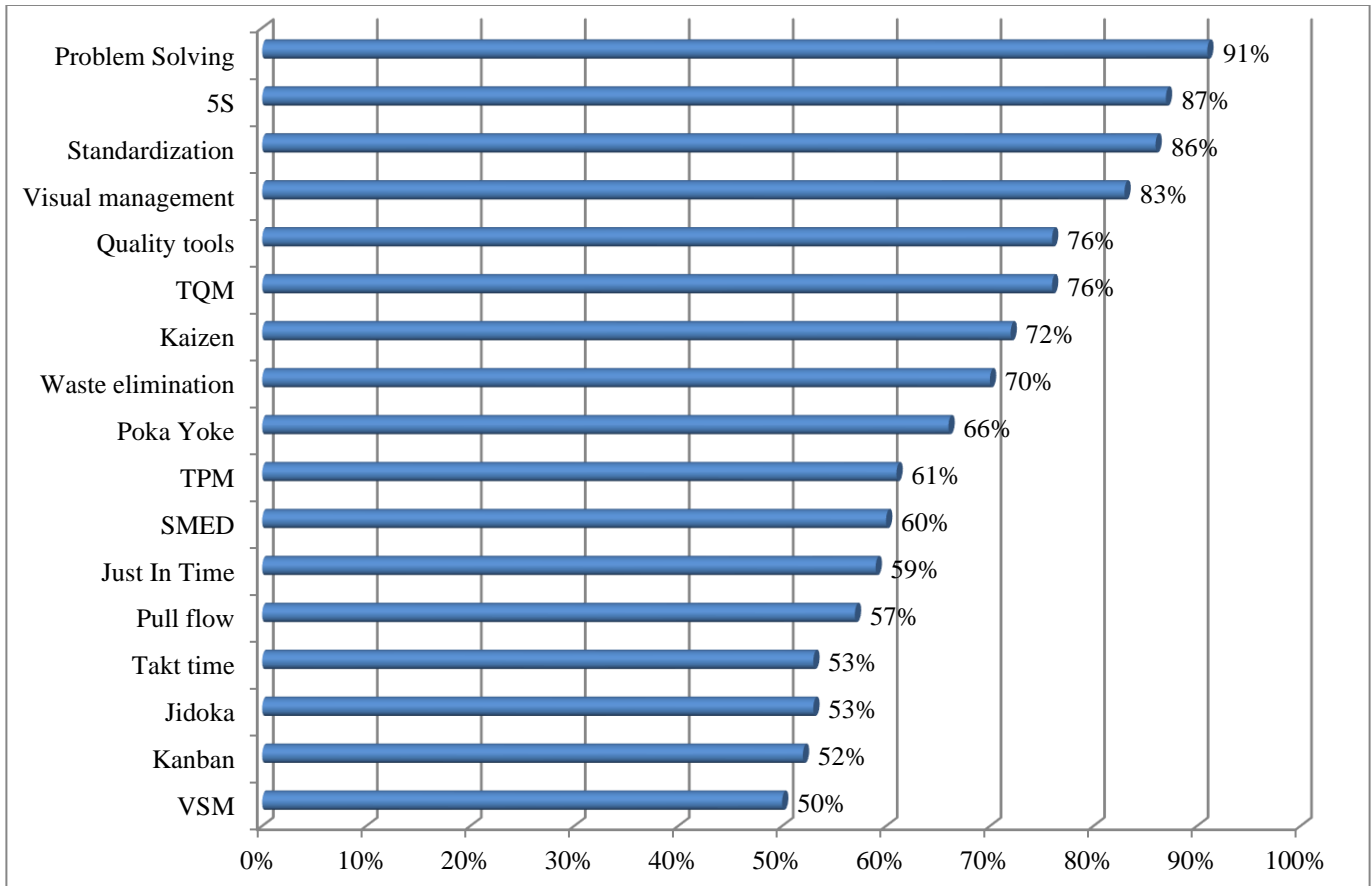


Fig. 8 Average levels of deployment of Lean tools of OpEx in surveyed companies

The automotive sector is exceptional compared to other industries; all equipment manufacturers must be certified by IATF 16949 (INTERNATIONAL AUTOMOTIVE TASK FORCE) to be able to deliver their products. The IATF 16949 standard, introduced in October 2016, ultimately adopts the higher-level structure without citing the text of ISO 9001 and integrates the specific requirements of the automotive sector. The automotive reference system strengthens the management system in terms of continuous improvement, risk analysis and prevention, and Leadership. It integrates the idea that actors in the automotive industry need to continuously adjust to their environment, which requires efficiency and adaptability.

In the case of the two automotive manufacturers in Morocco, namely RENAULT and PSA, certain requirements are found:

Product safety, LPA Layered Process Audit, Potential risk analysis (FMEA), Preventive actions, Emergency plans, Advanced product quality planning (APQP), Measurement systems analysis (MSA), Product acceptance process (PPAP), Total productive maintenance (TPM), Statistical process control (SPC), Problem-solving, Error-proofing devices. Surveillance plan Based on the results of audits of 48 Moroccan automotive suppliers, the level of deployment of Operational Excellence differs from one company to another

through the rigorous application of these tools. Fortunately, for most automotive companies subject to the study, various Lean tools had been implemented within their organizations, and the results are illustrated in Figure 8. According to these results, the major tools that are weakly deployed are Value Stream Mapping (VSM) (50%) and Kanban (52%). The tool's complexity could explain the low application of the practice related to VSM. Implementing VSM helps visualize a manufacturing flow's value-added or non-value-added steps [24]. The objective of this method is to eliminate waste (muda in Japanese) while ensuring the continuity of the production flow from the supplier to the end customer. The application of value stream mapping and implementing an associated action plan for improvement have facilitated remarkable gains for industrialists [25], especially in the automotive industry [26]. However, numerous studies have shown the low use of this tool despite its importance in deploying a Lean approach [27]. However, the same figures show a strong application of problem-solving at 91%. This can be explained by the requirements of manufacturers who have put in place rigorous monitoring through platforms to control quality and the cycle time of 8D reports and through supplier audits to evaluate the effectiveness of on-site analyses. However, despite the use of this methodology, users record many recurrences. Indeed, manufacturers' audits reveal that root causes are often not identified.

Table 2. Fundamentals of Operational Excellence Leadership

	Average difficulty	Difficulty level		
	(%)	Not at all + Not particularly difficult	Moderately difficult	Extremely + Substantially difficult
Production managers actively encourage and participate in process improvement initiatives	71,67	7,51	46,76	45,73
Production managers foster a collaborative leadership style, motivating, mentoring, and training operators while facilitating their work	70,51	8,19	47,78	44,03
Production managers prioritize employee empowerment and continuous improvement over control	69,49	9,22	49,15	41,64
Production managers encourage operators to participate in problem-solving processes	65,29	13,82	52,22	33,96
For production managers, quality takes precedence over productivity and efficiency	63,14	24,40	38,40	37,20
Actively communicate and engage with operators on a regular basis regarding objectives	59,42	20,99	51,54	27,47
Production managers communicate quality results to employees in collaboration with quality managers	57,51	25,09	49,15	25,77
Production managers encourage operators to stop machines and production lines in the event of a quality issue	48,81	36,35	52,05	11,60
Production managers take full responsibility for product quality.	45,05	46,76	38,23	15,02

To address this gap and to promote the implementation of an effective problem-solving tool to avoid recurrence, the research introduces a novel tool, DINNA Diagram "Double Ishikawa and Naze Naze Analysis", which links the Ishikawa 8 diagram [28] and the 5 whys method [29]. The goal is to achieve the same result if two groups of similarly skilled workers analyze the same problem separately. This method was first published at the following international conference: International Conference on Industrial Engineering and Operations Management and was developed in 5 dimensions: occurrence, non-detection, system, effectiveness, and efficiency for a second publication at the following international conference: International Conference on Machine Learning & Trends.

7. Leadership Practices of Moroccan Managers

In order to gain a deeper understanding of the impact of national leadership value systems, a quantitative study was undertaken, employing a nine-question survey focused on the fundamental principles of operational excellence leadership. The results of this analysis are summarized in Table 2. Our analysis shows that 45.05% of production managers are not sufficiently involved in product quality management. Additionally, 48.81% do not effectively encourage operators to halt production when quality problems occur. These results highlight the challenge production managers face in prioritizing quality over productivity, as indicated by a 63.29% difficulty rating. The study further indicates that 71.67% of production managers struggle to engage employees in process improvement initiatives and adopt a supportive

leadership style. They find it particularly challenging to motivate, mentor, and train operators while facilitating their work (70.51%). These findings contrast with research on successful global organizations [30], which indicates that effective operational management is more about supporting improvement than control (69.49%). This aligns with the broader literature emphasizing the role of production managers as facilitators rather than supervisors [31]. Everyone needs to live a culture of continuous improvement through their actions. Managers should coach and develop employees, foster daily kaizen, and establish a shared vision and goals [32]. Indeed, the evolution of the role and behavior of production managers, characterized by greater transparency and trust, a reduction in barriers to communication with employees, the adoption of the Genba spirit (going to the Gemba), direct contact with operational teams, increased employee empowerment coupled with continuous support, is undoubtedly a fundamental pillar of OpEx success.

As Farris points out, leadership practices such as encouraging employees to participate in continuous improvement projects, integrating them into problem-solving teams, and providing them with training are recognized as essential components of OpEx leadership [33]. In conclusion, our study shows that production managers are not fully engaged in continuous improvement initiatives and lack the necessary skills to support their teams. These findings highlight the challenges companies face in adopting OpEx practices. This is largely due to the paradigm shift required to move away from traditional management approaches. In

conclusion, the success of OpEx hinges on the commitment of production managers and top management to create a culture of continuous improvement.

8. Conclusion

This study aims to enrich scientific research on Operational Excellence (OpEx) in Morocco's automotive sector. It evaluates the level of maturity of OpEx and its integration into Moroccan automotive companies. A quantitative and qualitative study approach addressed different knowledge management strategies. The first step involved conducting surveys with all Moroccan automotive companies, achieving a response rate exceeding 80%, and the second step was an exploratory study, consisting of conducting directive and semi-directive interviews. An analysis of the current state of integration of operational excellence in Moroccan automotive companies was conducted. This exploration aimed to dissect the perception of different hierarchical levels of operational excellence in terms of understanding the concepts, the management and organizational structure of OpEx within the company, and the level of deployment of Lean tools and practices of this concept. The study results revealed that the company's size is a determining factor in the level of maturity of OpEx and that a large part of Moroccan automotive companies are new structures that started with the factory of the second Moroccan

manufacturer. It was observed that 67% of the companies have established OpEx entities, and 66% of the participating companies have appointed OpEx "champions" in their organization for system management, which explains the importance of integrating OpEx into the organizational chart of the companies.

Finally, the average deployment levels of OpEx's Lean tools within the surveyed companies were analysed. The study's results confirm that these relevant tools, such as problem-solving methods, 5S, standardization, and visual display, are deployed in practice. However, their level of deployment strongly depends on human behaviour and their perception of the OpEx concept.

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