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Challenges in Embracing Green Supply Chain in Morocco's Auto Industry

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Abstract
As global environmental awareness grows, businesses are increasingly pressured to integrate environmentally responsible practices into their supply chains. However, the automotive industry in Morocco needs to be faster to embrace Green Supply Chain Management (GSCM). This research applies the rigorous Analytic Hierarchy Process (AHP) approach and polls industry specialists to evaluate and prioritize the most significant barriers to broad GSCM deployment in the automobile industry. The results show that financial hurdles are the most difficult to overcome, whereas technical and infrastructure hurdles are less than others. This ground-breaking study provides important insights into the barriers to GSCM implementation in Morocco's automotive industry. These results could motivate governments, business leaders, and academics to create concrete plans to address the challenges highlighted here. The primary goal of this study is to promote environmental stewardship and drive corporate growth in Morocco's automotive sector by adopting of green supply chain techniques.

Keywords:
green supply chain management; barriers analysis; analytic hierarchy process; automotive industry

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INTRODUCTION

The concept of Green Supply Chain Management (GSCM) traces back to the late 1980s when companies began incorporating environmental considerations into their operations in response to the quality and supply chain revolutions. Discussions on the green supply chain can be attributed to Kelle and Silver's study in the 1960s, which introduced an optimal forecasting system for reusable products (Fortes, 2009). Over time, GSCM has evolved to encompass various dimensions such as green design, life-cycle analysis, reverse logistics, waste management, and green manufacturing. These developments have contributed to a more comprehensive understanding of GSCM's potential in driving sustainable practices throughout the supply chain.

Empirical evidence strongly supports the positive impact of GSCM implementation on automotive supply chain performance. The automotive companies in Portugal demonstrate the favorable influence of GSCM on supply chain performance (Carvalho et al., 2010). Similarly, research on Volvo, Trans Alta, and Nortel suggests that adopting GSCM practices can balance economic growth and environmental preservation (Rowledge et al., 2017). Furthermore, studies examining the economic implications of GSCM adoption highlight significant benefits (Rao & Holt, 2005). For instance, a study on manufacturing companies in the UAE reveals that green purchasing enhances economic performance through reduced energy and material consumption and increased average profit and sales returns (Younis et al., 2016). Consequently, green purchasing is considered a strategic approach to bolster economic vitality. Companies are faced with several obstacles in their pursuit of environmentally responsible practices despite the number of reasons pushing them to adopt Green Supply Chain Management (GSCM) and advance corporate sustainability. It is clear that GSCM implementation is a challenging task (Giunipero et al., 2012).

In the automotive industry, a vanguard of visionary automakers has emerged as trailblazers, leading the charge in Green Supply Chain Management (GSCM) and redefining the industry's future. With a proactive mindset, these companies embrace green design, sustainable purchasing, eco-friendly marketing, efficient production, eco-conscious packaging, and recycling practices. Remarkably, their commitment to sustainability goes beyond profit; it is a collective responsibility. Moreover, Moroccan automobile manufacturers, echoing this environmental consciousness, have integrated greening strategies, with Renault standing out for its remarkable CO2 emissions reduction through energy optimization and renewable energy utilization, alongside eliminating liquid industrial waste and reducing water charges (Haddach et al., 2017). These pioneers set a powerful precedent, underscoring that profitability and environmental stewardship can harmoniously drive the automotive industry toward a cleaner, greener, and more sustainable tomorrow.

However, challenges persist for other automakers, particularly in India, where limited customer demand, lack of knowledge, and concerns about additional costs hinder full GSCM implementation. Nonetheless, empirical evidence and case studies demonstrate the potential benefits of GSCM adoption, encouraging organizations to consider sustainable practices for both environmental preservation and economic growth. As a result of increasing public awareness as well as the efforts of key manufacturers, the automotive industry's future may be more promising than was once anticipated.

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Various countries have various environmental laws and regulations, which has led to disagreements about what is preventing Green Supply Chain Management (GSCM) from being implemented in the automotive industry. Others have yet to implement GSCM for various reasons, including low customer demand, a lack of expertise, and the perception that GSCM is an unnecessary expense. One must have an in-depth understanding of the potential barriers that may arise to successfully implement Green Supply Chain Management (GSCM) in the automotive industry. Numerous studies have been conducted, and their findings have shed light on modern enterprises' challenges.

Dashore & Sohani (2013) combed through the available literature and met with industry professionals to compile a list of twenty distinct obstacles to GSCM. Mohammadjafari et al. (2014) identified around twenty sub-barriers, which they divided into the categories of technology and funding. Zhu et al. (2007) highlighted regulatory compliance as a significant barrier, particularly in light of China's entry into the World Trade Organization. Several studies have shed light on the specific barriers in the Indian context. Luthra et al. (2011) identified 11 barriers and established contextual relationships using the Interpretive Structural Modeling (ISM) approach. Similarly, Mathiyazhagan et al. (2013) examined 26 barriers and assessed their impact on GSCM implementation in the Indian automobile industry, using ISM to determine the most significant barriers.

In the Indian mining industry, Muduli & Barve (2013) revealed that poor legislation and lack of environmental awareness were critical obstacles to GSCM adoption. Focusing on the viewpoint of a first-tier supplier, Silva et al. (2018) examine the challenges facing the Brazilian automobile sector in its efforts to adopt Green Supply Chain Management (GSCM). It classifies 43 GSCM roadblocks, verifies 13 of them with the help of experts, and evaluates their effect on different parts of the business using the Analytic Hierarchy Process (AHP). The cost implications barrier (B1) stands out as the most significant, with a weight of 22 times that of the thirteenth-ranked barrier (B21). Due to the interdependence of the companies involved in a supply chain, it is possible to eradicate some impediments to Green Supply Chain Management (GSCM) at a time. Therefore, supply chain members often need to establish priorities for overcoming these obstacles and work to do so in a way that considers their relative significance and urgency (Govindan et al., 2014).

This study is a first of its kind since it examines the obstacles to Green Supply Chain Management (GSCM) in the automotive sector, specifically in Morocco, where such research is still in its infancy. This study intends to shed light on the unique challenges encountered by the Moroccan automobile industry in adopting GSCM since the factors preventing its widespread adoption vary widely depending on the country and sector. The main goal is identifying and prioritizing these obstacles, offering crucial information for supply chain managers to target and overcome the most obstructive difficulties proactively. While other studies have looked at GSCM roadblocks, this one stands out by focusing on an understudied environment and industry to uncover novel difficulties and provide specialized solutions that can help supply chain managers push sustainable practices forward. The study aims to help the Moroccan automobile industry switch to more green practices as soon as possible by identifying and removing the most pressing impediments.

METHODS

Analytic Hierarchy Process (AHP) is a collection of axioms that closely determine the aspects of the environmental problem (Saaty, 1986). It is a decision-support tool in business industries. It is a methodology that compares alternatives concerning a criterion in a natural, pair-wise mode. AHP is based on a well-defined mathematical structure of consistent matrices and their associated right Eigen vector's ability to generate true or approximate weights (Kumar et al., 2009). The major objective is to determine what stood in the way of the widespread implementation of Green Supply Chain Management (GSCM) in the Moroccan automotive industry. We chose AHP because it has been suggested as a helpful method by previous GSCM researchers for understanding the driving forces and constraints underlying GSCM adoption.

Table 1. Barriers and sub-barriers analyzed by using AHP.

Barrier category	Specific barriers
Financial (F)	Deficiency of finances (F1) The unavailability of bank loans (F2) Costs of GSCM implementation (F3) Costs of hazardous waste disposal (F4) High investment and less return on investment(F5)
Organizational and operational (O)	Lack of commitment from Top, middle management and individual (O1) Bad company's culture (O2) Lack of company efforts to adopt the Rs practices such as reuse, recycle etc. (O3) Lack of ethical value and corporate social responsibility (O4) Lack of government initiatives and supportive policies (O5) The suppliers' refusal to adapt to green concepts (O6)
Technological and infrastructure (TI)	Non-adoption of advanced cleaner technologies (TI1) Complexity in recovery operations (TI2) Lack of research and development (TI3)
Knowledge and support barriers (KS)	Customers' unawareness of GSCM practices (KS1) Lack of knowledge and experiences on environmental impact and green practices (KS2) Lack of environmentally conscious human resources and skilled in GSCM practices (KS3) Lack of staff training about GSCM (KS4) Lack of support from supply chain players (KS5)

This research into the GSCM literature led us to discover as many as nineteen sub-barriers that together impeded GSCM's widespread adoption. To better understand these obstacles, we broke them down into the four categories shown in Table 1. As part of our study, we surveyed Moroccan automotive experts and professionals with knowledge of GSCM deployment. To ensure that the pair-wise comparison questionnaire, a crucial aspect of the AHP process, would provide valuable insights, we made a great effort in selecting the respondents.

We chose AHP for our analyses because of the following reasons. First, AHP is well-suited, because of its widespread reputation for simplicity and ease of application. We kept the matrix acceptable in size and minimized the possibility of inconsistency by

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restricting the number of sub-barriers to 19. In addition, the Analytic Hierarchy Process (AHP)'s capacity to build a hierarchical framework for analyzing choice criteria makes it a good fit for our research aims. This research focused our efforts where they would have the most payoff, efficiently prioritizing the many difficulties inherent in GSCM. Although we randomly polled 52 experts in the Moroccan automotive sector, we only received usable responses from 14. Notably, AHP is more of a decision-making tool than a statistical one. Therefore, its effectiveness in practice is not dependent on big sample sizes.

Figure 1. AHP Framework for Identifying Key Barriers of GSCM Implementation

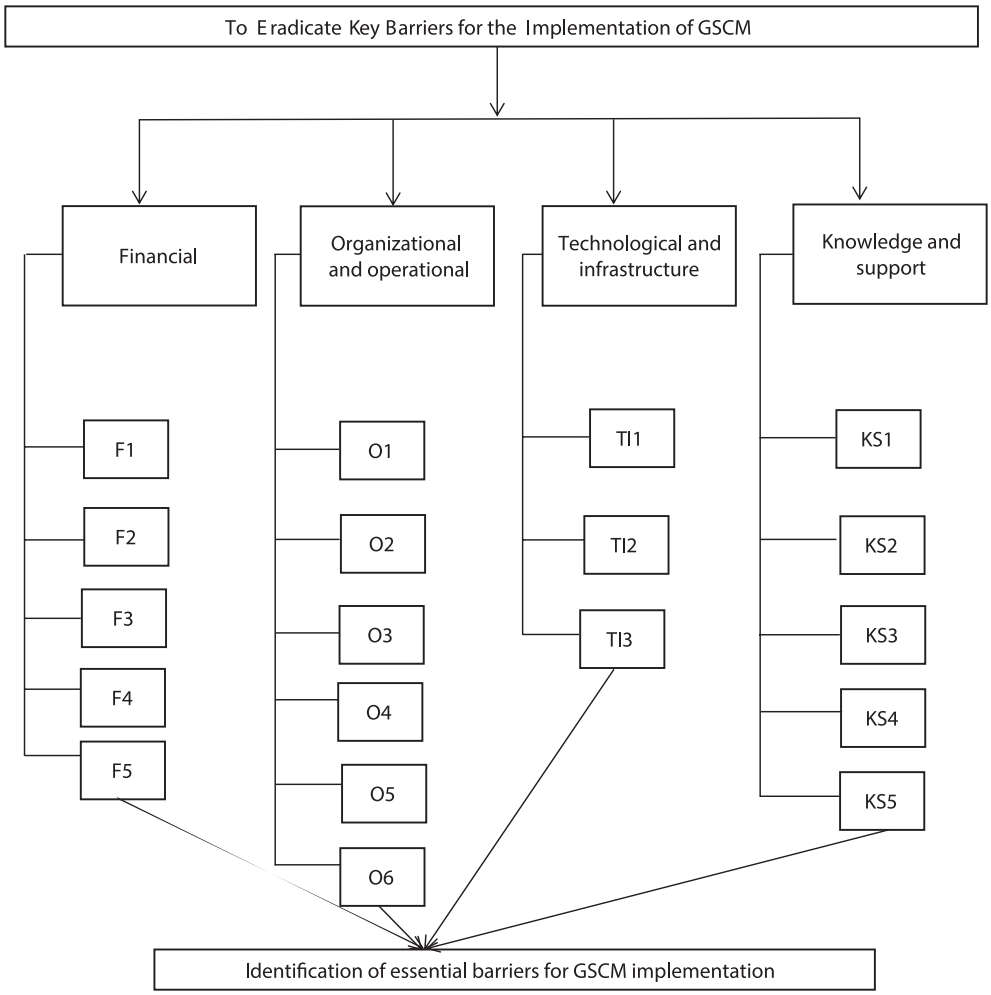

Figure 1 depicts the hierarchical prioritizing model we developed to achieve our study objective of identifying and removing critical impediments to the widespread adoption of GSCM. The literature evaluation yielded a four-tiered framework, with the top level representing the research objective, the next level representing the barrier categories, and the bottom level representing the specific barriers within each category. We developed a five-part, pair-wise comparison questionnaire to help us assess the significance of each obstacle and give them the attention they deserve. The questionnaire made it easy to compare broad categories of obstacles to specific obstacles within each category.

After collecting and analyzing filled-out surveys, the AHP approach is used to determine the standardizing weight for each category and individual barrier. In conclusion, we gained insight into the obstacles blocking the widespread implementation of GSCM in Morocco's automotive industry with the participation of expert respondents.

RESULT AND DISCUSSIONS

Table 2 shows the findings of an AHP study of the challenges associated with implementing green supply chain management (GSCM) in the Moroccan automotive sector. Several types of obstacles, including those related to Financial, Organizational and Operational, Technological and Infrastructure, and Knowledge and Support, are cataloged in the research. Global weights are then determined, considering both the relative relevance of each barrier within its category and the overall significance of all barriers. The financial barrier has the highest weight (0.38244). Among the four barrier categories, it is the most significant impediment to GSCM adoption in the Moroccan automotive sector. The second highest weight is given to the knowledge and support barrier category, indicating that it also considerably influences GSCM adoption. Organizational and operational barriers are ranked third, whereas technological and infrastructural barriers obtained the lowest weights (0.1054).

Among the barriers, the Costs of the GSCM implementation barrier (F3) have the highest global weight, followed by the lack of support from supply chain players (KS5). The high investment and lower return on investment (F5) has obtained the third-highest global weight. Moreover, the fourth-highest global weight went to the suppliers' refusal to adapt to green concepts (O6). At the same time, the bad company's culture (O2) is the less impactful barrier to the GSCM implementation. Financial barriers are a significant and continuous element slowing the automotive industry in Morocco's shift from conventional to GSCM. The most prominent challenge to implementing GSCM is a need for more financial resources. Financial barriers as significant restraints to GSCM implementation (Lee, 2008: Khan & Qianli, 2017). Lee (2008) pointed out that the costs of implementing GSCM might be a significant barrier for organizations looking to embrace green practices.

The findings are intriguing since they oppose the argument by Besbes et al. (2013), who posited that large enterprises may not face significant financial hurdles. On the other hand, this research shows financial barriers to implementing GSCM techniques at even the largest automotive companies in Morocco. The biggest financial obstacle found in this research is the costs of GSCM implementation (F3), which entail extra expenditures that are at odds with the financial objectives of these businesses. Moreover, the expensive investment and low return on investment (F5) are significant impediments, and the financial (F1) deficiency prevents substantial investment in GSCM processes. The unavailability of bank loans (F2) exacerbates the financial constraints, as Moroccan banks do not offer specific loans for green initiatives. These results highlight the critical importance of overcoming financial barriers to promote broader and more fruitful adoption of GSCM techniques.

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Table 2. Local and Global Weights of All Barrier Categories and Specific Barriers for the Implementation of GSCM

Barrier category	Relative weights using AHP	Barriers	Relative weights using AHP	Global weights using AHP	Rank
Financial	0,38244	F1	0,17454	0,06675	5
		F2	0,10984	0,04201	13
		F3	0,41884	0,16018	1
		F4	0,05704	0,02182	16
		F5	0,23974	0,09169	3
Organizational and operational	0,23469	O1	0,19684	0,04620	8
		O2	0,04898	0,01149	19
		O3	0,18304	0,04296	12
		O4	0,06512	0,01528	17
		O5	0,19672	0,04617	9
		O6	0,30930	0,07259	4
Technological and infrastructure	0,10541	TI1	0,41357	0,04359	11
		TI2	0,13800	0,01455	18
		TI3	0,44843	0,04727	7
Knowledge and support	0,27745	KS1	0,11882	0,03297	15
		KS2	0,21054	0,05841	6
		KS3	0,14277	0,03961	14
		KS4	0,16489	0,04575	10
		KS5	0,36298	0,10071	2

The second-highest impact barrier is knowledge and support. This result agrees with Abdullah et al. (2016), who similarly argue that lack of information and assistance hinders GSCM implementation. According to Abdullah et al. (2016), adopting green practices with sufficient understanding and support from stakeholders is only possible. According to the results, the biggest problem in this area is the need for more support from supply chain players (KS5). The success of GSCM depends on the combined efforts of everyone involved in the supply chain. The assessed businesses ran into this problem because they could not convince their stakeholders of the importance of environmental impact and green practices (KS2). The lack of staff training about GSCM (KS4) is also cited as a significant barrier. The only way to overcome these roadblocks is to provide workers with training and guidance in environmentally friendly methods.

However, it seems contradictory that customers' unawareness of GSCM practices (KS1) was given the lowest priority. Companies may be motivated to adopt green practices apart from client demand to improve their brand image, meet future regulatory obligations, or follow global sustainability trends. This research indicates that automotive manufacturers in Morocco are becoming more environmentally responsible, even without direct market pressure. The organizational and operational obstacles are next on the list of GSCM implementation barriers. The most critical challenge in this group is the supplier's refusal to adapt to green concepts (O6). Since the automotive industry needs parts from suppliers, it might be challenging to implement GSCM if those companies are hesitant to provide environmentally friendly materials. Successful GSCM deployment and reducing environmental effects need strong supplier collaboration. The second most important is the

need for more commitment from the top, middle management, and individuals (O1). Jayant & Azhar (2014) point out the importance of top and middle management in shaping a company's approach to environmental management. These results stress the need for full buy-in and dedication from top management before GSCM can be successfully implemented. When businesses adhere to sustainability principles, they better allocate resources, integrate environmental initiatives, and become more resilient in adversity.

The lack of government initiatives and supportive policies (O5) is another critical obstacle to GSCM implementation. This study corroborates the results of prior research suggesting that excellent government policy may encourage environmentally friendly practices in the private sector. Despite companies' best intentions, RS practices like reuse, recycling, etc. (O3) are not being implemented, indicating that more work must be done to encourage mainstream green practice adoption. Lastly, obstacles such as lack of ethical principles and CSR (O4) and a poor company culture (O2) are underlined. These challenges underscore the need for a business culture and values aligned with sustainability principles to promote successful GSCM implementation. When considering the challenges posed by technology and infrastructure, the absence of R&D (TI3) is often cited as the primary cause of concern. Education and research on GSCM could be much better in Morocco, which impedes progress in this area. To successfully apply GSCM processes, businesses need access to cutting-edge research and tools. Garcia-Torres et al. (2019) also highlighted the significance of R&D in the spread of green practices, which is consistent with these results.

The second most common challenge to GSCM implementation is the non-adoption of advanced cleaner technologies (TI1). Consistent with findings by Alonso-Muñoz et al. (2022), this finding highlights the role of technical innovation in enabling sustainable operations. Since the Complexity in recovery operations (TI2) is the least apparent technical barrier, it may not be as significant of a challenge to the adoption of GSCM. Even though this research suggests reduced Complexity in recovery operations, businesses still need to look for ways to simplify and enhance their waste recovery procedures to get the best possible environmental outcomes.

CONCLUSION

This study accomplished its primary goals, concentrating on identifying and comprehending the many obstacles Moroccan automotive firms confront in implementing green supply chain management (GSCM). The problems separated them into four groups: monetary, institutional, technical, and informational. Our detailed analysis of the hurdles within each category has helped the Moroccan automobile sector get a deeper and more nuanced understanding of the challenges it confronts in adopting sustainable supply chain practices. These results provide a solid foundation for future efforts, equipping stakeholders with the insights needed to devise concrete measures to remove these impediments.

Governments should take decisive action to overcome the most significant obstacles. Such action might include setting aside funds for environmentally friendly operations or teaming with banks to set up loans expressly for GSCM projects. As a method of amplifying the effects of GSCM adoption, it highlights the potential advantages of international cooperation with other countries and green-focused organizations. We stress the need

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for information sharing and capacity development beyond only policy. Increased training opportunities and easier access to conferences and summits are two ways authorities may better equip industry stakeholders with a thorough grasp of GSCM plans.

Finally, our findings show that increasing management's trust in GSCM's financial benefits for automotive companies is critical. This assurance is vital for resolving the recognized problems without risking the company's bottom line. Barrier elimination and supply chain resilience evaluation should be at the forefront of these efforts. Implementing GSCM requires careful forethought, setting short-term and long-term objectives, and a relentless review cycle. Financial pressures may be reduced, and a sustainable culture can be fostered by fostering cooperation and cost-sharing agreements among all partners in the supply chain. Building solid relationships with supply chain participants, governmental authorities, and shareholders is essential to securing access to vital resources, information, and greener technologies.

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