

Research paper

# The Resilience of the Supply Chain to Disruptions: Analysis of Preparedness by Industrial Companies in Morocco for Crises and Supply Interruptions\*

Raissouni Rajaa<sup>1, \*</sup>, Raissouni Mohammed Rabih<sup>2</sup>, Samadi Sedki<sup>3</sup>, Raissouni Kenza<sup>4</sup>

<sup>1</sup> Centre for doctoral studies in economics and management and sustainable development, Abdelmalek Essaadi University, Tetouan, Morocco

<sup>2</sup> Research team Science Teaching and Issues of Multilingualism and Diversification of Learning Modalities in the Digital Era, Regional Center for Education and Training, Tangier, Morocco

<sup>3</sup> School of Science and Engineering Laboratory, Al Akhawayn University, Ifrane, Morocco

<sup>4</sup> Industrial Technologies and Services Laboratory, Higher School of Technology, Sidi Mohamed Ben Abdellah University, Fes, Morocco

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## ABSTRACT

Resilience and the efficiency of the supply chain are critical for the competitiveness of Moroccan businesses. However, these enterprises are encountering escalating disruptions that threaten the smoothness of their operations. Supply chain interruptions are particularly concerning, capable of paralyzing activities and jeopardizing the longevity of businesses. This article focuses on the preparedness and response of companies in Morocco to these crises, emphasizing supply interruptions in an interconnected and globalized context. The analysis examines the practices, strategies, and preparations used to address these challenges, underscoring the increasing necessity of supply chain resilience. The article is based on the theoretical foundations of supply chain resilience, presenting a conceptual model and detailing the research methodology. In conclusion, the obtained results are presented and analysed, providing an overview of the strategies implemented by companies in Morocco to ensure the continuity of their operations.

## 1. Introduction

The efficiency and robustness of the supply chain are essential pillars for the competitiveness and stability of industrial businesses in Morocco, a country experiencing significant economic growth. However, in an increasingly complex global environment, these companies are facing more frequent and unpredictable disruptions that jeopardize the smoothness of their supply chain. Among these disruptions, supply chain interruptions represent one of the most formidable challenges, capable of paralyzing entire operations and compromising the longevity of businesses. The central objective of this article is to examine how industrial businesses in Morocco prepare for and respond to crises and disruptions within their supply chain, particularly in the face of supply interruptions. As supply chain resilience becomes increasingly crucial in a context of global market globalization and interdependence among chain actors, this analysis specifically delves into the practices,

\*Corresponding author. Email: raissounirajae1@gmail.com

strategies, and preparations implemented by Moroccan companies to address these challenges. In this demanding context, these companies are enhancing their resilience skills to ensure the continuity of their operations. The central issue is presented as follows: How are industrial companies in Morocco preparing to strengthen the resilience of their supply chain in the face of crises and supply interruptions, and what mechanisms and strategies are being implemented to address these disruptions?

In order to answer our problem, we will first examine the theoretical principles underlying the resilience of the supply chain to establish the theoretical context. Then, we will explore the meaning of the resilience of a supply chain, then we will expose the conceptual model followed by a review of the applied research methodology. In conclusion, we will present the results obtained, analysing them subsequently.

## 2. Conceptual Framework

The conceptual framework of this study is based on three primary elements. Firstly, it defines supply chain resilience by describing a company's ability to anticipate, absorb, react, and quickly recover from disruptions in its supply, encompassing proactive strategies, crisis preparedness measures, and the ability to return to normal operations after a disturbance [1]. Secondly, the study identifies the preparedness strategies of companies in Morocco against disruptions in their logistics chains. These strategies encompass proactive risk management, continuity of operations plans, collaboration with suppliers, the use of advanced technologies, as well as training and awareness. These actions aim to mitigate the negative impact of disruptions on operational continuity and ensure an effective response to these situations [2]. Finally, this framework highlights the link between the resilience of the supply chain and the competitiveness of companies, emphasizing that this resilience reduces disruptions and associated costs, strengthens customer confidence, guarantees the quality of products, and thus maintains competitiveness by allowing companies to adapt quickly to changes and remain competitive on the market. The aim of this study is to establish a structural model that explains the link between all the factors and the resilience of the supply chain in the industrial sector, based on the hypotheses formulated:

- H1: Proactive risk management would positively impact the resilience of the supply chain in the era of disruptions.
- H2: Business continuity plans would positively impact the resilience of the supply chain in the era of disruptions.
- H3: Use of advanced technologies that would positively impact the resilience of the supply chain in the era of disruptions.
- H4: Collaboration with suppliers would positively impact the resilience of the supply chain in the era of disruptions.
- H5: Training and awareness-raising would positively impact the resilience of the supply chain in the era of disruptions.

We have developed a theoretical model that traces the relationship between the resilience of the supply chain and each of the following explanatory variables: proactive risk management, business continuity plans, collaboration with suppliers, the use of advanced technologies, as well as training and awareness. According to the presentation of the variables, we can propose our conceptual model by admitting the variable resilience of the supply chain as a variable dependent on the model.

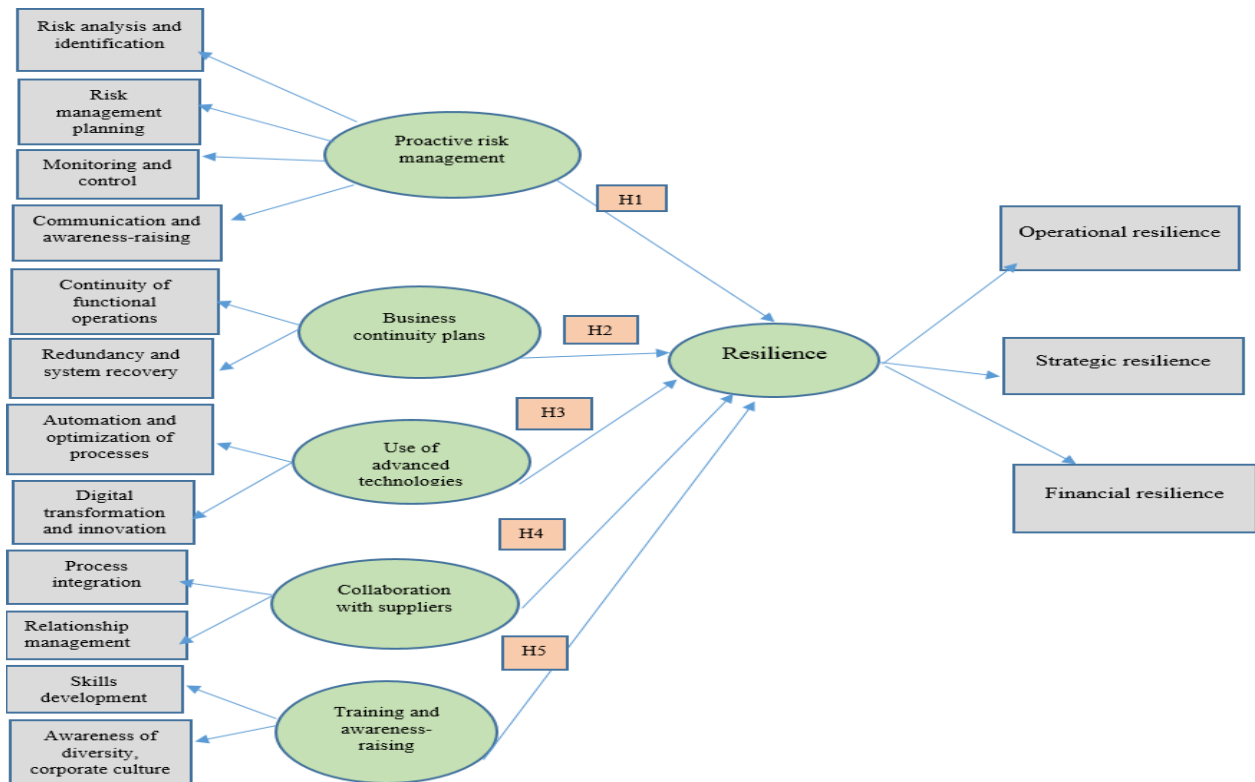


Fig. 1. The conceptual model.

### 3. Research methodology

This study adopts a mixed approach, combining both qualitative and quantitative methods. This combination will allow a thorough understanding of the practices of industrial companies in Morocco in terms of supply chain resilience, while offering a solid database for quantitative analyses. We have selected a sample of 15 industrial companies in Morocco of different sizes, and from different sectors, including automotive, food processing, chemistry, and electronics. This sectoral and size diversification has allowed us to obtain a complete representation of the way Moroccan companies approach the resilience of their supply chain.

**Qualitative data:** Semi-structured interviews were conducted with senior managers and logistics managers of each company in the sample.

**Quantitative data:** We have developed an online survey based on the qualitative information collected during the interviews.

During the interview and survey questions, we explored in depth the supply chain management practices, the challenges encountered during past disruptions, the lessons learned, and the strategies put in place to deal with supply disruptions.

### 4. Result

his study examines the logistics chain resilience across various industrial sectors in Morocco, focusing on enhancing resilience within the agri-food, automotive, and electronics industries. It evaluates the resilience strategies and practices of 15 selected companies operating in these sectors. Agri-food companies, facing significant logistical challenges due to product seasonality, raw material fluctuations, and quality requirements, emphasize the importance of resilience [3]. Similarly, automotive companies, notable for their substantial experience and involvement in international supply chains, require increased resilience against various logistical disruptions [4]. Electronic companies, heavily reliant on international chains, stress the crucial importance of

effective resilience in the face of these disruptions [5]. The study delves into the strategies adopted by these companies to fortify their logistical resilience in response to the specific challenges within their respective sectors.

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#### 4.1 Selecting a Template

The qualitative analysis of the interviews revealed that the automotive companies had developed solid business continuity plans, in particular by diversifying its suppliers and establishing backup contracts in the event of critical supply disruptions.

The quantitative analysis of the survey showed that automotive companies had obtained high scores in terms of supply chain resilience, thanks to practices such as the establishment of strategic buffer stocks and the use of advanced logistics management technologies.

The in-depth case study of automotive companies made it possible to explore in detail their supplier management strategy and to highlight a concrete example of successful collaboration with suppliers to mitigate the risks of disruptions.

#### 4.2 Selecting a Template

The qualitative analysis of the interviews revealed that the companies in the electronics sector had put in place a solid business continuity planning, with alternative supply plans in the event of a critical supply disruption

Quantitative data showed that companies in the electronics sector had implemented resilience practices such as diversification and collaboration with suppliers and the use of real-time tracking systems to improve the visibility of its supply chain.

The in-depth case study of companies in the electronics sector allowed us to explore in detail its supplier diversification strategy and highlight concrete examples of rapid response to disruptions.

##### 4.2.1 Selecting a Template

Structural equation analysis is an approach based on the estimation of the covariance matrix, makes it possible to judge the quality of fit of the model to the data by its distributional properties. This method therefore aims to establish the quality of a pre-established model based on the data [6].

We tested the significance of the relationship between each analysis dimension and the resilience of the supply chain. The results obtained are presented in the following Table 1.

**Table 1.** Test for the significance of the relationship between the dimensions of analyses.

Explanatory relationships		Significance threshold
Proactive risk management	→ Supply chain resilience	0.008
Business continuity plans	→ Supply chain resilience	0.013
Use of advanced technologies	→ Supply chain resilience	0.015
Collaboration with suppliers	→ Supply chain resilience	0.018
Training and awareness	→ Supply chain resilience	0.452

According to the analysis presented in this table, aspects such as proactive risk management, operational continuity plans, the use of advanced technologies, and collaboration with suppliers are the ones that contribute

to explaining the resilience of the logistics chain. Therefore, hypothesis H5 is not confirmed within the scope of our research. The research model obtained is validated by the data showing good fit indices. This model has allowed us to test the main research hypotheses.

**Table 2.** Validated Research Hypotheses

Research hypotheses	Relationship	Standardized coefficient	Probability	Decision
H1	Proactive risk management → Supply chain resilience	0.586	0.000	Validated
H2	Business continuity plans → Supply chain resilience	0.165	0.004	Validated
H3	Use of advanced technologies → Supply chain resilience	0.178	0.000	Validated
H4	Collaboration with suppliers → Supply chain resilience	0.673	0.000	Validated

#### 4.2.2 Analysis of the Results

As part of our study on the resilience of the supply chain of industrial companies in Morocco, the presentation of the results of our analysis, highlighting the best practices and the differences in approaches between these companies:

**Identification of Common Disruptions:** We have identified several types of common disruptions in the logistics chain in Morocco, including supply disruptions, delivery delays, workers' strikes, and problems related to customs regulations, climatic incidents, technological problems, supplier failures, health or epidemiological risks. These disruptions have had varying impacts on companies, ranging from minor delays to major interruptions in production.

**Impact Assessment:** The impact of disruptions varies depending on the preparation of each company. Those that have put in place solid business continuity plans have been able to react quickly and mitigate the negative effects. On the other hand, less prepared companies suffered significant revenue losses and a deterioration in their reputation.

**Best Practices in Terms of Preparedness:** The best practices observed include business continuity plans, the establishment of safety stocks, regular staff training in crisis management, and the use of real-time tracking technologies to monitor the supply chain. Companies that have invested in strong partnerships with their suppliers have also been able to better manage disruptions.

**Comparison of Approaches:** We found that large multinational companies tend to have more structured approaches to resilience, with teams dedicated to risk management and detailed business continuity plans. SMEs, on the other hand, were sometimes less prepared due to limited resources. However, some innovative SMEs have adopted agile strategies to cope with disruptions, such as the establishment of flexible supplier networks.

### 5. Discussion of the Results

Industrial companies in Morocco have adopted a holistic approach to preparing for disruptions in their supply chain. They have understood that proactive risk management, collaboration with stakeholders, business continuity plans and the use of advanced technologies are all essential strategies to ensure the resilience of their supply chain in the face of an increasingly complex and unpredictable environment [2]. The lessons learned from our study highlight the crucial importance of preparing for the resilience of the supply chain in Morocco. To strengthen their preparedness for crises and disruptions, it is essential that these companies diversify their sources of supply, establish strong partnerships with local and international suppliers, and regularly assess potential risks within their supply chain [7]. In addition, investing in advanced technologies, such as automation and the Internet of Things, can allow real-time monitoring and rapid reaction in the event of supply disruptions. The training of

personnel to deal with emergency situations is also a key aspect [8]. In terms of research perspectives, it would be beneficial to deepen the understanding of local factors that influence logistics resilience in Morocco, as well as to explore best practices in risk management and the development of continuity plans. This will contribute to strengthening the resilience of industrial companies in the face of supply chain disruptions in a constantly changing environment [9].

## 6. Conclusion

After a literature review that allowed for the design of a theoretical research model, capable of determining the variables that contribute most to explaining the resilience of the industrial sector's supply chain in Morocco [10], both the quantitative and qualitative studies significantly contributed to the research. These studies were integrated to compare the theoretical conclusions with the actual practices observed within the interviewed companies, identifying the fundamental factors necessary for a resilient supply chain as per industry experts.

In conclusion, our study revealed that resilience in the face of disruptions is not only imperative for industrial companies in Morocco but also a global requirement [11]. Our analysis of the measures taken by these companies to address crises and supply chain disruptions highlights the crucial importance of proactive risk management. Furthermore, close collaboration with reliable suppliers, investment in advanced technologies, and the development of operational continuity plans emerge as fundamental pillars for an effective response to ever-evolving challenges [12]. However, this research highlights the need for an ongoing exploration of local specificities and factors influencing logistical resilience, especially in Morocco. Encouraging innovation in risk management is imperative to proactively address changing challenges [13]. Companies pursuing this path position themselves advantageously to confront future disruptions, thereby ensuring robust logistics chains and contributing to the growth of the Moroccan economy within a dynamic global environment [14].

## References

- [1] S. Ambulkar, J. Blackhurst, S. Grae, "Firm's resilience to supply chain disruptions: Scale development and empirical examination," *Journal of operations management*, vol. 33, pp. 111-122, 2015.
- [2] G. Altintas. "La capacité dynamique de résilience : L'aptitude à faire face aux événements perturbateurs du macro-environnement," *Management & Avenir*, vol. 115, 2020.
- [3] L. T. Andrea. N. Simone. R. Lucia. "Environmental sustainability of agri-food supply chains: An LCA comparison between two alternative forms of production and distribution of endive in northern Italy," *Journal of Cleaner Production*, vol 140, Part 2, pp. 725-741, 2017
- [4] R. Benkirane. A. El Moudni. "Enhancing supply chain resilience to face supply disruptions: An experimental study in the Moroccan automotive sector," *Procedia CIRP*, vol. 41, pp. 91-96, 2016.
- [5] A. Mabrouk. A. Najjar. M. Dhouib. "Managing supply chain risk in Moroccan companies: Current practices and challenges," *Procedia CIRP*, vol. 58, pp. 28-33, 2017.
- [6] E. Jakobowicz. "Contributions aux modèles d'équations structurelles à variables latentes. Mathématiques," Conservatoire national des arts et métiers, Thèse, CNAM, PARIS, 2007.
- [7] Y. Al Meriouh. A. Elkharraz. F. Al Barrak. "Etude de l'impact des systèmes d'information sur la gestion des approvisionnements dans l'industrie automobile," *Revue Marocaine de Management, Logistique et Transport*, vol. 2, pp. 25-45, 2017.
- [8] K. Moukadem. A. Elkharraz. "Systèmes D'information et Résilience De La Chaîne Logistique Globale : Étude Exploratoire Auprès des Entreprises De L'industrie Automobile Au Maroc," *European Scientific Journal ESJ*, vol. 15, 2019.
- [9] A. Elkharraz. K. Moukadem. "Contribution de l'usage des systèmes d'information à la résilience de la chaîne logistique globale : Élaboration d'un modèle théorique," *International Journal of Innovation and Applied Studies*, vol. 25, no. 2, 2019.
- [10] A. M. Elkhoully. B. K. Pagnoncelli. "A multi-criteria decision-making approach to improve supply chain resilience in the Moroccan automotive industry," *International Journal of Production Research*, vol. 55, no. 13, pp. 3925-3940, 2017.
- [11] A. Salma. A. M. Youssef. "Usage Des Systèmes D'information Inter Organisationnels, Agilité Et Performance De La Chaîne Logistique. Vers Un Nouveau Modèle De Recherche," *European Scientific Journal ESJ*, vol. 15, 2019.
- [12] I. Merrouni. A. Elhannani. "S. Elfezazi. Evaluating supply chain disruption risks in Moroccan automotive industry: The case of Renault Tanger," *Procedia CIRP*, vol. 41, pp. 58-63, 2016.
- [13] U. Jüttner. S. Maklan. "Supply chain resilience in the global financial crisis: an empirical study," *Supply Chain Management: An International Journal*. vol. 16, no. 4, pp. 246-259, 2011.
- [14] Y. Larbi. "La relation : Innovation et résilience des coopératives, élaboration d'un modèle conceptuel," *revuecca*, vol. 4, 2019.