

# **Sustainable Supply Chain and reverse logistics management: An empirical study in the Moroccan automotive sector**

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## **Abstract**

Considering the increasing pressure from civil societies for a more sustainable and responsible environmental management, some companies are conscious of the insufficiency of internal capabilities and guidelines to move their logistics function toward a more environmentally responsible and sustainable model. Ageron et al. (2012) presented a theoretical framework for Sustainable Supply Management (SSM); where they empirically studied 187 French companies. The paper proposes a more generic theoretical framework for Sustainable Supply Chain Management (SSCM), the objective is evaluating sustainability all among the supply chain incorporating reverse flow management. To evaluate this proposed framework, the authors studied the practices of 78 selected Moroccan companies. The study proposes a questionnaire which aims to evaluate industrial performance in terms of sustainability in the context of an empirical study. The questionnaire comprises 5 axes containing 118 questions and it is intended for the leader of industrial structures, managers and logistics managers. Finally, a summary of relevant findings and conclusions are reported.

## **Keywords**

Sustainability, Reverse logistic, Empirical research, Framework.

## **1. Introduction**

According to the opening of the new car assembly plant of PSA Peugeot Citroen which is considered as the second largest car maker, Morocco is moving toward being a hub for the automotive industry in Africa. There are multiple reasons explaining this success: 1) Geographic location which is an ideal location for car manufacturers to set up their plants eyeing exports to Europe and Africa; 2) Stability of the economy and the political regime encourages automakers to invest in the country and to locate their plant units; 3) Governmental effort, tax advantages and skilled men power, all of which attract investors in the automotive industry. All the above has been a significant part of the kingdom's overall strategy to diversify its economy. As a developing country, Morocco faces typical problems such as restrained government spending, tremendous constraints on private activity and foreign trade, and the lack of a sustainable economic growth. In this sense Morocco is moving toward a green economy compliant with ecological balances and capable of opening new opportunities for wealth creation and sustainable jobs. This perspective has become part of the new sustainable development strategies.

Sustainable supply chains were the subject of great interest from researchers and industry in the last decade, it is a critical and timely topic that captures increasing concerns over sustainability, whether driven by current legislation, public interest, or competitive opportunity. Linton et al. (2007) provides a background to better understand current trends in this multidisciplinary field that intersect with operation management and the research opportunities and challenges it presents. As defined by Handfield et al. (1999), the supply chain encompasses all activities associated with the flow and transformation of goods from raw materials stage (extraction), through to the end user, as well as the associated information flows. Material and information flow both up and down the supply chain. Supply chain management (SCM) is the integration of these activities through improved supply chain relationships to achieve a sustainable competitive advantage. In other hand, Sustainable development is defined as "a development that meets the needs of the present without compromising the ability of future generations to meet their own needs" (WCED 1987). While diverse comprehensions of sustainability coexist, one central concept helping to operationalize sustainability where a minimum performance is to be achieved in the environmental, economic and social dimensions (Jonathan et al. 2002). While sustainable supply chain management is the management of material, information and capital flows as well as cooperation among companies along the supply chain while taking goals from all three dimensions of sustainable development, economic, environmental and social into account, which are derived from customer and stakeholder requirements (Mukhopadhyay et al. 2008). In sustainable supply chains, environmental and social criteria need to be fulfilled by the members to remain within the supply chain, while it is expected that competitiveness would be maintained through meeting customer needs and related economic criteria. This definition is rather wide and combines those given for sustainability and supply chain management. It is also able to integrate green/environmental supply chain management as one part of the wider field.

Today, the interest in sustainability is clear, research on this point has focused primarily on the financial impacts of specific environmental behaviors such as pollution control (Hart et al. 1994), recycling (Jorgensen et al. 2003) or reverse logistics (Mukhopadhyay et al. 2006). Gold et al. (2012) highlights that partner-focused supply management capabilities evolve to corporate core competences as competition shifts from an inter-firm to an inter-supply-chain level. The authors explore the role of sustainable supply chain management as a catalyst of generating valuable inter-organizational resources and thus possible sustained inter-firm competitive advantage through collaboration on environmental and social issues. J. Markley et al. (2007) Argue that firms can increase their competitive advantage as a result of a stronger triple bottom line, propositions are created from a natural-resource-based view of the firm perspective that is supported using accounting theory, management strategy, green logistics and supply chain literatures.

Multiple studies in the literature propose models that could be used by companies to measure the sustainability of their supply chain. Seuring (2013) reviews existing research on quantitative models and modeling approaches for sustainable supply chain management. Quariguasi Frota Neto et al. (2010) analyze if and when the closed-loop supply chains are assumed to be sustainable supply chains. The study illustrates the findings based on the Electric and Electronic Equipment (EEE) supply chain. Seuring et al. (2008) propose two purposes in their paper, firstly a literature review on sustainable supply chain management taking 191 papers published from 1994 to 2007 into account. Secondly a conceptual framework to summarize the research in this field comprising three parts. Along the same lines, Chaabane et al. (2012) introduce a mixed-integer linear programming based framework for sustainable supply chain design that considers life cycle assessment (LCA) principles in addition to the traditional material balance constraints at each node in the supply chain. Ageron et al. (2012) developed a theoretical framework and then to study this framework by means of an empirical study using perceptions and practices of selected French companies. The study collected 178 responses, all of them usable. Those individuals questioned included supply chain managers, purchasing managers, CEOs, and other managerial staff. Carter et al. (2010) discuss also sustainable supply chain. The authors perform a large-scale literature review and use conceptual theory building to

introduce the concept of sustainability to the field of supply chain management and demonstrate the relationships among environmental, social, and economic performance within a supply chain management context.

The aim of our study is to propose a model for measuring sustainability throughout the supply chain in the automotive sector in Morocco. The idea is to provide information on sustainability in a potential sector in Morocco and to propose a model for the automotive companies to assess their sustainability. The proposed study aims to examine sustainability in the automotive sector through an empirical study. The study involves interviewing leaders of a number of automotive companies on their strengths and their sustainability strategy. In this study, we propose a model based on the work of Ageron et al. (2012). The proposed model generalizes the work of Ageron et al. (2012) started, by taking into consideration the reverse flow management in these companies. The study proposes a questionnaire which aims to test the model and measure of industrial performance in terms of sustainability in the context of an empirical study. The questionnaire comprises 5 axes containing 118 questions. The questionnaire is intended for the leader of industrial structures, managers and logistics managers.

## **2. A model for sustainable supply chain management (SSCM)**

Hereafter, we present the proposed conceptual model for Sustainable Supply chain Management (SSCM) based on the literature review and analysis. The add value of the model comparing the one proposed by Ageron et al. (2012) is the performance criteria which have been given with more and considering the sustainability all among the supply chain. This aspect makes the model more operational and allows to better estimate sustainably among the supply chain. The model consists of 5 “building blocks” that will influence SSCM: (1) reasons for sustainable SSCM, (2) Benefits and motivation for SSCM, (3) Performance criteria for SSCM, (4) Barriers for SSCM, (5) managerial approaches for SSCM. The Fig. 1 shows the details of the proposed model.

The third block of SSCM considers the performance criteria for SSCM along the supply chain, starting from the product design, to the manufacturing process, packaging choice and characteristics of suppliers, information system, and finally the reverse flow management. The objective is measuring the performance all along the supply chain.

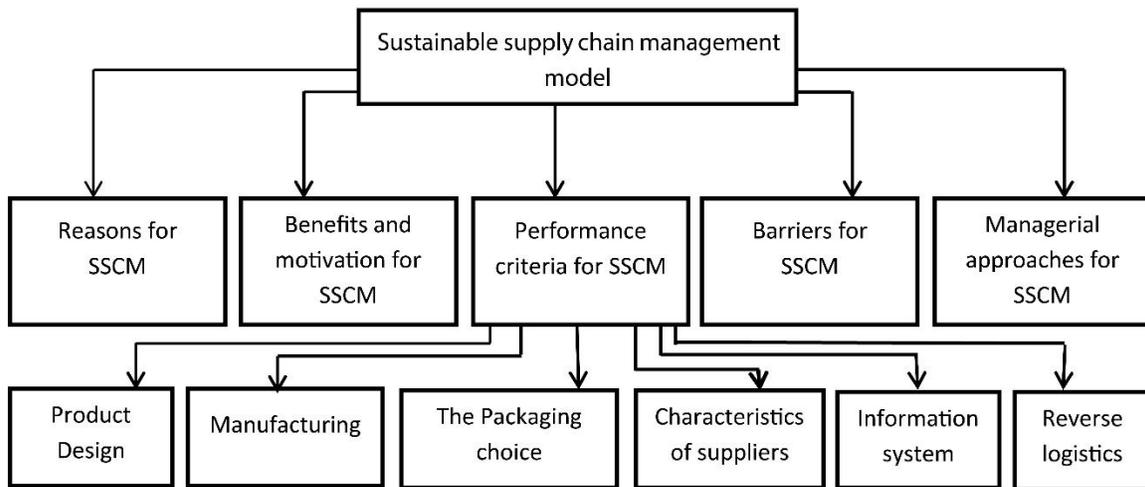


Figure 1 Generic Model scheme

## **3. Research Methodology**

The study aims to investigate the managers of the automotive companies and their suppliers about the sustainability of their manufacturing units. For this reason, we prepare a questionnaire based on the 5 axes of the proposed model containing 118 questions to evaluate sustainability of their supply chain. Most of the questions were presented using a Likert scale. Respondents were invited to state the degree to which they agree with specific statements on a 10point dimensional range from strongly disagree to strongly agree.

The purpose of this study is to develop a better understanding of sustainable supply chain management (SSCM). The aim is to determine if sustainability is currently taken into while the management of the supply chain. The responses gathered will help us to determine the reasons for SSCM, the criteria employed for SSCM, the greening supply chains strategy adopted by companies, the characteristics of suppliers concern with sustainability, the managerial approaches for SSCM , the barriers, the benefits and the motivation for SSCM.

The first phase was to define and delimitate the companies to contact. The second step was to contacting the managers of these structures and have their responses about the questions proposed. While the last step was about

data analyses according to their structural dimensions. This should allow identification of relevant issues and interpretation of results

#### **4. Empirical Analyses:**

After completing and validating the questionnaire in 78 Moroccan automotive companies. We passed to empirically test the model by collecting data; the individuals questioned included supply chain managers, logistic managers, Planners, purchasing managers, CEOs, and other managerial staff.

We analyzed the collected data according to the 5 “building blocks” of SSCM which include. Reasons for sustainability in supply management, benefits of SSCM, barriers for SSCM, the SSCM strategy, and performance criteria employed for SSCM including Product Design, manufacturing, packaging, information systems, and reverse logistics.

##### **4.1 Reasons SSCM**

The analyzes of the reasons of a sustainable supply chain show that the main reason is government regulatory requirement that forces many companies to respect many conditions, while the second important reason is the costumer’s expectations. The main reason for delocalization of these automotive industries to morocco is the cost reduction and due to its connection with the corporations and finally meeting their costumers needs.

Also many other reasons have been pointed out, like competitors actions that force many companies to move in order to avoid losing their market share. In the other hand, top management vision is still humble and it varies from a firm to another. However it should be strongly integrated and developed as reported by the investigated managers.

##### **4.2 Benefits of SSCM:**

Following the data analyzes, we notice that flexibility, quality, customer satisfaction, trust in suppliers and supplier’s capabilities to innovate are the most significant motivations for SSCM in the Moroccan automotive industries. Given that by these reasons these companies try to improve their image with their customers and stakeholders, and to have a positive impression among their partners. Thereby, it is clear that all the benefits of a sustainable supply chain in these companies is justified by the marketing aspects and their necessity to develop their image among the competitors as reported by Agreon et al. (2008) and Bai et al. (2015).

##### **4.3 Barriers of sustainable supply chain**

Following the data analyzes, the main barriers of a sustainable supply chain are the financial costs, return on investment, supplier’s skills, size and facilities, and focal company human skills. These analyzes show clearly that the financial costs and human capital present a real big barrier for automotive industries in morocco.

##### **4.4 Manufacturing technics for SSCM:**

In this section, we analyze the performance criteria for SSCM. The following analyzes focus on 6 axes from Product Design to manufacturing, the Packaging choice, Purchasing & Supplier’s selection, Sustainable issues involving your suppliers concern, the characteristics of suppliers involved in sustainable management, Reverse logistics, green supply chain, and finally the information system sustainability:

- The barriers of supply chain management are various such as the product design and reuse or recycling efficiency. Analyses show the managers responses analyzes concerning the main barriers of a sustainable supply chain. The data analyzes show that managers believe that the product design is one of the most significant barriers toward a sustainable supply chain, also the firm’s responsible show that renewability could be considered as barrier that prevents standardizing regular solutions aiming to establish sustainability in supply chain.
- In the manufacturing level, many technics could be useful to help companies to have a sustainable manufacturing process which contribute in establishing a sustainable supply chain. In the proposed questionnaire, data analyzes show that the most technics used in the Moroccan automotive industries are the lean manufacturing and achieving economies of scale in production which are judged as low cost solution while selecting less carbon intensive energy sources and fuel efficient tools and machines are still limited in the Moroccan automotive industries.
- Choosing a sustainable packaging is considered one of the factors of a sustainable supply chain management. The questioned managers show that durability and reusability are the main factors considered in choosing the type of packaging to use. Some of the questioned managers’ report that recyclability may also be one of the selection criteria of the sustainable packaging.
- Sustainable supplier’s selection is very important to insure the sustainability of the supply chain management. The reported points of view of the automotive industries managers show that service rate, quality, reliability, delivery, flexibility, economic dependency, and certification. The price is not considered in almost the cases as a major determinant factor for the companies aiming to establish a sustainable supply chain. However, company

size, social responsibility, and personal relationships are not considered as key factor for a sustainable supply chain management in the Moroccan automotive industry.

- Establishing a sustainable supply chain management imply integrating all the collaborators, the certification ISO 14001, ISO 9001, and OSHAS 18001 are considered by the managers of the Moroccan automotive manufacturing unit necessary for a sustainable supply chain. However, all the questioned managers impose that the obligation of having the ISO/TS 16949 Certification which related to the automotive sector. The questionnaire analyses highlight the importance of the lean manufacturing principles to improve efficiency and organizational performance
- Management reverse flow is considered as one of the key factor of a sustainable supply chain. The manager's claim that their companies focus on reducing wastes and carbon footprint which is the example of the Renault Tangiers plant on which the conventional boilers have been replaced by biomass boilers burning locally sourced olive stones as fuel and emitting zero carbon.
- The analyses show that in morocco, the companies benefit from the advantages of the information system. The companies system could hold the future activities of the company and permit connectivity and communication with the suppliers & the clients and an integrated planning with the suppliers & the clients

#### **4.5 Managerial approaches for SSCM**

The analyses shows that the sustainable supply chain management approaches in Moroccan automotive sector are pro-active and very often individual actions.

#### **5 Findings & Conclusion:**

In this study, we proposed a generic model that englobes sustainability in the supply chain. The objective is to propose a model to evaluate sustainability in supply chain.

- Customer tendency to environmentally friendly products: owing to the tendency of the European customers to environmentally friendly products and given to their position as the leader market for the Moroccan automotive industry products, so commercially companies tend to produce sustainably their products to meets the expectations of today's customers .
- Collaboration between all the participants in a supply chain (downstream and upstream) stills the best way to ensure a sustainable supply chain. It should be adopted exhaustively along the supply chain.
- Sustainability enlarges top management vision to include three bottoms to their management strategies so they can resist sustainably to the constant change of business environment.
- Green supply chain is almost identic to sustainable supply chain due to the weakness of social bottom in company's strategies.

These findings can be used as research hypotheses to expand the scope of further research on SSCM.

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### **Biography**

**Jalil Baddaoui**, graduated from the faculty of Juridical, Economic and Social Sciences of Tangier 2013. He started a PhD in economy and business in 2013. His research interests are sustainability and supply chain management.

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**Zouadi Tarik** assistant professor at the international university of Rabat, graduated from National school of applied sciences of Tetouan in 2012. He started a PhD in science and technic of engineer in the same engineering school in 2012. His research interests are the reverse flow management, modeling and optimization.

### **Appendix**

## QUESTIONNAIRE

### Sustainable supply chain

**1) Company characteristics:**

1. Name of the company: .....
2. Activities of the company: .....
3. Your company is: .....
  - a. *Independent*
  - b. *A subsidiary*
  - c. *National*
  - d. *International*
4. Birth of your company: .....
5. Number of employees: .....
6. Sales amount: .....

**2) Personal demographic characteristics.**

1. Your name: .....
2. Your phone number: .....
3. Your mail address: .....
4. Your sex: .....
5. Your age: .....
6. Your function in company: .....
  - a. *Supply chain*
  - b. *Operations*
  - c. *Supply*
  - d. *Purchasing*
  - e. *Quality*
  - f. *Marketing*
  - g. *Sales*
  - h. *Finances*
  - i. *R&D*
  - j. *CEO*
  - k. *Other:*
7. Your experience in the company: .....
8. Your experience in the function: .....

### Appendix 1

	Strongly disagree	Disagree	Slightly disagree	No opinion	Slightly agree	agree	Strongly agree
Sustainability in your company results from the following reasons:							
1) Top management vision							
2) Customer's expectations							
3) Suppliers green initiative							
4) Competitors action							
5) The business nature							
6) Government regulatory requirement							
7) Other Stakeholders ( such as NGO)							
8) Other: .....							
The main benefits for sustainable supply management are							
1) Flexibility							
2) Quality							
3) Fill rate							
4) Customer satisfaction							
5) Trust in suppliers							
6) Order fulfillment costs							
7) Supplier lead-time							
8) Supplier's capabilities to innovate							
9) Upstream supply chain risk management							
10) Reduction of stock							
Barriers of supply chain management							
1) Financial costs							
2) Return on investment							
3) Green investments							
4) Green induced changes							
5) Product price							
6) Characteristics of product							
7) Focal firm top management commitment							
8) Focal firm previous experiences on sustainability							
9) Focal company facilities							
10) Focal company human skills							
11) Supply chain configuration							
12) Suppliers location							
13) Supplier's firm size							
14) Supplier's firm culture							
15) Supplier's top management commitment							
16) Supplier's facilities							
17) Supplier's skills							
Performance criteria for SSM							
1) Product Design							
1.1) Low-impact materials							
1.2) Design impact measures for total carbon footprint							
1.3) Design for reuse and recycling							
1.4) Energy efficiency							
1.5) Renewability							
2) Manufacturing							
2.1) Selecting less carbon intensive energy sources							
2.2) Fuel efficient tools and machines							
2.3) Lean manufacturing approach in the firms							
2.4) Achieving economies of scale in production							
3 The Packaging choice take into consideration							
3.1) Durability							
3.2) Reusability							
3.3) Minimize toxicity							
3.4) recyclability							
4 Purchasing & Supplier's selection							
4.2) Price							
4.3) Service rate							
4.4) Quality							
4.5) Reliability							
4.6) Associated services							
4.7) Delivery							

Appendix 2

	4.8) Flexibility								
	4.9) Size								
	4.10) Confidence								
	4.11) Geography proximity								
	4.12) Long-term relationships								
	4.13) Economic dependency								
	4.14) Personal relationships								
	4.15) Information technology and information system								
	4.16) Environmental issues								
	4.17) Social responsibility								
	4.18) Certification								
5	Sustainable issues involving your suppliers concern								
	5.1) Certification ISO 140001								
	5.2) Certification ISO/TS 16949								
	5.3) Certification ISO 9001								
	5.4) Certification OSHAS 18001								
	5.5) Lean management								
	5.6) Waste reduction								
	5.7) Savings from packaging								
	5.8) Product life cycle management								
	5.9) Eco-design								
	5.10) Production resources system								
	5.11) Clean programs								
	5.12) Reverse logistics								
	5.13) Reducing carbon footprint								
	5.14) Green transportation channel								
6	What are the characteristics of suppliers involved in sustainable management								
	6.1) Strategic suppliers								
	6.2) Non-strategic suppliers								
	6.3) Large scale companies (MNE)								
	6.4) Small and medium sized enterprises (SME)								
	6.5) Geographically near suppliers								
	6.6) West European suppliers								
	6.7) Central European suppliers								
	6.8) North American suppliers								
	6.9) South American suppliers								
	6.10) Asian suppliers								
7	Reverse logistics in your company is considered as:								
	7.1) Strategic weapon								
	7.2) Competitive Reasons								
	7.3) Good corporate citizenship								
	7.4) Clean channel								
	7.5) Recapture Value & Recover assets								
	7.6) Legal disposal issues								
8	Establishing a green supply chain in your company focus on:								
	8.1) Reducing carbon footprint								
	8.2) Green transportation channels								
	8.3) Reducing wastes								
9	Information system sustainability								
	9.1) The system could hold the future activities of the company								
	9.2) the system permit connectivity and communication with the suppliers & the clients								
	9.3) the system permit an integrated planning with the suppliers & the clients								
In your company, the sustainable supply management are									
	1) Pro-active								
	2) Reactive								
	3) Active								
	4) Collective								
	5) Collaborative								
	6) Individual								

Appendix 3