Barriers' analysis for implementing Green Supply Chain: a case study in Morocco

Cherrafi Anass[1], Elfezazi Said[1]

[1]EST- SAFI/ Cadi Ayyad University, Morocco

ABSTRACT: *The purpose of this paper is to develop a structural model of the barriers to implement Green Supply Chain (GSC) in Morocco. Interpretive Structural Modeling (ISM) and MICMAC approaches have been used to identify and classify the barriers to implement GSC in Morocco. This paper has identified 11 GSC barriers and developed an integrated model using ISM and the fuzzy MICMAC approach, which is helpful to identifying and classifying the important GSC barriers and revealing the direct and indirect effects of each barrier on the GSC implementation by Moroccan. The integrated approach is developed, since the ISM model provides only binary relationship among obstacles, while fuzzy MICMAC analysis provides precise analysis related to the driving and dependence power of the barriers. Better understanding of these barriers will help Moroccan organizations to prioritize better and manage their resources in an efficient and effective way. This is the first kind of study to identify the GSC barriers and further, to deploy ISM and fuzzy MICMAC in order to analyze the barriers that influence GSC implementation in Moroccan. It is also the first paper in suggesting solutions ensuring effective and efficient development of GSC in the country.*

Keywords: *Green Supply Chain, Barriers to implement, Interpretive Structural Modeling, Morocco.*

I. INTRODUCTION

The supply chain activities are significant sources (totally 30.8 %) of greenhouse gas emissions and air pollution [1]. Consequently, the Green Supply Chain management is emerging as a new proactive approach to integrating environmental considerations into the supply chain management, throughout the product life cycle analysis. Green Supply Chain management covers all phases of product's life cycle from design, production and distribution phases to the use of products by the end users and its disposal at the end of product's life cycle [2]. The growing amount of research on the Green Supply Chain is a sign that managers and researchers are beginning to understand the importance of integrating environmental considerations into strategic and operational decisions linked to the supply chain [3]. Morocco is also affected by these changes. Indeed, Morocco is intensifying efforts to improve supply chain competitiveness and productivity. This has also improved the country's international trade competitiveness. Despite these developments, the implementation of the GSC in Morocco encounters several barriers.

The main objectives of this paper is to identify these barriers, establish relationships among the identified barriers using ISM, and find out driving and dependence power of barriers to implement Green Supply Chain in Morocco using Impact Matrix Cross-Reference Multiplication Applied to a Classification (MICMAC) analysis. ISM is a technique used to give fundamental understanding of complex situations where quantitative measure of the variables affecting the system is not possible [4]. ISM technique is suitable for our research work as the various barriers to implement GSC are not quantitatively measurable.

Starting with a literature review of the concept 'Green Supply Chain' and its characteristics as compared to a traditional supply chain; we will first analyzing the situation of the Green Supply Chain in Morocco while focusing on its shortcomings and structural - both organizational and infrastructural - problems. Then, we will be studying the development of a structural model of the barriers to implement GSC in Morocco using ISM. Finally, suggestions for improvement are to be made in order to contribute to the development of a more efficient and effective Green Supply Chain.

II. LITERATURE REVIEW: GREEN SUPPLY CHAIN

The concept of Green Supply Chain management was first put forward by the Manufacture Research Consortium (MRS) in Michigan State University in 1996 [5]. In the literature, the definition of a Green Supply Chain varies according to the perception of each researcher; it varies from green purchase to an integrated supply chain. [6] has defined the Green Supply Chain as the extension of the traditional supply chain to include activities aimed at minimizing the environmental impacts of a product throughout its life cycle , such as eco-design, resource saving , reduction of hazardous materials , reuse and recycling of products. According to [7], the Green Supply Chain is the process of integration of environmental considerations in purchasing decisions and in long-term relationships with suppliers. [8] defined it as the sum of the green purchasing, green manufacturing, green distribution / marketing and reverse logistics. According to [9] Green Supply Chain is

more than just putting some green practices in place: the environmental performance on all levels of the supply chain management has to be improved as well as on the shop floor levels. [10] defined the Green Supply Chain management as the integration of environmental consideration in the management of the supply chain, including product design, material sourcing, selection processes, delivery of the final product to consumers as well as the end of life cycle of the product after its useful life. According to [11], it is a concept that covers all phases of the life cycle of a product, from extraction of raw materials through the design, production and distribution, product use by consumers and their treatment at the end of their life cycle. [12] defined green or sustainable supply chain management as the management of material, information and capital flow between companies, whilst integrating environmental, social and economic goals [13].

III.   TRADITIONAL SUPPLY CHAIN VERSUS GREEN SUPPLY CHAIN

Despite the interdependence between traditional supply chain and Green Supply Chain; there exist significant differences between traditional and Green Supply Chain. The difference between a GSC and a traditional supply chain is that the GSC uses best practices to minimize waste and emissions along the value chain [14]. [15] compares traditional and Green Supply Chain in terms of objective, ecological optimization, supplier selection, cost, and flexibility. Management of Green Supply Chain involves a change in the structure and objectives of the traditional supply chain , and the addition of new material flow and information related to the activities of reverse logistics and cooperation between partners. We see it important to enrich the comparison criteria of traditional supply chain and Green Supply Chains, given by [13]. Table 1 summarizes the differences between traditional and Green Supply Chain.

Table 1. Difference between the conventional and Green Supply Chain.

Characteristics	Conventional Supply Chain Management	Green Supply Chain Management
Objectives	Economic	Economic and ecological
Structure	Linear	Closed loop
Supplier selection criteria	Price; Switching suppliers quickly; Short term relationship.	Ecological aspects; Long term relationship.
Information sharing	Low	High
Flexibility and speed	High	Low
Cost pressure	Low	High

IV.   IDENTIFICATION OF BARRIERS TO IMPLEMENT GREEN SUPPLY CHAIN IN MOROCCO

In a competitive environment, Morocco now need, more than ever, a competitive, sustainable and dynamic supply chain. However, the development of a Green Supply Chain remains relatively underdeveloped due to several barriers. In order to identify these barriers, we used on our experience as researchers and a review of literature and scientific articles and reports published by various state agencies: the Ministry of Economy and Finance, the Ministry of Infrastructure and Transport and the Ministry of energy, Mines, Water and Environment. All of the barriers identified from these sources are summarized below.

1.   *Lack of governance and government support*

The lack of the governance and government support is further identified as a barrier. It is related to the number of administrations involved in tackling environmental issues. In Morocco, the area of environment falls under a multitude of governmental departments, public, semi-public and private, all of which represent directly or indirectly management institutions, coordination or consultation with an environmental concern. This diversity of responsibilities presents a barrier which is characterized by a dispersion of efforts and bears the risk of a recurrent 'multi-cephalic power' which results a lack of harmony and cooperation in decision making and a risk of withdrawal of certain responsibilities [16]. The lack of specialist government agencies responsible for environmental regulation represents a failure of the national system of environmental management. Indeed, the most advanced in this area are countries like (Germany, Switzerland, Canada, USA, Tunisia ...) which chose early on to establish specialized agencies of environmental protection that ensure regulatory compliance. At the legislative level, the rules and regulations are rarely applied; despite the text being present, the application seems to be a problem. A key institutional and legislative difficulty is the poor financial state support available from the state. The challenge faced by Green Supply Chain is to convince companies to invest more. This is a valid and justifiable solution when the economy is booming and the state financially supports the green initiatives in the logistics sector. However, when things are more difficult, such as when the national economy is largely affected by the global economic crisis, which makes access to finance and state support is very difficult.

On the other hand, some state policies prevent Moroccan consumers from enjoying the value of less environmental harmful and more efficient use of resources. Examples include subsidies for fossil fuels (failure of public action), or the absence of incentives to build energy-efficient buildings (split incentives) and reduction

in air pollution (negative externalities). Therefore, lack of governance and government support constitute a barrier to implement Green Supply Chain in Morocco.

2. *Poor quality of human resources*

Qualified human resources are a key element for the development of a Green Supply Chain. A competent human capital can provide new ideas for business, learn new technologies easily, share knowledge with others and use new techniques to solve problems [17]. Training and education are the main requirements for the successful implementation of Green Supply Chain in any organization [18].

In Morocco the problem of training always exists despite 'inflation' training. Now, logistics training is experiencing uncontrolled acceleration: many are Graduate Programs (both private and public sector) and College level Professional Development Trainings program now exits. Nonetheless, these trainings have been criticized for failing to respond to increasing, specialized and demanding requirements [19]. Such existing training seems not to be structured nor coordinated.

Certainly commendable efforts are underway to regulate training and gain visibility into existing and necessary trainings. At this level the national logistics strategy (2010-2015) aims to affect the training of more than 61,000 people in 2015. So the lack of qualification and training of human resources is a major barrier to implement Green Supply Chain in Morocco.

3. *Lack of organizational culture*

Supply chain management has not yet been integrated into most Moroccan companies, which are still largely unaware of the issues involved in supply chain management. Given this situation, Morocco is still far away from mastering the concept of Green Supply Chain as a newly emerging one. Small and medium-sized enterprises (SMEs) and very small enterprises (VSEs) are an essential component of the Moroccan economic. They represent over 95 percent of all companies in the country [16]. They are characterized by family structures with limited technical and financial resources; and often lack the necessary human capital management, training and skills. These companies are also unable to detach themselves sufficiently from the local culture, and thus do not hire competent young managers capable of leading the company towards modernization and reengineering.

According to [16], who has conducted several studies on companies, the only companies in Morocco that have truly integrated logistics approaches, from a competitiveness perspective, are subsidiaries of multinational enterprises [20]. These structural deficiencies also prevent Moroccan companies from enjoying the benefits of outsourcing.

The level of subcontractors in Moroccan enterprise's logistics is currently very low; with only 10 percent proceeding by subcontracting against 75 percent for some benchmark countries such as Japan [21]. By outsourcing logistics, economic operators can fully concentrate on their business and generate more value while respecting the environment. It is clear that the organizational structure of Moroccan companies is a major barrier to implement Green Supply Chain in Morocco.

4. *Limited use of Information and Communication Technologies*

The use of Information and communication technologies (ICT) has substantially improved the exchange of information along the supply chain, which has led to the development of integrated production and logistics management systems, and has therefore improved, in different ways, the performance of supply chain [22]. The effective implementation of ICT is needed to support the Green Supply Chain through all stages of the product life cycle. It can be very useful for the development of environmentally friendly products, as well as for their reuse and recycling. An effective information system is necessary to track merchandise, especially where customer returns are needed [18]. Now it has become possible with a system or software for transportation management (TMS: Transport Management System) to plan, monitor and improve the performance of operations; this allows a reduction of claims and returns.

The tools used for geo-tracking of vehicles, radio navigation, labeling goods with bar codes, and radio frequency identification (RFID) all facilitate the identification or dematerialization of administrative procedures. These are all examples of the optimization of a Green Supply Chain. In addition, ICT provides essential support for the philosophy of Green Supply Chain management: it reduces costs and excess inventory levels while reducing environmental waste (energy, paper use, CO_2 emissions, etc.).
It is apparent that, the limited use of ICT and the low deployment of computing tools across the supply chain is an important barrier to implement Green Supply Chain in Morocco.

5. *Lack of innovation and scientific research*

To establish a Green Supply Chain, a country needs a strong capacity for technological and scientific innovation. In Morocco, public and private sectors pay little attention to innovation in supply chain and environmental issues. Only subsidiaries of multinational companies and a few Moroccan companies interested

in research and development (R&D) have dedicated structures, while the majority of Moroccan companies do not even have a research and development department. In addition to low investment, scientific research also lacks a clear strategy within the public authorities. The budget for scientific and technical research does not exceed one percent of GDP, in addition to which there is a lack of cooperation between universities and companies. To date there are not major research centers for logistics in Morocco. Researchers do not disseminate their work (through international conferences and journals). The challenge of green logistics in a country can not now be met without technological and scientific innovation's control. Therefore, lack of innovation and scientific research is a barrier to implement Green Supply Chain in Morocco.

6. *Low competition and market uncertainty*

In the current scenario, market instability is very high because of international competitiveness and customer requirements [23]. Moreover logistics services are weak and poorly diversified in Morocco. First, companies that offer a large range of logistics services are limited: there are less than a dozen throughout Morocco. Second, companies that offers a full range of logistics services are virtual subsidiaries of European companies and, most often, act as clients of multinational enterprises. Some segments of the supply chain are characterized by quasi-monopolistic behavior. For example, the evaluation of the intensity of competition through the calculation of markup results in a markup of 1.33 for the transport sector. This indicator stays away from one which reflects a weak competitive intensity [16]. Appendix 2 confirms the weakness of logistics services in Morocco.

Competition is essential to promote the development of Green Supply Chain in Morocco. Competition has allowed several economic sectors to reduce costs and therefore lower their prices. It has also improved the quality of services and products as a result to the remarkable decision to employ three dimensions of sustainable development. We assume that instability and low competition in the logistics market constitute the greatest barrier to implement Green Supply Chain in Morocco.

7. *Lack of internal and intermodal transport*

Internal transport faces mainly the problem of road transport that doesn't allow ensuring a high quality offer. It is characterized by the following difficulties:

Table 2. Barriers of internal transport.

Barriers	Statistics
Predominance of the informal sector.	Estimated at 70-75% of the total annual transport.
Transport offer particularly atomized.	90% of companies having 1 or 2 trucks and 50 companies with a fleet of 20 trucks.
Aging fleet of trucks.	Average fleet age of 13 years.
Absence of a rational management with real accounts.	Limited to 10 to 15% of Moroccan enterprises.
Distance traveled by trucks under 8 tones gross vehicle weight.	Higher than it should be.
Road safety.	68,458 accidents, 3,148 fatalities and 65,310 non-fatal accidents.

All of these barriers make the integration of the environmental dimension very difficult without prior sector reform. To these barriers added the poor development of intermodal transport characterized by the lack of rail transport. This last offers several environmental assets in particular through the standardization of the traffic. The intermodality is not synonymous of durability. In the best case scenarios, it is a requirement but not sufficient because we can extremely well imagine an intermodal transport system which is truly effective and safe from failures, but which does not answer all the criteria of durability [24].

In Morocco, the transport sector, represents more than 41 percent of national consumption in final energy and contributes to more than 23 percent of greenhouse gas emissions [16]. Consequently, lack of internal and intermodal transport is a barrier to implement Green Supply Chain in Morocco.

8. *Unawareness of Moroccan consumers and weakness of Non-Governmental Organizations*

A major barrier to implement Green Supply Chain is unawareness of Moroccan consumers about the advantages of green products. The pressures exerted by the consumers constitute a factor of adoption of green practices [17].The consumers are key player to make change, everything they do in their daily lives impacts on the environment. In the United States, 75 percent of consumers affirm that their purchases are influenced by the company image and 80 percent would be ready to pay more for eco-friendly products [25]. In Morocco, many consumers don't care about the environmental impact of the products they buy. There is little culture of citizenship on three dimensions of consumption: buying better, using better and discarding better. The intervention of non-governmental organizations also remains weak, for two primary reasons. First, the environmental movement is young, emerging only at the end of the last century. Second, the suppliers' lobby is very powerful, and defends its interests strongly. Suppliers tend to consider environmental organizations as

enemies instead of partners, which ensures that the fact that the influence of NGOs remains limited. The difference between these organizations keeps the environmental lobby's influence small. It has not yet acquired the same force as similar groups in other countries, especially in Europe [26]. We can therefore say that the lack of awareness of Moroccan consumers and the weakness of NGO's is a major barrier to implement Green Supply Chain in Morocco.

9. *Lack of financing mechanism*

Green Supply Chain requires higher initial investments, exceeding the financial capacity of Moroccan companies, of which 95 percent are SME. Getting engaged in environmental management involves two types of cost, direct cost and transaction cost. Both types of costs are likely to constitute significant barrier to implement Green Supply Chain [27].

Integration of ICTs, acquisition of new technologies, hiring of new staff with different expertise, motivation and training of employees to the practices of GSC will require financial resources. Financing mechanism is not appropriate. Moroccan companies have difficulty in obtaining financing from banks. For this reason, financial implication is a serious barrier to implement efficient GSC in Morocco.

10. *Lack of top management commitment*

Top management commitment is the factor that determines the tipping point between potential success and failure when developing and implementing Green Supply Chain [28].Top management commitment to the environment is essential to build a culture of environmental consideration and to empower employees to take actions to prevent negative environmental impacts from company operations [29]. Top management has significant ability to influence, support actual formation and implementation of green initiatives across the organization [30]. Consequently, lack of top management commitment is an important barrier to implement Green Supply Chain in Morocco.

11. *Lack of collaboration and green initiatives*

Implementation of green initiatives can help companies to respect the environmental standards and it's a good way to improve their public image. The most Moroccan companies select their suppliers based on costs and a partnership limited to economic values. There are few certified companies (ISO 14001, ISO 26000) engaged in strategic policies to minimize gas emissions, energy consumptions and maximize raw material efficiency.

Each member of the supply chain deals with the management of his own flow and his own environmental impact, without any collaboration with the other supply chain members. This situation prevented these companies from carrying out environmental profits through standardization of flows and resource sharing. Consequently, the lack of collaboration and green initiatives is a significant barrier to implement Green Supply Chain in Morocco.

V.   INTERPRETIVE STRUCTURAL MODELING OF BARRIERS TO IMPLEMENT GREEN SUPPLY CHAIN IN MOROCCO

1. *Interpretive Structural Modeling*

First proposed by J. Warfield in 1973, ISM is an effective methodology for dealing with complex issues. It enables individuals or groups to develop a map of the complex relationships between the many elements involved in a complex situation [4].ISM is often used to provide fundamental understanding of complex situations, as well as to put together a course of action for solving a problem [31]. It has been used worldwide by many prestigious organizations, including NASA. ISM is a combination of three modeling languages viz: words, digraphs and discrete mathematics, to offer a methodology for structuring complex issues. ISM is particularly useful and interpretive as judgment of working participants in a group for the study decides whether and how the variables are related [32]. The various steps, which lead to development of an ISM, are shown in appendix 1.

2. *Development of Structural Self-Interaction Matrix*

Based on the contextual relationship 'among identified barriers', we developed a structural self-interaction matrix (Table 4). This matrix indicates the pair wise relationships among the barriers affecting the implementation of Green Supply Chain management in Morocco. The symbols used to denote the direction of the relationship between the barriers are given below. Let us assume that the barriers under study are i and j, then the symbol 'V' denotes that barrier i will help to achieve barrier j, the symbol 'A' means that barrier j will be needed to achieve barrier i. The symbol 'X' means the barriers i and j will help each other to be achieved, and the symbol 'O' means barriers are unrelated. Using this, an initial reachability matrix is made as shown in Table 3.

Table 3. Structured Self-Intersection Matrix for barriers to implement Green Supply Chain in Morocco.

N°	Barriers to implement Green Supply Chain in Morocco	11	10	9	8	7	6	5	4	3	2	1
1	Lack of governance and government support.	V	V	V	V	V	V	V	V	V	V	X
2	Poor quality of human resources.	O	A	A	O	O	O	V	V	A	X	
3	Lack of organizational culture.	V	V	V	O	O	V	X	V	X		
4	Limited use of Information and Communication Technologies.	V	A	A	O	O	O	O	X			
5	Lack of innovation and scientific research.	O	A	A	O	O	O	X				
6	Low competition and market uncertainly.	V	A	A	O	O	X					
7	Lack of internal and intermodal transport.	V	O	O	O	X						
8	Unconsciousness of Moroccan consumers and weakness of Non-Governmental Organizations.	V	V	V	X							
9	Lack of financing mechanism.	V	A	X								
10	Lack of top management commitment.	V	X									
11	Lack of collaboration and green initiatives.	X										

3. Reachability matrix

We derived the reachability matrix from the structural self-interaction matrix (SSIM) developed in the previous step [33].

The initial reachability matrix is constructed from the structural self-interaction matrix (SSIM) using the following rules:

Rule 1: If the (i, j) entry in the SSIM is V, the (i, j) entry in the reachability matrix is set to 1 and the (j, i) entry is set to 0.

Rule 2: If the (i, j) entry in the SSIM is A, the (i, j) entry in the reachability matrix is set to 0 and the (j, i) entry is set to 1.

Rule 3: If the (i, j) entry in the SSIM is X, the (i, j) entry in the reachability matrix is set to 1 and the (j, i) entry is set to 1.

Rule 4: If the (i, j) entry in the SSIM is O, the (i, j) entry in the reachability matrix is set to 0 and the (j, i) entry is set to 0.

The final reachability matrix (table 4) is constructed from the initial reachability matrix taking into account the transitivity rule, which states that if a variable 'x' is related to 'y' and 'y' is related to 'z', then 'x' is necessarily related to 'z' [33].

Table 4. Initial Reachability Matrix for barriers to implement Green Supply Chain in Morocco.

N°	Barriers to implement green supply chain in Morocco	1	2	3	4	5	6	7	8	9	10	11
1	Lack of governance and government support.	1	1	1	1	1	1	1	1	1	1	1
2	Poor quality of human resources.	0	1	0	1	1	0	0	0	0	0	0
3	Lack of organizational culture.	0	1	1	1	1	1	0	0	1	1	1
4	Limited use of Information and Communication Technologies.	0	0	0	1	0	0	0	0	0	0	1
5	Lack of innovation and scientific research.	0	0	1	0	1	0	0	0	0	0	0
6	Low competition and market uncertainly.	0	0	0	0	0	1	0	0	0	0	1
7	Lack of internal and intermodal transport.	0	0	0	0	0	0	1	0	0	0	1
8	Unconsciousness of Moroccan consumers and weakness of Non-Governmental Organizations.	0	0	0	0	0	0	0	1	1	1	1
9	Lack of financing mechanism.	0	1	0	1	1	1	0	0	1	0	1
10	Lack of top management commitment.	0	1	0	1	1	1	0	0	1	1	1
11	Lack of collaboration and green initiatives.	0	0	0	0	0	0	0	0	0	0	1

Table 5. Final Reachability Matrix for barriers to implement Green Supply Chain in Morocco.

N° of barrier	1	2	3	4	5	6	7	8	9	10	11	Driving power
1	1	1	1	1	1	1	1	1	1	1	1	11
2	0	1	1*	1	1	0	0	0	0	0	1*	05
3	0	1	1	1	1	1	0	0	1	1	1	08
4	0	0	0	1	0	0	0	0	0	0	1	02
5	0	1*	1	1*	1	1*	0	0	1*	1*	1*	08
6	0	0	0	0	0	1	0	0	0	0	1	02
7	0	0	0	0	0	0	1	0	0	0	1	02
8	0	1*	0	1*	1*	1*	0	1	1	1	1	08
9	0	1	1*	1	1	1	0	0	1	0	1	07
10	0	1	1*	1	1	1	0	0	1	1	1	08
11	0	0	0	0	0	0	0	0	0	0	1	01
Dependence Power	01	07	06	08	07	07	02	02	06	05	11	62

Computing the degree of driving power and the degree of dependence power is made according to the following two rules:

Rule 1: the degree of driving power is obtained by summing each column.

Rule 2: the degree of dependence power is obtained by summing the lines.

4. Level partitioning

The Reachability Set (RS) and the Antecedent Set (AS) [34] are extracted from the final RM. The RS consist of the criterion itself and the others which it may help achieve whereas the AS consists of the criterion itself and the other criteria which may help achieve it. Intersection of RS and AS is obtained for all the criteria [35]. The criteria for which the RS and intersection set are the same is ranked 1st and placed at the top level in the ISM hierarchical structure. Once the top level criteria are identified, the criteria are removed and the iteration is continued to find the level of each criterion [34]. In this case, the level partitioning process for the 11 criteria was completed in 5 iterations. Iteration 1 and the final level partitions are given respectively in Table 6 and Table 7.

Table 6. First Iteration for partitioning of levels of barriers to implement Green Supply Chain in Morocco.

N°	Reachability Set	Antecedent Set	Intersection	Level
1	1,2,3,4,5,6,7,8,9,10,11	1	1	
2	2,3,4,5,11	1,2,3,5,8,9,10	2,3,5	
3	2,3,4,5,6,9,10,11	1,2,3,5,9,10	2,3,5,9,10	
4	4,11	1,2,3,4,5,8,9,10	4	
5	2,3,4,5,6,9,10,11	1,3,5,8,9,10	2,3,5,9,10	
6	6,11	1,3,5,6,8,9,10	6	
7	7,11	1,7	7	
8	2,4,5,6,8,9,10,11	1,8	8	
9	2,3,4,5,6,9,11	1,3,5,8,9,10	3,5,9	
10	2,3,4,5,6,9,10,11	1,3,5,8,10	3,5,10	
11	11	1,2,3,4,5,6,7,8,9,10,11	11	01

Table 7. Level partitioning of barriers to implement Green Supply Chain in Morocco.

N°	Barriers to implement green supply chain in Morocco	Level
11	Lack of collaboration and green initiatives.	01
04	Limited use of Information and Communication Technologies.	02
06	Low competition and market uncertainly.	02
07	Lack of internal and intermodal transport.	02
02	Poor quality of human resources.	03
03	Lack of organizational culture.	03
05	Lack of innovation and scientific research.	03
08	Unconsciousness of Moroccan consumers and weakness of Non-Governmental Organizations.	04
09	Lack of financing mechanism.	04
10	Lack of top management commitment.	04
01	Lack of governance and government support.	05

5. Development of Diagraph

Directed graph is generated from the final RM by the vertices and edges [36].

After removing the transitivity, a final diagram is developed. The relationship between the criteria is represented by an arrow. In the digraph the top level criteria obtained from level partitioning is positioned at the top and subsequent lower levels are placed till the bottom level is placed at the lowest position in the diagram [34]. The final diagram developed after removing the transitivity links is given in Figure 1.
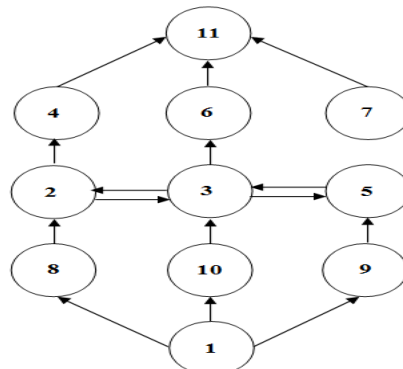

Figure 1. Final diagram for barriers to implement GSC in Moroccan Industry.

6. Classification of barriers to implement Green Supply Chain in Morocco

The objective of this study is to analyze the driving power and the dependence power of barriers to implement Green Supply Chain in Morocco. Higher dependence values for a barrier means a large number of barriers to be removed for its removal and high driving value of a barrier means a large number of barriers that could be removed by removing it [36]. The variables are classified into 4 sections: autonomous variables, dependent variables, linkage variables and driver variables. The MICMAC analysis for the barriers to implement Green Supply Chain in Morocco is shown in Figure 2.
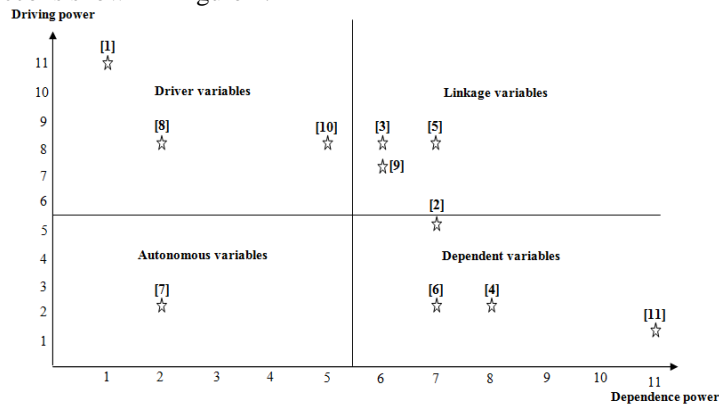
Figure 2. MICMAC analysis for barriers to implement Green Supply Chain in Morocco

Autonomous variables have low driving power and low dependence. They can be isolated from the system. In our study, one barrier named lack of internal and intermodal transport (7) is lying in this range. The second cluster is named dependent variables. They have low driving power and high dependence power. In our study, four barriers named poor quality of human resources, limited use of Information and Communication Technologies; Low competition and market uncertainty and lack of collaboration and green initiatives (2, 4, 6 and 11) are lying in this range. They are unstable due to the fact that any action on them will have an effect on others and also a feedback effect on themselves.

The third cluster named linkage variables having strong driving power and strong dependence power. In our study, three barriers named lack of organizational culture, lack of innovation and scientific research and lack of financing mechanism (3, 5 and 9) are lying in this range. The fourth cluster named driver variables has strong driving power and weak dependence power. In our study, three barriers named lack of governance and government support, unawareness of Moroccan consumers and weakness of ONG and lack top management commitment (1, 8 and 10) are lying in this range. The Other barriers could be eliminated by removing the barriers of this cluster [37]. The three elements of this cluster are related to the government, companies and civil society. So the implementation of Green Supply Chain in Morocco cannot success without collaboration and partnership between them.

7. The Final ISM Model

The diagram presented in figure 1 is converted into the final ISM model by replacing the barriers nodes with statements [34]. The final model is presented in figure 3.
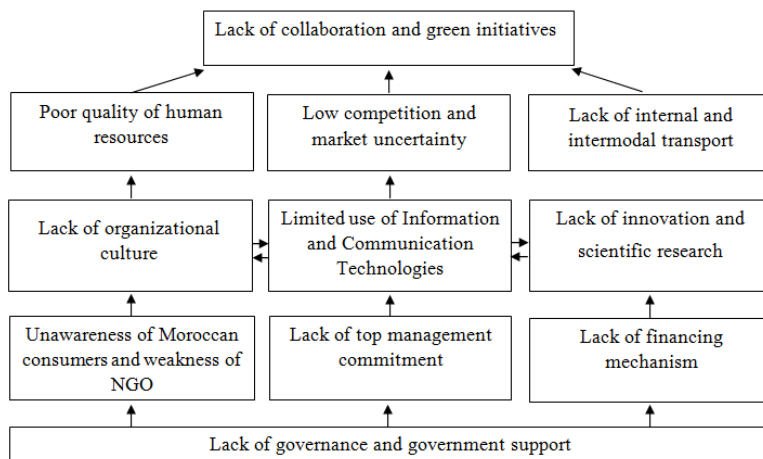

Figure 3. Final ISM model.

The barriers involved in the implementation of Green Supply Chain management in Morocco were solved in a hierarchical process by means of ISM modeling. From Figure 3, it is evident that the barrier 'lack of governance and government support' is coming at the bottom of the structural model. Therefore, Morocco should focus on this barrier in order to implement an efficient and effective Green Supply Chain.

VI.   PROPOSED SOLUTIONS FOR THE PROMOTION OF GREEN SUPPLY CHAIN IN MOROCCO

We can resume all solutions proposed in 'house of Green Supply Chain in Morocco' as a symbolic representation: it relies on foundations and three pillars (Moroccan state, private sector and civil society) to support the purpose of the Green Supply Chain: highest quality, lowest costs, in short time while maintaining the protection of the environment. The implementation of a Green Supply Chain in Morocco necessarily requires collaboration and partnership between government, private sector and civil society.

The State is required to implement its commitments in 2015, as mentioned in the contract logistics program, as well as the new Moroccan Constitution of the Moroccan kingdom which affirms the commitment of the State to organize economic development, taking into account the environment and favoring sustainable development (Preamble of the Constitution). This commitment has also resulted in the creation of an economic, social and environmental council (Article 101).

It is even more important that private companies represented by the General Confederation of Moroccan Companies begin to encourage the implementation of environmentally sound practices, and the adoption of advanced technologies, qualification of human resources and the environmental management systems and continuous improvement. These innovative practices involve the reduction of production costs by reducing waste (elimination of dangerous solid waste, energy conservation and recycling of materials).

Civil society must also fulfill its advocacy role. In particular, the new Moroccan Constitution of 2011 who guarantees the right of access to information (Article 27 of the Constitution), and also provides new roles for civil society allowing them to contribute indirectly in the context of managing public business, and submit proposals to parliament, government and other public institutions. In turn, the education system is expected to play its role as a vector for the transmission of universal values in order to develop a culture of citizenship among Moroccan consumers.

No one can succeed without collaborating with others; the establishment of a Green Supply Chain in Morocco - or civil society or public or private sector. This requires better cooperation in the most diverse partnerships so as to accelerate concrete measures and initiatives in order to move towards a sustainable, innovative and competitive Green Supply Chain (see Appendix 3).

VII.   CONCLUSION

In this research paper, an attempt has been made to identify and analyze the major barriers to implement Green Supply Chain in Morocco using the ISM model and MICMAC analysis. Eleven barriers to implement Green Supply Chain in Morocco have been identified and interpretive structural modeling methodology has been used for finding contextual relationships among them.

ISM has shown that poor quality of human resources, limited use of information and communication technologies, low competition and market uncertainty as well as lack of collaboration and green initiatives are identified as the dependent variables. Lack of organizational culture, lack of innovation and scientific research, and lack of financing mechanism are identified as linkage variables. Lack of governance and government support, unawareness of Moroccan consumers and weakness of the Non-governmental organizations, and lack of top management commitment are identified as driver variables. The removal of these barriers will help to implement Green Supply Chain in Morocco. Lack of governance and government support is coming at the bottom of the structural model. It means that it is most powerful barrier and removal of this barrier will remove maximum number of other barriers.

Because the future cannot wait, partners ought to respond to the challenges related to Green Supply Chain and make a step forward, for an opportunity today will be tomorrow's obligation.

The above model is based on interpretive structural modeling methodology, which has its own limitations. The model is dependent on the judgments of the author's team. In the future, we plan to use structural equation modeling (SEM) to test the validity of the suggested model. A questionnaire survey can be conducted to catch the insight on the barriers to implement Green Supply Chain in Moroccan industry.

REFERENCES

[1]   T., Paksoy, N.Y. Pehlivan, and E. Özceylan, Fuzzy multi-objective optimization of a Green Supply Chain network with risk management that includes environmental hazards. *Human and Ecological Risk Assessment*, 18(5), 2012, 1120-1151.
[2]   A.B., Borade, and S.V. Bansod, Domain of Supply Chain Management –A state of Art. *Journal of Technology Management and Innovation*, 2(4), 2007, 109-121.
[3]   Q., Zhu, J. Sarkis, and Y. Geng, Green Supply Chain management in China: pressures, practices and performance. *International Journal of Operations and Production Management*, 25(5), 2005, 449–468.
[4]   Md.F., Ansari, K.K. Ravinder, L. Sunil, S.L. Shimmi, and C. Chatterji, Analysis of barriers to implement solar power installations in India using interpretive structural modeling technique. *Renewable and Sustainable Energy Reviews*, 27, 2013,163-174.
[5]   R.B. Handfield, *Green Supply Chain: Best Practices From the Furniture Industry*, paper presented at the annual meeting of the Decision Science Institute, Houston, November 22 -25.
[6]   B.M. Beamon, Designing the Green Supply Chain. Logistics Information Management, 12 (4),1999, 332–342.
[7]   S. Gilbert, *Greening Supply chain: enhancing competitiveness through green productivity*. Taiwan: Tapei, 2001.
[8]   A.A Hervani, M.M. Helms, and J.Sarkis, Performance measurement for Green Supply Chain management. *Benchmarking: An International Journal*, 12(4), 2005, 330–53.
[9]   J. Davies, and S. Hochman, The greening of the supply chain. *Supply Chain Management Review*,11 (5), 2007,13–14.
[10]   K.S. Srivastava, Green supply-chain management: a state-of-the-art literature review. *International Journal of Management Reviews*, 9(1),2007, 53–80.
[11]   H. Walker, L. Di Sisto, and D. McBain, Drivers and barriers to environmental supply chain management practices: lessons from the public and private sectors. *Journal of Purchasing and Supply Management*, 14 (1),2008, 69–85.
[12]   S. Seuring, A review of modelling approaches for sustainable supply chain management. *Decision Support Systems*, 54,2013, 1513–1520.
[13]   M., Elbounjimi, A. Georges, and D. Ait Kadi, Contribution à la conception de la chaîne logistique verte, paper presented at the 10e congrès international de génie industriel, La Rochelle, 12-14 juin 2013.
[14]   N. Kumar, R. Prasad, R. Shankar, and K.C. Iyer, Technology transfer for rural housing: An interpretive structural modeling approach. *Journal of Advances in Management Research*, 6(2), 2009, 188–205.
[15]   J.C. Ho, M.K. Shalishali, T.Tseng, and D.S. Ang, Opportunities in Green Supply Chain Management. *The Coastal Business Journal*, 8(1), 2009,18-31.
[16]   Ministry of Economy and Finance, *The freight sector: constraints and remedies reforms*. Rabat, Morocco: Printing Office, 2013.
[17]   C. Yu Lin, and Y. Hui Ho, An Empirical Study on Logistics services provider, intention to adopt Green Innovations. *Journal of Technology, Management and Innovation*, 3(1), 2008; 17-26.
[18]   V. Ravi, and R.Shankar, Analysis of interactions among the barriers of reverse logistics. *International Journal of Technological Forecasting and Social Change*, 72 (8),2005, 1011-1029.$
[19]   M. Elkhayat, *The need for training in logistics*. Today, 2013.
[20]   World Bank and Ministry of Infrastructure and Transport, *Logistics and competitiveness of Morocco*. Rabat, Morocco: Printing Office, 2006.
[21]   Ministry of Equipment and Transport, *National strategy for development of logistics competitiveness*. Rabat, Morocco: Printing Office, 2010.
[22]   D.S. Rogers, and R.S. Tibben-Lembke, *Going Backwards: Reverse Logistics Trends and Practices*. Pittsburgh, PA: Reverse Logistics Executive Council, 1998.
[23]   A. Hosseini, Identification of Green Management of system's factors: A Conceptualized Model. *International Journal of Management Science and Engineering Management*, 2 (3), 2007, 221-228.
[24]   S. Joseph, Decision-making, intermodal transportation, and sustainable mobility: towards a new paradigm. *International Social Science Journal*, 55(2),2003, 170- 173.
[25]   R. Lamming, and J. Hamapsonn The environmental as a Supply Chain Management issue. *British Journal of Management*, 7, 1996, 45-62.
[26]   T. El Malki, *Social responsibility: the case of Morocco*. Rabat, Morocco: East Africa Edition Eds, 2014.
[27]   T. AlKhidir, and S. Zailani. Going Green in Supply Chain towards Environmental Sustainability. *Global Journal of Environmental Research*, 3(3), 2009, 246-251.
[28]   J. Sarkis, Q. Zhu, and K. Lai, An organizational theoretic review of Green Supply Chain management literature. *International Journal of Production Economics*, 130 (1), 2011, 1–15.
[29]   G.G. Bergmiller, and P.R. McCright, *Are Lean and Green Programs Synergistic?*, paper presented at the Industrial Engineering Research Conference. Miami, Florida, May 30 - June 3, 2009.
[30]   J. Sarkis, *A boundaries and flows perspective of green supply chain management*. working Papers No. 2009-07, Clark University, October , 2009.
[31]   S. Neena, and S. Nagendra, Developing interpretive structural model for quality framework in higher education: Indian context. *Journal of Engineering, Science and Management Education*, 5, 2012, 495–501.
[32]   FR. Janes, Interpretive structural modeling (ISM): a methodology for structuring complex issues. *Transactions of the Institute of Measurement and Control*, 10 (3),1998, 145–154.
[33]   D. Kshitij, and S. Nagendre, Green Supply Chain Management: A Hierarchical Framework for Barriers. *International Journal of Engineering Trends and Technology*, 4(5), 2013, 2172-2182.
[34]   J.W. Warfield, *Developing interconnected matrices in Structural modeling*. IEEE Transcript on Systems, Men and Cybernetics, 4 (1), 1974, 51-81.
[35]   S. Balasubramanian, A hierarchical framework of barriers to Green Supply Chain management in the construction sector. *Journal of Sustainable Development*, 5 (10), 2012, 15-27.
[36]   S. Jharkharia, and R. Shankar, IT enablement of supply chains: understanding the barriers. J*ournal of Enterprise Information Management*, 18(1),2005, 11-27.
[37]   G. Kannan, P. Noorul Haq, S. Sasikumar, and S. Arrununchchalam, Analysis and Selection of green suppliers using interpretive structural modeling and analytic hierarchy process. *International Journal of Management and Decision Making*, 9(2),2008, 163-182.
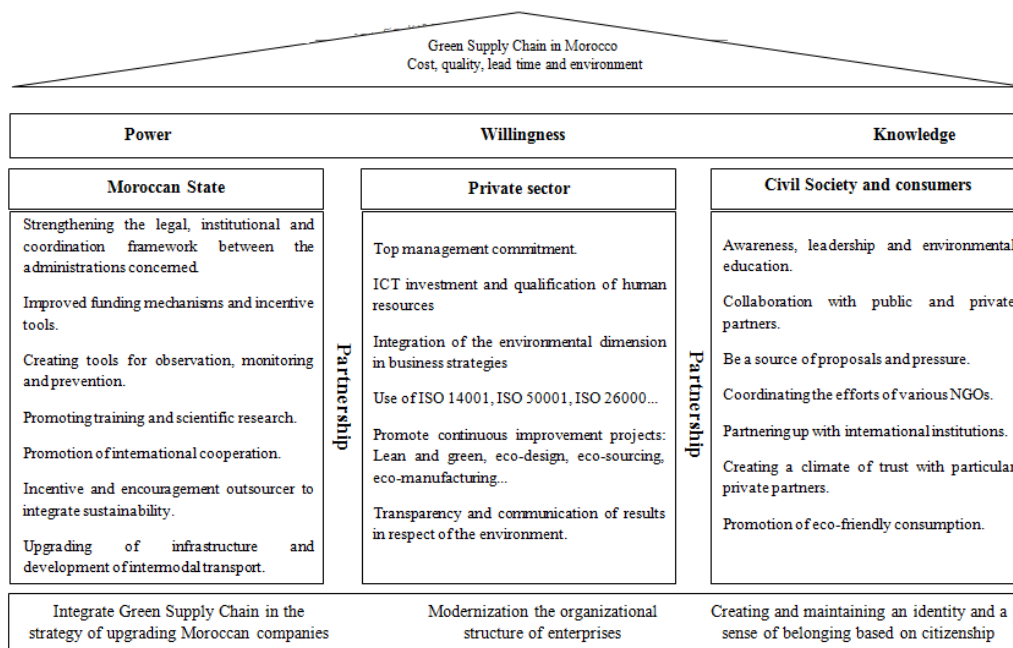
APPENDIX
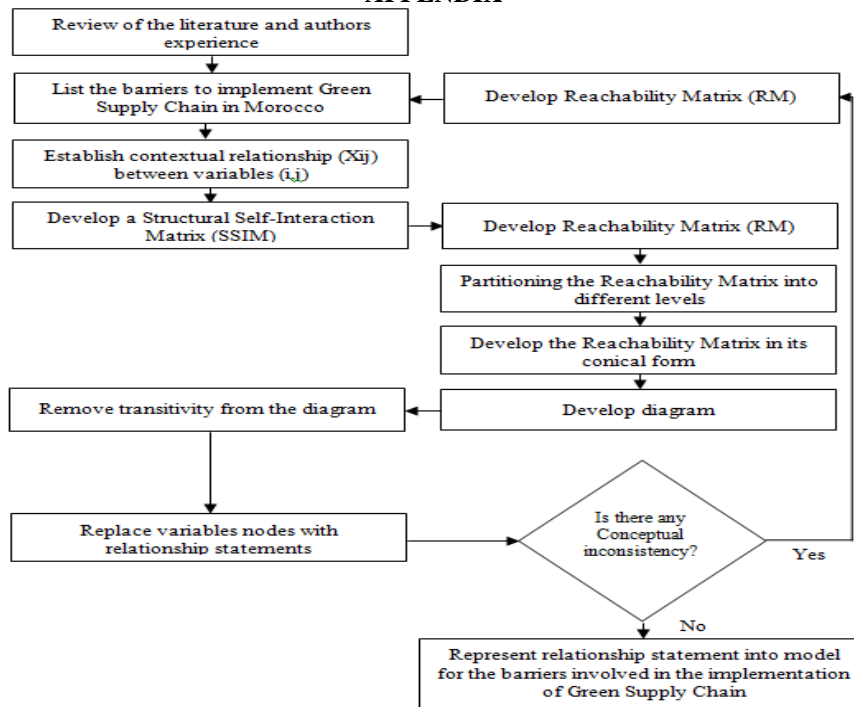
Appendix 1. Flow diagram for preparing ISM.

	La Voie Express	**SDTM**	**Exel**	**Geodis**
Nationality	Moroccan	Moroccan	Foreign	Foreign
Storage	No	No	Yes	Yes
Stock management	Yes	No	Yes	Yes
Picking	No	No	Yes	Yes
Transport	Yes	Yes	Yes	Yes
Recouvrement	Yes	Yes	No	No
Guidance	No	No	Yes	No
Related IT services	No	No	Yes	No

Appendix 2. Activities of key logistics providers in Morocco

Appendix 3. House of Green Supply Chain in Morocco".