

Developing Green Supply Chains for New Kuwait: A Strategic Approach

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Abstract

Green Supply Chain Management (GSCM) refers to the concept of integrating and incorporating green concepts and eco-friendly thinking to traditional Supply Chain management Initiatives (GSCI) which include processes such as products design, materials sourcing and selection, manufacturing and production management. This research work is an approach at strategic level to evolve Green Supply Chains practice for New Kuwait, the State of Kuwait's national development plan towards a prosperous and sustainable future. Grounded on the Institutional Theory and the Natural Resource Based View (NRBV), a framework is developed to act as a decision making tool for top management in prioritizing and implementing selected green strategies. This study investigates how Company XYZ for Metals and Recycling, ISO 14001 certified, prioritizes its green strategies and where its GSCIs are implemented. For different green strategies, the outcomes of the Analytical Network Process (ANP), Analytical Hierarchy Process (AHP), and Structural Equation Modelling (SEM) clearly showed Company XYZ the different prioritizations and which to enforce such as; pollution prevention, product stewardship and clean technology through green initiatives. Using our developed decision-making framework, product stewardship was the most significant strategy to adopt for Company XYZ in order to become green, gain a competitive advantage, and achieve cost reduction it thrives for.

Keywords

Green Supply Chain Management (GSCM), Institutional Theory, Natural Resource Based View (NRBV), Analytical Network Process (ANP), Analytical Hierarchy Process (AHP), and Structural Equation Modelling (SEM).

1. Introduction

The production of a physical goods consists of several stages such as: raw material, manufactures, transportation, retailers, and customers. These stages forms a supply chain network that contributes to delivering products to the customers (Chopra and Meindl, 2016). The role of Supply Chain Management (SCM) is central in any business vision. SCM is the building block to have an overall success; connecting and integrating all the firms, employees, and distributors in the network and focusing on upgrading the outcomes as shown in Figure 1.

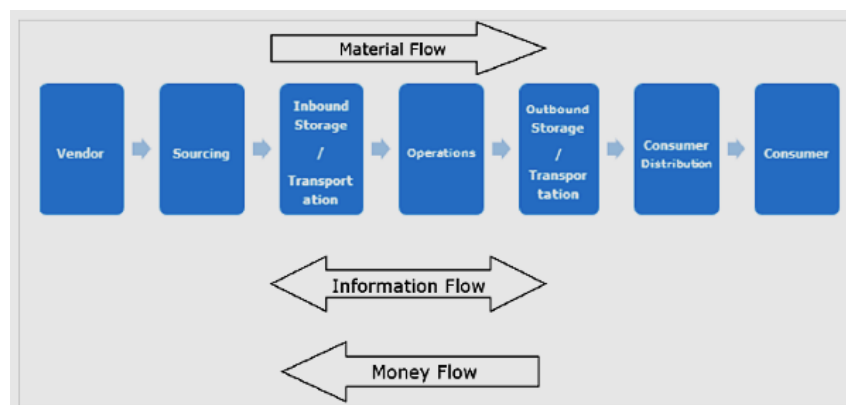


Figure 1: Supply Chain Network (Alstytne, 2014)

The main benefit of SCM is to design a delivery mechanism to minimize delays before it reaches customers, thus, it improves the productivity and business and minimize system wide cost. In addition to what traditional SCM do, GSCM is the incorporation of green or environmental practice and eco-friendly thinking to supply chain. In GSCM, we can say products flow in a loop of upstream and downstream and includes activities such as reuse, recycle, remanufacture and revers logistic as shown in Figure (2).



Figure 1: Green Supply chain management Flow (Saint Leo University, 2017)

Recently, the growing trend of incorporating environmentally friendly practices has changed the nature of competition between manufacturing organizations. The deviated progression towards this type conscious-thinking is no longer surprising as it is a result of various sources of pressure from stakeholders, in both local and global communities. Kuwait has unveiled a new plan to transform the country into a regional financial and cultural hub by 2035 through 164 strategic development programs. New Kuwait is the State of Kuwait's National Development Plan toward a sustainable future. This plan states Kuwait's pursuit for long-term development on a day-to-day basis. It is structured around five desired outcomes and seven pillars which emphasize investment and improvement. Thus, each pillar has a specific strategic program to reach New Kuwait's vision by 2035. The seven pillars are public administration, infrastructure, living environment, human capital, health care, global position, and economy. There are numerous studies which evaluate and prioritize environmental practices. While focusing on the operational level, these studies fail to deal with a strategic level of decision-making (Masoumik and Abdul-Rashid, 2015). This research, focuses on analyzing strategies and procedures through some decision-making tools such as ANP, AHP, and SEM to prioritize and enforce them by top managements for strategic level planning. By adopting and implementing proper green strategies, organizations can gain competitive advantages in terms of cost reduction, reputation and legitimacy, and future positioning.

2. Background and literature review

The main idea behind the oscillating trend of adopting green conscious-thinking practices incorporated in the supply chain is the quest of sustainability. Whether it was from pushing stakeholder and business owners or, from the competitiveness of the market thriving to transform ideas and visions to a practical solution implemented in real life. (Ghazilla, Abdul-Rashid and Masoumik, 2014). A lot of published studies investigated the relationship between green eco-friendly practices and sustainability factor. Moreover, according to a recent study conducted by (Geng, Mansouri and Aktas, 2016) tried to group or revise all the published work regarding these two relationship and found out that there is definitely a significant relationship between the GSCM and the overall organizational performance. However, the initial adoption of such practices requires a prior investment leading to an increasing amount of operational costs in just early stages of incorporating these new techniques. No matter how this raises a lot of question and further studies, but in fact a lot of recent studies are published as an evidence to support the fact that GSCM is correlating positively with the firms' performance.

After the growing interest in GSCM in literature, a lot of researchers examined the possible outcomes of implementing such concept. A number of intriguing questions are put forward to put the term "Green" into test (Geng, Mansouri and Aktas, 2016). Introducing the idea of competitive advantage that was developed by Michael E. Porter in 1985 it is the quality or characteristic that put the firm in a better position compared with other

competitors using the term better competitiveness. Interpreting this term can be viewed in few ways according on the firm's point of view. Competitive advantage (CA) can be seen as a profit, cost reduction, reputation, or even future position or growth (Porter, 1985).

After introducing the idea of competitiveness another scholar wanted to examine this topic in Hart (1995) article. The natural resource-based view theory (Hart, 1995) (NRBV) that was developed by Hart explains the role of environmental practices in creating CA. Also, according to Hart, 1995 initiating environmental green practices can with no doubt lead to competitiveness in terms of cost reduction, better reputation, and future positions. The GSCI is classified into five main operative areas. Eco-product design contains initiatives concerned with the design of products for environmental purposes that involve reuse, recycling, and waste and emission reduction. Greening upstream, involves initiatives such as green purchasing and cooperation with suppliers in environmental improvement programmers. Green production initiatives cover the improvement of manufacturing processes to eliminate waste and emissions. Greening downstream is associated with the environmental improvement of transportation, green packaging, and collaboration with customers with environmental intentions. Greening post-use states that environmentally associated actions at the product's end-of-life which contains actions such as material recycling and product recovery (Masoumik and Abdul-Rashid , 2015).

Adding the term "sustainable" in supply chain converts it to a closed loop supply chain. In other words, the product flows on a loop of upstream and downstream. Furthermore, Applying sustainability in supply chain has benefits in social, environmental, and financial fields; creating long-term practices that deal with the environment, the well-being of workers and a future vision generation. At the same time, it optimizes profitability and competitive advantages for organizations.

To benefit from sustainability, companies must consider all the external and internal factors when deciding which green strategy to receive. The priorities of GSCIs to reach these prioritized strategic goals are determined. These priorities are made based on two factors: the importance of the green initiatives to the achievement of the desires of the green strategy, and the current performance of the company in each green initiative. NRBV theory suggests three main strategies which are pollution prevention, product stewardship, and clean technology (Masoumik, Abdul-Rashid and Oulgu , 2015). It illustrates the three different strategies extracted from the literature.

- **Product stewardship strategy:** it is by minimizing the emission and the environmental impact in every stage of the product's life cycle.
- **Pollution prevention strategy:** it is the operation of waste reduction and improvement of the company's currently followed procedure and replacing it with more environmental material or activities.
- **Clean technology strategy:** is the strategy of which the firm is willing to find other innovative solutions to deal with the environmental issues whenever they arise.

On the other hand, many previous papers have investigated the kinds of pressures that may drive the company to improve their environmental performance as discussed by (S.Maryam Masoumik , 2015) . There are four types external pressure that are working as a motivation to push companies to cooperate different environmental practices with keeping in mind the positive outcome for such action. Regulatory pressure, customer pressure, competitor pressure, and society pressure are the four types of pressures imposed to business owners as the institutional theory explained.

Depending on the institutional theory and natural-resource based view (NRBV), that classify three clusters of decision factors for prioritizing green strategies that consequence on the business manager's decisions to implement the green supply chain initiatives. As shown Figure 3: Clusters and Their Elements.

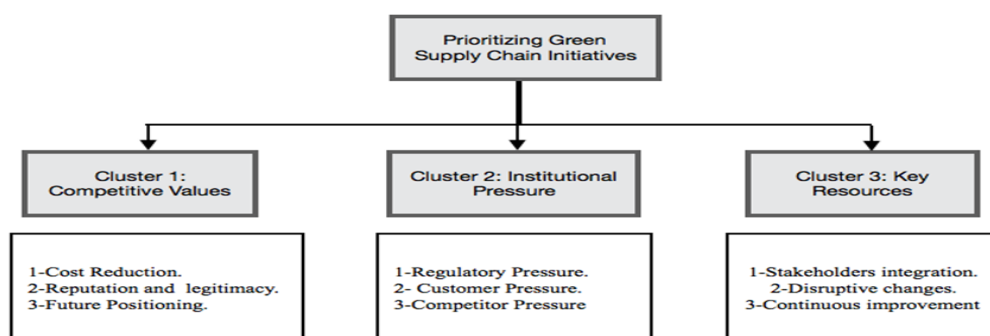


Figure 3: Clusters and Their Elements

A main concern when applying green supply chain is to insure a competitive position, in current times the manufacturing market is very vicious, and the companies are being encouraged to include and use environmental strategies in their business. Implementing green initiatives in supply chain can be formed in a lot of ways, starting from raw materials to processing till it reaches the end of the life cycle of the product. But the problems is these practices and their affect can be differ from each system to other, in other words prioritizing green practices can be very difficult to decide. After reviewing some of previous implementation of green supply chain and studying their methodology, concept, and approach. According to (S.Maryam Masoumik , 2015) “conducting a survey among 139 manufacturing companies that have a ISO-14001 certification as certified companies will be affect positively while applying the environmental practices (Hammar , 2018). These surveys were handed to the Key informant for Environmental Management Representative (EMS) in each company. SEM is a 2nd generation statistical data analysis method that allows the researchers to visualize the relationship between different dependent and independent variables simultaneously (Wong , 2013). After getting all the information of green practices and companies’ performance from the ERM, they were able to construct a partial least square-based structural equation model (PLS-SEM).

After defining clusters and its elements using the analytical network process (ANP) modeling to construction our decision framework. Note that ANP is a more general form of the analytical hierarchy process (AHP) technique that was expanded to prioritize the alternatives in a decision problem, by formulating the problem as a hierarchic structure consisting of a goal, criteria, and alternatives. The ANP formulates the network consisting of clusters and sub-clusters; statement the decision problem in a network structure permit the mutual relationship between the decision clusters or elements among the different levels and a two-way relationship between the elements at the same level indicating the inner dependencies between the elements within a cluster (Masoumik, Olugu and Abdul-Rashid)

3. Problem Statement and Objectives

Under to the vision of New Kuwait which started in 2017, it is essential to follow some international standards listed under the main pillar labeled living environment. Based on Kuwait Chamber of Commerce & Industry (KCCI), Kuwait has 229 manufacturing companies that serve in the industrial sector. Unfortunately, only 26.6% of these companies have the sense of proactive towards developing sustainable green adjustments in their business, while 73.4% do not have any environmental practices to implement in their business (KCCI, 2018). Consequently, Kuwait is facing a huge problem regarding waste management (Zafar, 2017). According to this national development plan, any manufacturing company must fulfill all the required/preset standards in order to continue operating in their business. The new legislation No.42 by the Environment Public Authority states that companies should meet up to the new environmental standards to get a license, and for existing companies; they have given a limited time frame to make all necessary adjustments and updates to their existing operations/supply-chains in order to continue practicing their businesses. The objective of this research work is to design a decision-making tool that enable Kuwaiti manufacturing companies select and implement a proper green practice in order to meet New Kuwait standards and gain a competitive advantage in future market. In retrospect to the Natural Resource Based View Theory (Masoumik S. Maryam, 2015):

- Manufacturing companies will obtain a better future positioning, reputation and legitimacy, and optimal use of the firm’s own resources.
- Enhancing their performance in the supply chain which will lead to maximize productivity and profitability.

4. Case Study

To demonstrate the development of our research framework, Company XYZ is selected for the case study. The Company is ISO-14001 certified and has the sense to implement environment practices and GS in their business. According to Company XYZ, it’s recently having issues to gain CA in their business. Therefore, the developed framework will help the company to prioritize and decide which GS to implement in order to gain and enhance their CA. Company’s XYZ supply chain network is shown in Figure (4). There raw material is supplied by two supplier’s landfill waste and metal scraps which are them inspected to determine where the materials go (e.g., cutting yard for high thickness steel such as construction scrap). Moreover, shredding for light steel and low thickness steel such as cars, tins. Truck drives through a big weigh scale to weight the material before going to the shredding offloading the materials next to the shredding. Throwing the material inside the shredding process, there is huge rotated hammer tearing the scrap in small pieces. Then, a magnet separates into recycling or toxic waste process. Ferrous materials that enter to recycling process go through a conveyer to the product location. None-Ferro which enters in toxic waste process separated into copper, Aluminum, stainless steel, etc. Huge fans terminate the waste fluff to a conveyer that dropping the waste into waste location to be moved later to the land fill.

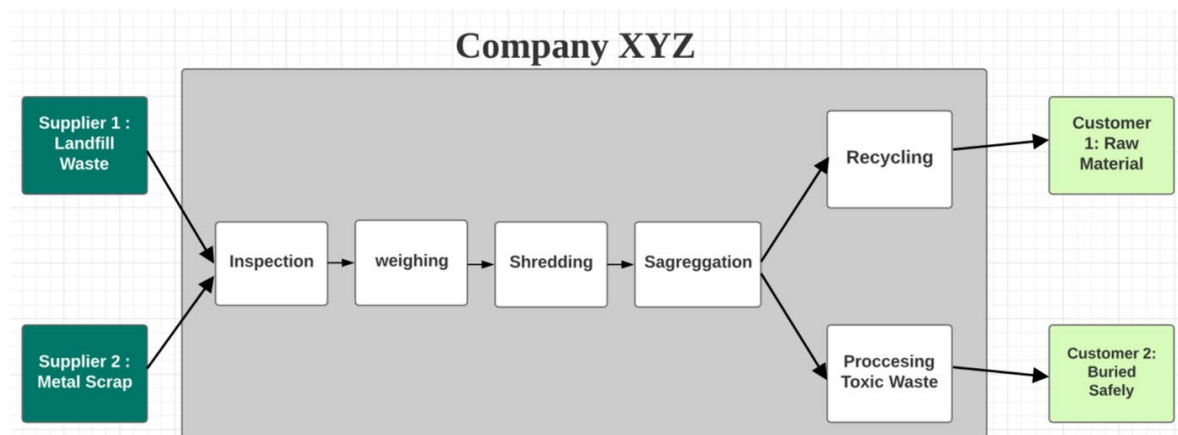


Figure 2: Company XYZ supply Chain Network

5. Conceptual Model

According to the institutional theory and natural- resource -based view (NRBV), it classifies three external and internal drivers of decision factors for prioritizing green strategies that consequence on the business manager's decisions to implement the Green Strategies (GS). These drivers are presented as framework for causal relationship model knowing as a conceptual model. All these factors are being considered to identify the importance according to business manager preferences. It would help managers to make more realistic decisions to improve their green supply chain initiatives to obtain achievable performance targets. After determining the prioritized list of the green strategies, the green supply chain initiatives are prioritized by seeing their importance for improving the company performance related with the green strategies. Moreover, the conceptual model divided in three phases in order to develop a decision-making making tool. Phase I, it is to study each driver with its elements. Then phase II study the link between external and internal drivers and how that can motivate the company to improve their green strategy, and to study how that drivers impact the green strategy itself as shown in Figure 5. In addition, using AHP to do pairwise comparisons by Excel software and get the total effect of each drivers on green strategies. For phase III, it is to study the relationship between green strategies and where to implement it in green supply chain initiatives as shown. By the ANP model using SmartPLS software and PLS algorithm to find the importance-performance maps analysis (IPMA).

5.1 Phase I:

The first phase study the external and internal drivers with their elements according to the company goals. For this phase the data was collected by distributing a survey, asking the company about the importance of each motivator. A questionnaire was given to the company manager about the most important factors to be considered by doing a pairwise comparison. For this project, a company that was certified with ISO 14001 was selected; as the company is more likely to achieve the objective of being green with the best green strategy with this certification. To obtain the relative intensities of the drivers and elements in the causal mode using a pair-wise comparison for defining the relative importance of the drivers was carried out for institutional pressures, key resources, and competitive values and their elements with respect to the goals of the company. According to the AHP approach, a scale from 1 (which is equally important) to 9 (which is extremely more important) was used for the pairwise comparison. Therefore, the company manager was asked to answer questionnaires for collected data of pairwise comparison questions. The pairwise comparisons were entered on Excel and to ensure of manger judgment we calculate consistency ratio (C.R) that should be less than 10%.

5.2 Phase II:

The second phase studies the link between external and internal drivers and how it can motivate the company to improve their green strategy. Also, it studies how drivers impact the green strategy itself. Data was collected by distributing a survey for the company manger, asking the company about the importance of each motivator with respect to green strategies. By doing a pairwise comparison same as phase I but the different is that asking about the relationship of each driver with green strategy. Using of the AHP approach, with a scale from 1 to 9 to was used for the pairwise comparison and then calculate the (C.R). The calculation used a PLS path model by estimating the direct, indirect and total relationship in the structural model (Masoumik, Olugu, and Abdul-Rashid, 2015).

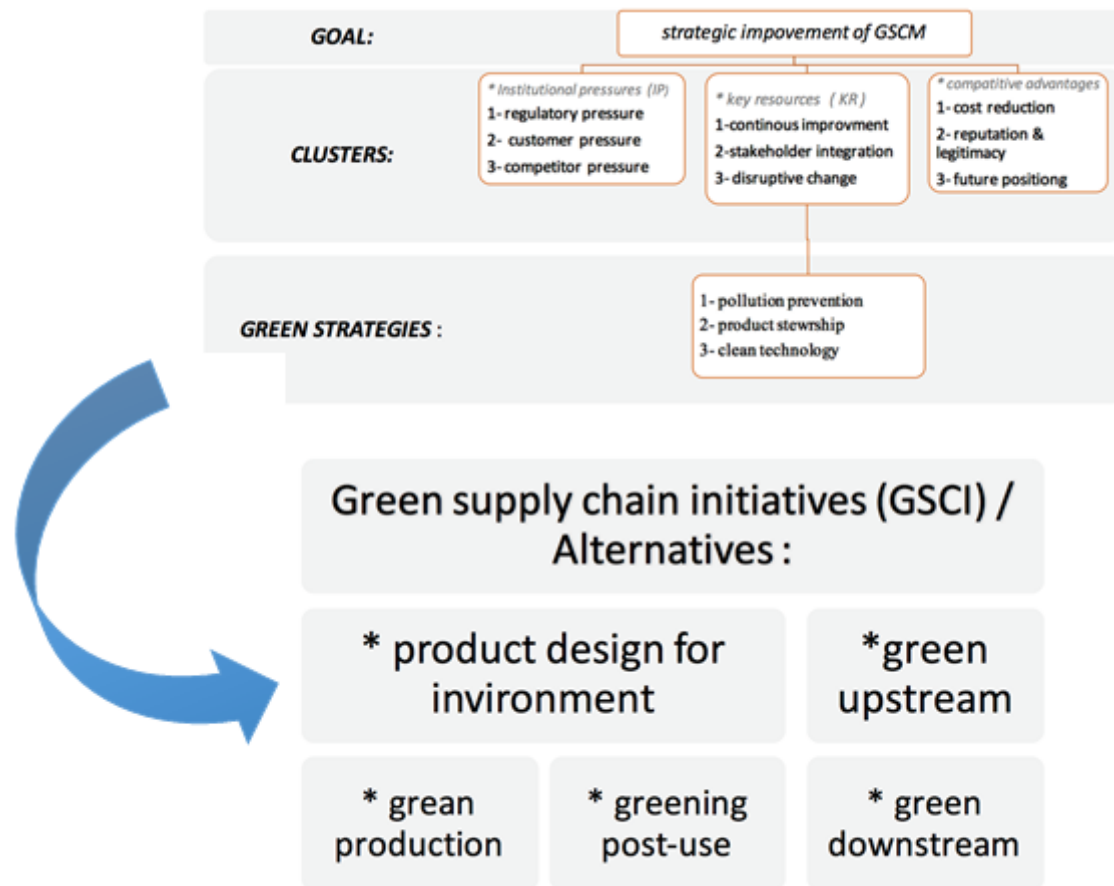


Figure 3: Research Conceptual Model.

5.3 Phase III:

This phase studies the relationship between green strategy and where to implement in green supply chain initiatives. To find this relationship we use survey to collect data about the performance of green initiatives using scale from 0 to 100. After that we use the ANP model using SmartPLS software. To perform calculation and obtain the priorities in Analytical Network Process (ANP) model. Based on the total effects result from PLS path model which use to calculate the weights that help to use the direct mode in SmartPLS software to input the weights as illustrates in Figure 6. After adding the data in software, the calculation was performed and formulates unweighted super matrix, weighted super matrix and limiting matrix. To clarify the limit matrix, it provides the relative priorities for each alternative within the decision framework. The priorities present the importance of each green strategy in sustaining the internal and external factors and the importance of every green supply chain initiative in achieving the prioritized green strategies. To confirm the model stability, we performed sensitivity analysis, which demonstrates how the optimal solution replies to changes in input parameters. According to the current performance of the company, it was important to compute the company's performance in every single part of green supply chain operation and conduct the importance-performance analysis. we develop a performance measurement system counting the measurement indicators and their weights related to the GSCIs. The indicators are the determinative measures that already collected data for and analyzed in the PLS-SEM. The weights for these determinative measures are the outcome from the results of measurement model in the PLS-SEM. To calculate the performance, the company was asked to assign a score between 0 (not at all) to 100 (excellent) to each indicator. The questionnaire to measure the performance was adapted from Masoumik and Abdul-Rashid (2015) and can be found in Appendix B. Finally, the priorities of green supply chain initiatives made bases on the importance-performance matrix analysis (IPMA).

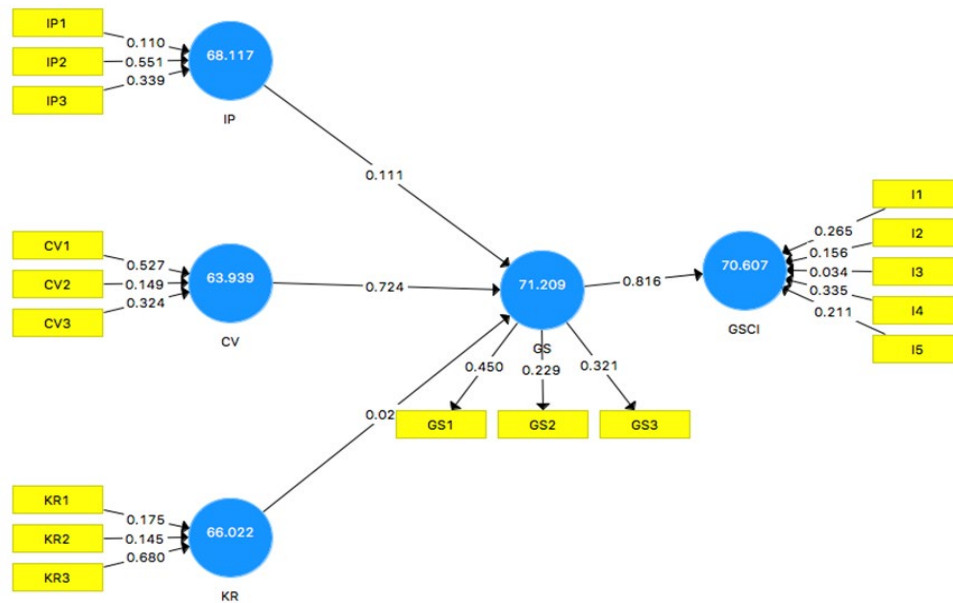


Figure 4: Analytical Network Processing (ANP) Model and Smart-PLS Analysis

6. Results and Discussion

According to case study, to find the relative intensities of the primary three drivers (IP, KR, and CV) with respect to the objective of the strategic development of GSCM, we were able to obtain through the help of the company manager representative's judgment for making pairwise comparison between the drivers and green strategies, and between the green strategies and green supply chain initiatives. In this study, we considered a company that has a certification of ISO 14001 to get a feedback about their performance on the subject of green initiatives and their preference. From the survey which was divided into 2 phases; the first phase, included the pairwise comparison between the three drivers that were extracted from literature reviews and GSs. The questions in the survey were distributed to the manager in three parts for each driver. For the AHP analysis, pairwise comparison is based on a scale from 1 to 9. Scale, 1 refers to the two considered indicators/variables having equal importance while 9 refers to the absolute importance of one indicator over the other. Table 2 shows the result of pairwise comparison for each driver individually as the highest weight for institutional pressure according to company goals with 64% then competitive values with 28% form the total weights. The next step is to compare those weights to the GS also using a pairwise comparison. The results of comparing the drivers to GS are shown in Table 1 which are considered as the final results of Phase 1 and Phase II of the project. According to phase I and II, the highest weight for product stewardship strategy with 48% weight of all green strategy, then pollution prevention 27%, and clean technology 25%.

Table 1: Results of Phase I and Phase II

Internal & External Drivers Green Strategies	Competitive Values	Key resources	Institutional Pressure	RESULT
	0.28	0.07	0.64	
Clean technology	0.27	0.27	0.24	0.25
Pollution prevention	0.64	0.61	0.06	0.27
Product Stewardship	0.09	0.12	0.7	0.48

Also, Figure 7 represents the final results of Phase II which illustrates that product stewardship strategy has the highest weight with respect with green strategies.

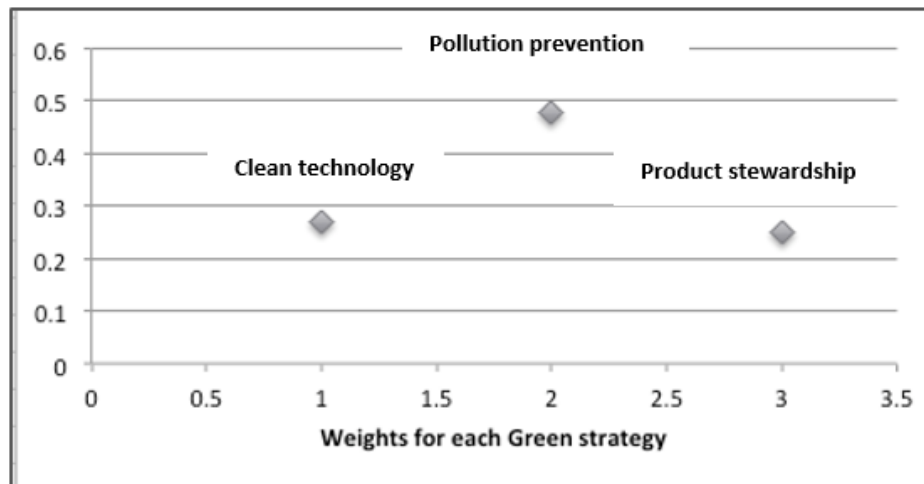


Figure 5: Final Result of Phase II

For identifying the priorities, PLS-SEM analysis provides information based on the relative importance of the target constructs that are the green strategies with other constructs, which are the drivers in the structural model. Data on the importance of constructs is used for drawing conclusions. Through the use of the Importance-Performance Map Analysis (IPMA) ranges the results of Smart-PLS with respect to the performance of each construct into account as shown in Figure 8. First computing the importance, after finding the relative intensities of the drivers and its elements in the ANP model, we can compute the importance of green strategies and green initiatives. Second, through using Smart-PLS software, we calculated the importance of each element in the drivers with respect to every green strategy. Third, in order to complete the analysis and confirm the priorities, we calculated the performance of each green initiative for the Company. Therefore, we asked the company XYZ to do a score between 0 (for not at all), and 100 (for fully implemented) for each indicator associated with the green initiatives as shown in Table 2. Then, we calculated the performance of the green supply chain initiatives by applying the equation (1):

$$\text{Performance of GIs} = \sum_{j=1}^m \text{score } I * \text{weight } I \quad (1)$$

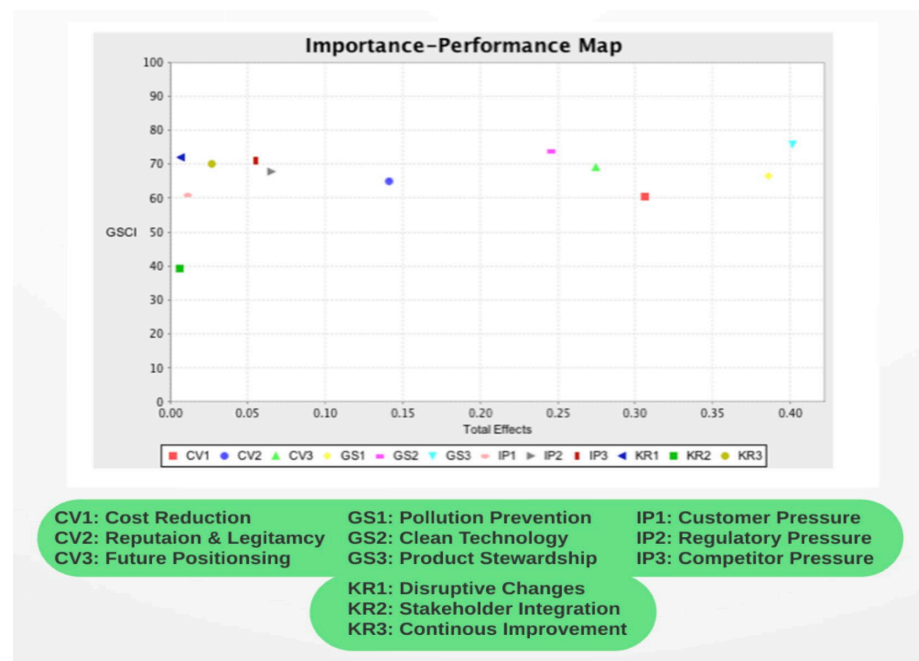


Figure 6: Importance- Performance Graph for Drivers on GS

Table 2: GSCI Performance Measures

	MV Performances
CV1	60.41
CV2	65.08
CV3	69.16
GS1	66.50
GS2	73.81
GS3	75.96
IP1	60.88
IP2	67.73
IP3	71.09
KR1	72.11
KR2	39.12
KR3	70.18

As a result of the final list of priorities; findings are:

- To gain the CA in terms of cost reduction company XYZ should start focusing on the Product stewardship (48%), and pollution prevention (27%), then clean technology (25%) based on their weights.
- The adoption of green strategies (GS) should start with greening post-use for having the highest importance 0.335 in the ANP Model.

If the company made these kinds of modifications, company XYZ will eventually gain the CV they are eager to achieve. Not to mention the reputation and legitimacy that every business manager is dreaming of once having.

7. Conclusion and research implications

To conclude, after reviewing the two main theories, which are the Natural Resource Based View theory, and the institutional theory, that represent the external and internal drivers affecting the implementation of GS in the supply chain, we were able to build our conceptual model and designing our decision-making tool. By identify the conceptual model for developing the green supply chain, which analyzes the importance and the performance of GSC initiatives. As the word importance refer to the significance of the green practices depending on the company's priorities for accepting and adopting green strategies. And the word performance measures the current level of the company's environmental improvement. The thought is devoted to make a relationship between empirical study and the approach of measurable decision-making tool by using statistical tools such as Analytic Network Process (ANP), Analytical Hierarchy Process (AHP), and Structural Equation Modelling (SEM). To improve and develop the strategic changes that needed to be considered by manufacturing companies to become green during this project. Through an approach to develop green supply chain to the New Kuwait in order to achieve the goal of the Kuwait National Development Plan of creating an environmental awareness in society that contributes to the pillar of living environmental. New Kuwait plan aims to transform Kuwait to be cultural and economic hub. As the outcome in Figure (9) this study found that prioritization of green strategies for XYZ Company should focus on product stewardship with the weight of 48% and then pollution prevention with the weight of 27%. These strategies should be implemented in their supply chain starting with 35% greening post use then 27% for the greening upstream to gain their competitive advantage in term of cost reduction.

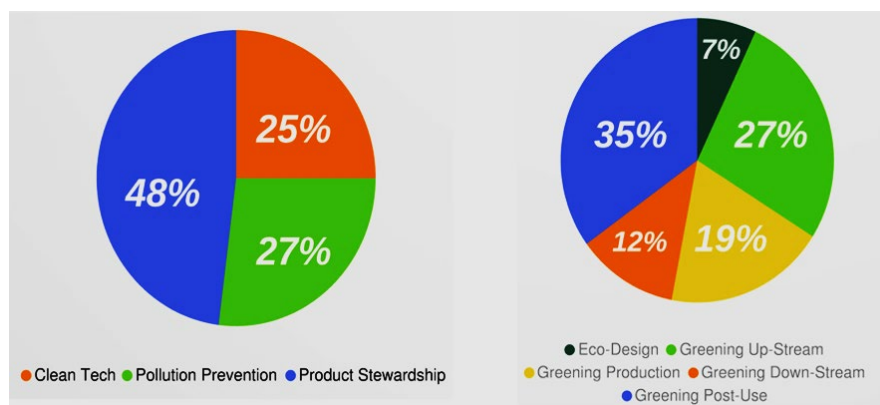


Figure 7: Project Outcomes

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Biographies

Ghaliah Al-Mutairi, Fatma Mhaisen, Rawan Al-Humaidi, Mariam Al-Ajran, and Hawraa Al-Bather are recently graduated students from the American University of the Middle (AUM) in Kuwait, majoring in Industrial Engineering. During their four years of study they gained several engineering and computational skills. They worked with computer software such as MS Office, AutoCAD, Minitab, MATLAB, Arena, Jack, and Visual Studio. They participated in many AUM academic activities and in addition to their major graduation project presented in this paper, they worked on several course projects in the area of manufacturing processes, safety and ergonomics, operation research, quality control, simulation, and lean six sigma.

Walid Smew is an Assistant Professor in Industrial Engineering at the American University of the Middle East (AUM), Kuwait. He earned B.Sc. and M.Sc. in Industrial and Systems Engineering from Benghazi University, Libya and PhD in Lean Supply Chain Management from the School of Mechanical and Manufacturing Engineering in Dublin City University (DCU), Ireland. Dr. Smew is a Chartered Engineer and member of Libyan Engineers Association, he is also a certified Lean Six Sigma Greenbelt and Product and Process Validation engineer in Ireland. Dr. Smew has published several journal and conference papers and supervised many graduation projects. He has an excellent experience, both theoretically and practically, in machining and metal forming operations and the application of Lean Six Sigma for problem solving and finding optimized solutions through the application of different statistical techniques. Dr. Smew provided technical guidance to assembly processes using work measurement techniques to identify opportunities to improve production performances in terms of time and cost. Dr. Smew has done consulting in the area Supply Chain Management (SCM) and Simulation Modeling along with Dr. John Geraghty from DCU; they developed a comprehensive production and distribution simulation model for Ireland's future oil supply on behalf of Byrne Ó Cléirigh for engineering and management consultancy. Dr. Smew research interest include Quality Control, Lean Six Sigma, SCM, Manufacturing Processes, Simulation and Optimization. Recently Dr. Smew and his research project colleagues won the first place of the Undergraduate Research Competition in IEOM 2018, Bandung-Indonesia, the first place of the Senior Design Poster Competition in IEOM 2018, Paris-France, and the first place of the Lean Six sigma Competition in IEOM 2018, Washington DC-USA.