

The impact of the integrated supply chain on the operational performance of companies in the Moroccan electric vehicle sector

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Abstract. This study supports the idea that supply chain integration decisions are essential in the choice of strategy for the electric automotive industry in Morocco. Some studies indicate that the most admired and feared competitors today are companies that link customers and suppliers and their internal processes to tightly integrated networks. On the other hand, empirical studies have shown that supply chain integration is no guarantee of success. On the basis of these assertions, we will examine the relationship between supply chain operational performance-dependent variables (cost, quality, flexibility, and time) and integration-independent variables (customer, supplier, and internal integration). The current research is considered a causality study, addressing the effect of the three dimensions of integration on the operational performance of companies in the Moroccan electric automotive sector. Empirical data were collected from 253 companies, using a questionnaire developed and refined through interviews with experts and the panel of judges. Statistical techniques such as descriptive statistics, correlation and multiple regressions were used. The results of the study indicate a significant positive relationship between the integrated supply chain and the operational performance of the supply chain of companies in the Moroccan electrical automotive sector. Thus, the results affirmed that this sector interlocutors report a close relationship between integration and supply chain performance.

Index Terms— Automotive supply chain, electric automotive sector, impact of integration on operational performance, integrated supply chain, operational performance.

1 Introduction

The Moroccan automotive industry is fastly growing, with several major international companies choosing this country thanks to its competitive advantages. It has been identified as one of the engines of growth, given the major development recorded in recent years by participants in the automotive supply chain. Despite its importance, the traditional automotive industry also has a significant environmental impact, due to the greenhouse gas emissions and energy consumption associated with internal combustion engine vehicles. This is why the electric automotive industry is increasingly seen as a sustainable alternative to the traditional automotive industry. In Morocco, the electric automotive industry is still relatively new, but it is growing rapidly. Indeed, many parts companies and automakers are joining the green initiative to transform the automotive industry into an eco-friendly one by producing automotive parts with eco-friendly, recyclable, and sustainable materials. This industry has the potential to significantly reduce greenhouse gas emissions and energy consumption associated with mobility. Electric vehicles produce fewer atmospheric pollutants and are generally more energy-efficient than internal combustion engine vehicles. The Moroccan automotive sector is facing significant challenges, including mainly the integration and coordination of international activities. Many researchers have long stressed the need for close integration between participants in the automotive supply chain, in order to achieve the

operational performance of the automotive sector (cost, quality, flexibility, and time). However, there are also limitations and challenges to the implementation of an integrated supply chain, such as the complex coordination of the activities of several companies, the need for effective communication, the resolution of conflicts of interest, and shared decision-making.

The aim of this study is to analyze the relevance of taking integration into account in the operational performance of the supply chain in the Moroccan electric automotive sector, while attempting to answer the following question: What is the impact of the integrated supply chain on the operational performance of this sector? More specifically, this issue raises the question on the way companies can improve their operational performance through better integration of their supply chain.

Our study can potentially fill several gaps in existing research, including the lack of specific studies on the Moroccan electric automotive industry. Indeed, there may be a lack of research dedicated to the impact of the integrated supply chain on the operational performance of electric automotive companies. Such research can provide in-depth, context-specific knowledge, as well as valuable insights into the benefits, challenges, and best practices of implementing an integrated supply chain in this specific sector. In need of case studies specific to Morocco, this research can help to fill this gap by providing concrete examples and practical insights from the Moroccan context. The subject of our research can add a significant value on several levels. On one hand, it provides a better understanding of the importance of the integrated supply chain in the Moroccan automotive sector and its impact on operational performance. This can help companies to improve operational efficiency, reduce costs, increase competitiveness, and better meet customer needs. On another hand, our research can contribute to the scientific literature on integrated supply chains in the automotive sector, which is still relatively limited in Morocco. In this article, we began with a general summary, then a presentation of the position of our research in the existing literature. Afterwards, we gave an overview of the methods approved and used, and then, we reported the results obtained, and we gave recommendations and suggestions that can be adopted. Finally, we close our article with a conclusion.

2 LITERATURE REVIEW OF PROBLEM VARIABLES

Documentary analysis of the problem variables involves collecting and carefully examining various relevant documents in order to understand the different elements that are important in the context under study.

- **The integrated supply chain**

Many studies define the integrated supply chain as a harmonious process in which all parties involved in the supply chain, including suppliers, organizations, and customers, work independently and dependently [1]. This allows to streamline operations, reduce delivery times, optimize stock levels, improve visibility of goods flows, and anticipate fluctuations in demand. After a thorough analysis of the research on supply chain integration, it is clear that this strategic approach aims to optimize the coordination, collaboration, and synchronization of logistics activities in order to improve the efficiency and responsiveness of the entire process [2]. By choosing this approach, companies in the automotive sector can gain a competitive edge by offering high-quality products and services, meeting evolving customer expectations, and adapting to market challenges. This approach is proving to be a key element in their efficient operation [3]. According to in-depth research studies in the field of integrated supply chain management, the instrument of integration could be classified

according to the following main perspectives or dimensions. First, there is the internal integration, defined by many researchers as "the degree to which a manufacturer structures its own strategies, practices, and processes into synchronized and collaborative processes to meet its customers' requirements and interact effectively with its suppliers" [4]. Secondly, there is the integration of a company with its customers, also known as "downstream" integration [5]. This refers to the process of interaction and collaboration between an organization and its customers to ensure an efficient flow of products and/or services to customers. Lastly, there is the company's integration with its suppliers [6], known as supplier integration. It is defined as "the degree of partnership between a company and its key supplier members". Some authors use the term upstream integration to express supplier integration. These different dimensions of supply chain integration are essential to ensure effective coordination, optimal collaboration, and smooth product and information flows throughout the supply chain.

- **Operating performance**

The automotive industry is a highly competitive and constantly evolving sector, where operational performance plays a crucial role. In this context, strong operational performance is essential to remain competitive in the global marketplace. According to an in-depth study on operational performance, it is clear that this is the result of a continuous improvement, where every stakeholder is committed to finding ways to optimize processes and achieve superior results [7].

Various key dimensions of operational performance play an essential role in the success of companies in the Moroccan automotive industry, including quality, time, flexibility, and cost. Firstly, the quality is extremely important in this industry, as it is essential for preserving manufacturers' reputations, building customer loyalty, and maintaining a competitive edge [8]. Secondly, the time dimension is crucial in this industry since there are several challenges in ensuring optimum operational performance, mainly reducing production lead-times, improving responsiveness to demand, and optimizing delivery times [9]. Flexibility is also a key dimension; greater flexibility means that new models can be introduced, vehicles can be customized to meet the customer preferences, and production can be adjusted accordingly. A flexible supply chain and the ability to adapt to change are valuable assets in this competitive environment [10]. Finally, costs play a crucial role since an effective cost management enables automakers to market their vehicles while maintaining profitability. This involves optimizing production processes, minimizing waste and seeking out savings opportunities [11]. Consequently, these different dimensions interact in complex ways in the automotive industry, and strong operational performance in each of them is essential to maintain competitiveness and market success.

- **The supply chain for the electric vehicle industry in Morocco**

The automotive industry's supply chain in Morocco is a key element in its efficient operation [12]. It involves all stages of production, supply, and distribution of vehicles, from the acquisition of raw materials to delivery to dealers and end customers. The automotive supply chain is complex and diversified due to several factors, such as the variety of finished products, the product life cycle, the large number of parts forming a vehicle, and the large number of suppliers involved. It is therefore essential to analyze different aspects of automotive supply chains in an emerging market with its own specific features [13]. In this context, a number of industry researchers and economists are examining the challenges and complexities of automotive supply chains. Historically, the automotive industry in Morocco has been characterized by a pyramid-shaped supply chain structure. Tier 2 and 3 suppliers form the base of this pyramid, while assemblers occupy the top, with tier 1 suppliers

positioned in the middle. Tier 4 suppliers are generally present to support companies or raw material suppliers, who are not necessarily specialized in the automotive industry. They are generally located along the pyramid, operating in a similar way to competing imports.

3 Methodology

The main objective of this research is to develop and test a conceptual model to study the impact of the integrated supply chain on the operational performance of the electric automotive industry in Morocco. Given the nature of the problem, a quantitative methodological approach was chosen, involving the use of a questionnaire administered to a representative sample of companies in the sector. This approach consists in formulating research proposals or theoretical hypotheses, which are then confronted with real, representative situations, in order to verify their validity and test the validity of the conceptual model built on these hypotheses. Automotive companies are considered the unit of analysis, given their central role in this industry's supply chain. In this study, the data collection method was electronic, with the heads of departments such as logistics, procurement, customers, and quality. For data analysis, the SPSS statistical software (version 23) was used, due to its key functionalities. Calculations included descriptive and reliability analyses, correlation techniques, confirmatory factor analysis (CFA), and structural equation modeling (SEM). All these elements are essential for a thorough data analysis and for reaching appropriate conclusions. Between the years 2021 and 2022, we contacted companies working directly or indirectly in the Moroccan automotive sector located throughout the country, enabling us to collect data from 253 companies that agreed to contact us. However, 4 companies declined to complete the questionnaire, making them invalid for this study. Consequently, we were able to exploit 249 of the initial 253 companies.

- **Theoretical framework and development of hypotheses**

The present study is based on the framework proposed in Fig. 1. This framework was established on the basis of Dynamic Capability Theory (DCT) to determine the relationship between integration, resilience, and operational performance of the automotive supply chain. This theory assumes that automotive companies must be responsive by reconfiguring their internal supply chain practices, and evolve towards closer integrations with their suppliers and customers.

- H1:** Internal integration has a positive influence on supply chain performance.
- H2:** Supplier integration has a positive influence on supply chain performance.
- H3:** Customer integration has a positive influence on supply chain performance.
- H4:** Supply chain integration has a positive influence on supply chain resilience.
- H5:** Supply chain resilience has a positive influence on supply chain performance.

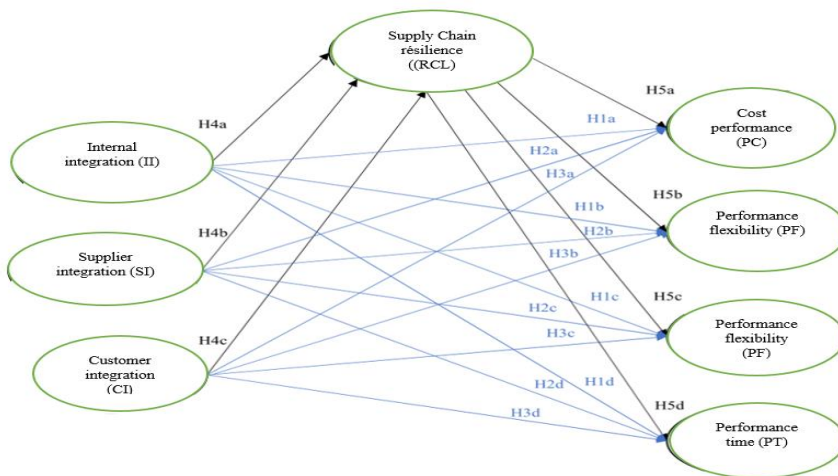


Fig. 1. Hypothetical research model.

- **Mediation analysis**

The literature on supply chain resilience and dynamic capability theory highlights the importance of supply chain integration as one of the means of generating synergistic effects within the supply chain network. In this context, supply chain resilience plays a crucial role in a company's success and survival. Companies that adopt a resilient approach are better prepared and able to cope with disruptions. In addition, the operational performance of the supply chain is an essential element in strengthening resilience within the supply chain. On this basis, it is proposed that supply chain resilience plays a mediating role in the relationship between the various dimensions of automotive supply chain integration and the components of operational performance.

H6: Supply chain resilience plays a mediating role in the relationship between integration and performance.

4 Data collection and analysis

From all that has been mentioned above, it appears that there is a close relationship between integrated supply chain and operational performance. This study extended previous empirical work by focusing on how resilience mediated the relationship between integration and operational performance in the automotive industry supply chain.

4.1 Assessing design validity

The average variance extracted (AVE) for each construct was tested to confirm convergent validity. The AVE for each construct was 0.68 for Supplier Integration, 0.634 for Internal Integration, 0.795 for Customer Integration, 0.568 for Supply Chain Resilience, 0.683 for Flexibility, 0.776 for Time Performance, 0.757 for Quality Performance, and 0.851 for Cost Performance. Values above 0.5 suggest that all item variations can be explained by the latent factor structures of the study. The AVE value for the supply chain performance construct was relatively low, but still exceeded 0.5, which is considered an adequate minimum convergence threshold. Consequently, the convergent validity of all variables was

confirmed. Table 1 shows that all constructs have AVE values greater than their squared correlations. Consequently, the discriminant validity of the constructs was confirmed. Passing this rigorous test can provide real proof of discriminant validity.

Table 1. Discriminant validity test.

	AVE	FI	II	CI	RCL	FLEX	TIM	QUAL	CO
FI	0.68	0.816							
II	0.634	0.861***	0.989						
CI	0.795	0.769***	0.887***	0.884					
RCL	0.568	0.518***	0.585***	0.468***	0.753				
FLEX	0.683	0.721***	0.619***	0.824***	0.278***	0.826			
TIM	0.776	0.737***	0.854***	0.854***	0.508***	0.813***	0.959		
QUAL	0.757	0.811***	0.926***	0.884***	0.780***	0.680***	0.898***	0.946	
CO	0.851	0.692†	0.796†	0.760†	0.772†	0.678†	0.760†	0.907†	0.972

4.2 Structural model and hypothesis testing

The fit statistics of the saturated theoretical model were identical to those obtained from the measurement model, confirming the correct transition from the measurement model to the structural model. The analysis yielded the following results: RMSEA=0.038, NFI=0.829, CFI=0.952, and TLI=0.949. The fit indices obtained in this study are within acceptable limits, indicating that the structural model is well fitted. Consequently, the validity of the structural theory is confirmed, given that the fit indices of the model are not significantly lower than those of the measurement model.

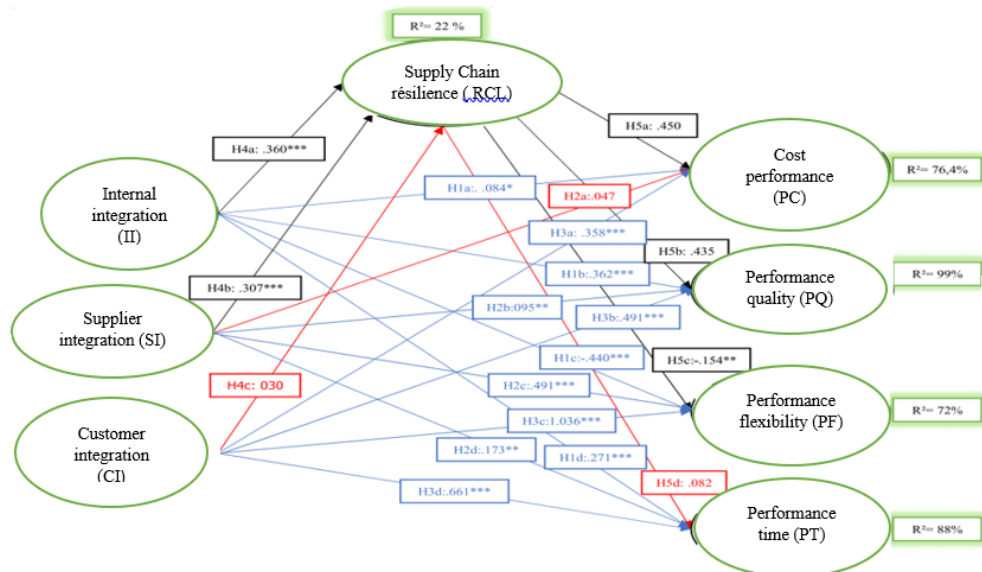


Fig. 2. structural path model.

The R2 value or estimate of the explained variance of endogenous constructs indicates the extent to which the model explains the variance of a construct. The R2 values of the structural model indicate that the model explains 22% of the variance in supply chain resilience, 76.4% of the variance in cost performance, 99% of the variance in quality performance, 72% of the variance in time performance, and 88% of the variance in flexibility. The results indicate that

all nine theorized structural paths are significant, as shown in Fig. 2 reporting the assumptions and their respective standardized β coefficients.

5 Results

The results highlight a non-linear relationship between integrated supply chain and operational performance, which is determined by the level of resilience in the supply chain. Thus, it is found that the benefits of external integration would not materialize in terms of performance if companies fail to incorporate resilience into their system. This study is a follow up to previous empirical work by focusing on how resilience mediated the relationship between integrated supply chain and operational performance. In this study, we found that internal integration, supplier integration, and customer integration were relatively important in building supply chain resiliencies. The empirical results also indicate that all three dimensions of integration affected supply chain resilience, which explained 22% of the variance in resilience. This result is in line with other studies [14][9]. Comparing the three dimensions of integration, we found that the impact of internal integration was much greater on resilience. Companies in the automotive sector in Morocco are encouraged to develop close relationships with their suppliers and customers, positioning themselves as key participants in the supply chain. Thanks to effective internal integration, these companies have access to concrete, accurate information, enabling them to reduce variations and react rapidly in the event of disruption. It is therefore essential to strengthen links and integration within the supply chain to maximize operational performance. Among all the constituent elements of operational performance, resilience exerts the greatest influence on cost performance, followed by quality performance, while it has a negative impact on flexibility. This finding is in line with previous studies conducted by Li et al. [9] and Wieland and Wallenburg [15].

The results of the study also highlight that companies in the Moroccan automotive sector show higher quality performance in relation to flexibility and cost performance when assessed in terms of supply chain resilience. The current study highlights the importance of customer integration in improving supply chain resilience. Thanks to close relationships with their customers, automotive companies in Morocco have been able to effectively respond to the customer needs. These results underline the importance of making customer satisfaction the main objectives of the supply chain. The results also show that automotive companies with integrated resilience have generated positive effects by improving the dimensions of cost, quality, and flexibility, while benefiting from a significant improvement in customer service. Moroccan automotive companies operating in a dynamic environment need to strengthen their integration capabilities, both internally and externally, by establishing close collaboration with their suppliers and customers. This approach will enable them to develop their resilience to cope with the dynamic changes and improve their operational performance. These results seem to corroborate the assertions of researchers such as Li et al. [9].

6 Discussion

The result of the present study shows the importance of supply chain integration within Moroccan automotive companies. Thus, this result should raise awareness among managers, supervisors, and other employees of these companies of the importance of supply chain integration and its effects on operational performance and the resilience of the overall supply chain. All independent variables show a high degree of integration (supplier, internal, and customer). The results indicate that customer integration is the highest and most crucial level of integration among the different components of supply chain integration. These results are

in line with those of Jassim [16], which demonstrated the positive impact of supply chain strategies focused on customer integration on the competitive advantage of industrial companies. The study concludes that supplier integration influences the operational performance of automotive companies in Morocco. This result is in line with Petersen et al. [17], who showed that supplier involvement had a positive impact on new product development and the improvement of financial performance. Our study also reveals that internal integration influences the operational performance of companies in the Moroccan automotive sector. This finding is supported by the work of Huo [18], which demonstrated that internal integration improved external integration, and that both these integrations had a direct and indirect impact on the company's supply chain performance. These results converge with the study's conclusions.

This study also encountered certain limitations. Firstly, as the study focused on Morocco, the results cannot be generalized to other countries and contexts with different characteristics and values. Secondly, the study relied on a single source of information from each manufacturing organization in order to examine the current framework involving supply chain integration, resilience, and performance. Thus, the study could be made more reliable by multiplying informants from the same company, using either a dyadic or triadic approach involving both customers and suppliers. Future studies could incorporate either of these approaches to increase the validity and generalizability of the results.

7 Conclusion

In conclusion, this study highlights the importance of the integrated supply chain in the Moroccan electric vehicle industry, and its impact on operational performance through resilience. The results underline that companies that succeed in effectively integrating their supply chain, by strengthening their resilience to market disruptions and changes, can improve their operational performance. This gives positive outcomes such as optimized costs, improved product and service quality, and greater flexibility to meet changing customer demands. By investing in close relationships with suppliers, customers, and supply chain partners, automotive companies in Morocco can benefit from improved responsiveness, reduced variation, and greater ability to cope with external disruptions. Therefore, an integrated and resilient supply chain becomes an essential element in strengthening the competitiveness and performance of automotive companies in Morocco.

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