

Final Review of the Application of the SCOR Model: Supply Chain for Biodiesel Castor – Colombia Case

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Abstract: This paper presents the final analysis on the process of characterizing the supply chain for Biodiesel Castor, made with the application of the SCC, SCOR Model, showing the strengths and weaknesses in the design of a strategic plan and logistics, as an important aspect in the search for alternatives, where tools such as SCOR and other applications or methodologies to characterize supply chains, may provide support for effective decision making, which somehow guarantees progress and development of production systems. This application, as a methodological tool, led to the identification of the different variables and operations that make up the supply chain processes such as obtaining Biodiesel from Castor, which determined what are the KPI's of this chain, a determining factor for the validation of logistics Biodiesel process operations in order to strengthen and identify disconnects.

In an increasingly globalized world, where the strength and competitiveness are defined by the effective management of the supply chain that enables better delivery of customer service and value chain through the management of information flows, product and financial flows, such management potentiates the compete successfully in today's markets, for the result produced by the combination of the objectives of supply chain and implementing best practice methodologies.

Keywords: Biofuels, Logistics, Biodiesel, Supply Chain, SCOR, Castor.

1. INTRODUCTION

The management of the supply chain currently includes many unique features and activities in distribution companies, from receipt of raw materials until the finished product is generated.

In order to provide reliable and useful information to the company's current management of the supply chain, identifying the activities for measurement and seeking continuous improvement, we applied the SCOR model (Supply Chain Operations Reference Model), which includes processes of business management indicators or KPIs (Key Performance Indicators), best practices, opportunities for improvement, performance measurement chain and the appropriate use of technology to support communication between partners that are part of the supply chain [1].

SCOR is a reference model that does not consider mathematical models or heuristics. It is based on the useage of indicators to analyze, compare and get the best improvement strategy, guidelines or standards. The main objective of Supply Chain Council [SCC] is to get companies involved in the supply chain and improve the performance of it.

One way to achieve this is by helping companies and organizations to develop systems based on successful experiences, which will result in better relations with customers and suppliers, thus integrating the whole supply chain [2]. The results presented here were part of a research project related to the biodiesel, as an object implementing the SCOR model in developing the strategic plan applied to the supply chain Castor biodiesel process.

Biodiesel is a renewable fuel derived from oils or fats of vegetable or animal. The prefix bio refers to renewable and biological nature in contrast to conventional diesel fuel derived from oil, while diesel refers to its use in engines of this type. As a fuel, biodiesel can be used in pure form or blended with petroleum diesel. Biodiesel has become a diesel fuel widely studied recently due to concerns of society today to decrease pollution, caused largely by the emissions from other fuels. In addition, biodiesel is made from renewable sources like vegetable oils and fats animals [3].

The main reasons that led to different countries to boost production of biodiesel have been [4]:

- Increased security of energy supply.
- Reducing dependence on fossil fuels.
- Reducing emissions of greenhouse gases.

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- Reducing harmful emissions from local effect.
- Soil protection through the use of biodegradable products.
- Reducing health hazards through the use of non-toxic.
- The minimization of surplus agricultural production.

For the foregoing reasons, some research areas for the production of biofuels from various products have been strengthened, such as oil palm, maize, sweet sorghum, *Jatropha curcas* and Castor, among others. Particularly for the Castor, which is the product utilized in this investigation, it is assumed that the Castor, is native to Africa from where it spread to the Middle East as a wild plant and probably was introduced in America after the discovery. The Castor (*Ricinus communis*) plant is also called Palm Christi, castor, fig infernal, spurge, and castor. It is a shrub that grows wild in most tropical regions; its seeds are poisonous and therefore are not consumed directly but are crushed and subjected to solvent extraction for oil and cake (transesterification process). The oil is not considered edible, but has multiple uses [4]:

Refined has pharmaceutical use.

Raw emulsifier is used as household disinfectants, and pesticides industry.

Modified is used as hydraulic oil, paint thinner, impregnation of textile and leather dyes, fusion of natural waxes and chemicals and for manufacture of polymers and plasticizer additive.

2. LITERATURE REVIEW

2.1. Supply Chains in the News

In a world with increasing demands of energy where solutions are needed from the environmental standpoint, is a huge challenge to it undertake. What energy services can provide, such as lighting, heating, cooking, motor transport, water pumping, etc. are essential for social and economic development of the human species. Energy services have a multiplier effect on health services, education, transportation, telecommunications, water and sewage as well as the investment and productivity and profitability of income generating activities such as agriculture and industry, be they the real sector of goods and / or services [5].

The ability to decentralize the production of fuels, new impetus to agriculture, job creation and energy sovereignty, converted the biodiesel - being renewable nature, and bringing to a reduction in greenhouse emissions can be with proper management and significant reduction in other emissions during combustion - a product line to solve the shortage of fuel and reduced emissions.

On the other hand, even the subject is weak in regions of emerging economies, where they have been an important development, introducing and regulating the use of sustainable production [6].

In solving these problems, optimization, using models designed to analyze and optimize the various processes in supply chains, have achieved an important and decisive role for years. These methods have become starting points to find more and better ways to improve processes, making them more optimal and more profitable sustainable growth.

Countries of Latin America have substantially increased production of biofuels, which has revealed the existence of problems throughout the supply chain, from the cultivation of raw material inputs to distribution and delivery of the final product for consumption by different means of transport [6].

The use of models and methodologies validated in applications to real sector processes is what defines the framework for the application of tools such as SCOR in order to be able to identify and define the supply chain in the field of biofuels.

2.2. Solution to Current Issues in Logistics

As part of the revision and history of this work, it can be stated that the performance of the supply chain affects the ability to provide customer value, especially in the most basic dimension of product availability. Therefore, there is a need to develop independent criteria for measuring the performance of the supply chain. This was precisely the motivation for the standardization initiatives such as the benchmarks of the Council of Supply Chain [7].

Some examples of measurements can be seen in [7]:

- Total costs in managing the supply chain.
- Cash cycle time.

- Flexibility in production.
- Performance on deliveries required.

The use of biodiesel has been growing worldwide. This growth occurs differently in each country due to local economic conditions, definitions of public policy decisions concerning taxes, land availability and other factors such as weather that can create synergies of various intensities. With rising oil prices and high rates of growth of China's economy, the biodiesel industry should be developed rapidly in the coming years. So far, the raw material for biodiesel production is used oil, but with the increase of the biofuels production, other commodities would be needed.

In Latin America, Brazil is the country with greater production of biofuels with high prevalence of bioethanol from sugar cane. In the seventies, the country established the "Proálcool" with the aim of replacing imported oil and implemented the use of bioethanol fuel. Today, bioethanol is traded "pure" (hydrated ethanol, 93.4%) and anhydrous ethanol (99.4% min.), blended gasoline in all vehicles in use in percentages between 20% and 25%, depending on the supply of alcohol. Ethanol has tax breaks compared to gasoline. The marketing of vehicles "flex-fuel" which began in 2002, allows the consumer to choose the fuel that gives you more advantages: alcohol or gasoline.

In Mexico, there is more consistent information about the prospects for biodiesel use in a feasibility study conducted by GTZ and the IDB [8]. In summary, the study warns the fact that Mexico still imports most of its oil seeds so that in case of increased domestic production of seeds, it should be exploited in the production of edible oils.

Colombia began a program of using biodiesel and is serving the stages foreseen by the Mining and Energy Planning Unit of the Ministry of Mines and Energy. In September 2005 they completed the regulation of product quality (technical specifications). The government definitions of price signals were completed in December 2005. The development of tests was scheduled for the period July 2005 to July 2006, the characterization of mixtures, laboratory testing and route. The regulation of logistics was scheduled for June 2006. Final adjustments were regulated by July 2007 and the beginning of the commercial phase program in June 2008. Colombia uses palm oil to produce biodiesel and plantations are expanding for it, additionally the country is doing research on the use of

Castor and *Jatropha Curcas*, among other products, because to the area of opportunity identified by the progress to now in terms of research and improvement of the production process inputs, the growth in demand and the strengthening of the country in the region, which places him in second place behind Brazil in biofuels, which has been good results, thus contributing to strengthening the agroenergy Colombian policies [9].

3. PROPOSED METHODOLOGY

This article is the result of research in Logistics Management and Supply Chain, which presents an analysis for the production of Biodiesel from Castor, from the approach taken by the SCOR model, which is proposed by the Supply Chain Council. This stage was to identify the links and logistics of the supply chain in the production of biodiesel from castor.

3.1. Agroindustrial Production Chains

A supply chain is a network of companies that perform supply of materials, transform these materials into intermediate or finished products and distribute these finished products to customers [10].

In this first phase of research, simulation methodology raised the productive chain as part of the theoretical construction and characterization of the system. Agribusiness production chains appear as supply chain, which are not described by a single linear sequence. The product does not follow a direct line between producer and end user; there may be hops between players, making the modeling more complex. Figure 1 [11] shows an example of a chain where the manufacturer supplies directly from the wholesaler and the industry, however, the retailer receives fresh produce and processed food producer in the food industry.

This sequence varies even from product to product, making the construction of the models independently (even for the same crop in different regions), validated by experts in the type of crop and industry studied.

Figure 2 [11] shows that there are some variables that describe the producer of fruits and vegetables, among which are: Computers, technology, tools, environment, storage, transport, waste rate, characteristics of crop inputs, arable land, income, costs, among others. Due to the complexity handled in an agro-industrial supply chain, these links should be simplified by choosing to use variables that summarize other variables, for example, a high production yield

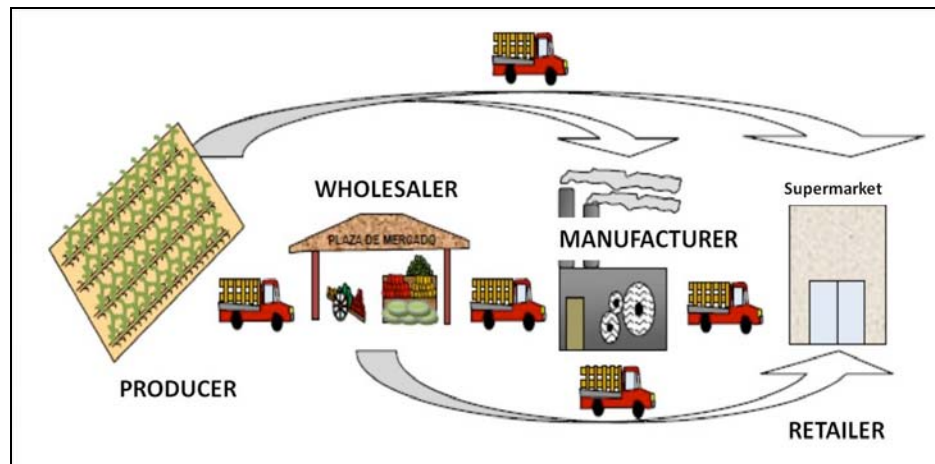


Figure 1: Agroindustrial Production Chain.

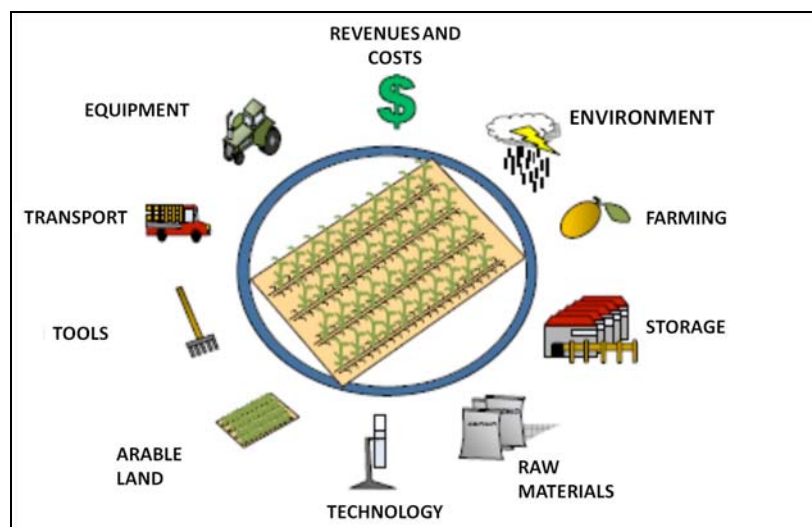


Figure 2: Variables related to the agricultural.

per hectare of farmers can be supported by technological conditions, equipment and right tools, good management and post harvest product suitable environmental conditions.

The proposed methodology characterizes the agribusiness production chain, in communion with the SCOR methodology to develop a strategic plan and logistics, based on the stages and components shown in Figure 3 [11], and consists of four major steps [12]:

- Construction of the global network.
- Characterization of actors.
- Detailed network construction.

Design and analysis of scenarios.

This methodology aims to work in the validation and verification of the chain, as well as awareness of it.

3.2. Methodological Model Applied to Biodiesel Castor

Considering this model, we identified the levels of the process, key performance indicators, attributes and logistics operations that are carried out throughout the chain. The usefulness of the application of the SCOR model is defined by the clear identification of the components that manages the chain, highlighting the strengths and weaknesses of external relations and internal logistics. From this perspective it is noted that the application of the SCOR model effectively contributes to efficient logistics operations back along the chain, marking the need for investigation of SCOR applications in production processes and more on biofuels. In this sense the results will follow and shape future research.

We identified components of the supply chain of the production process of biodiesel from castor, which is

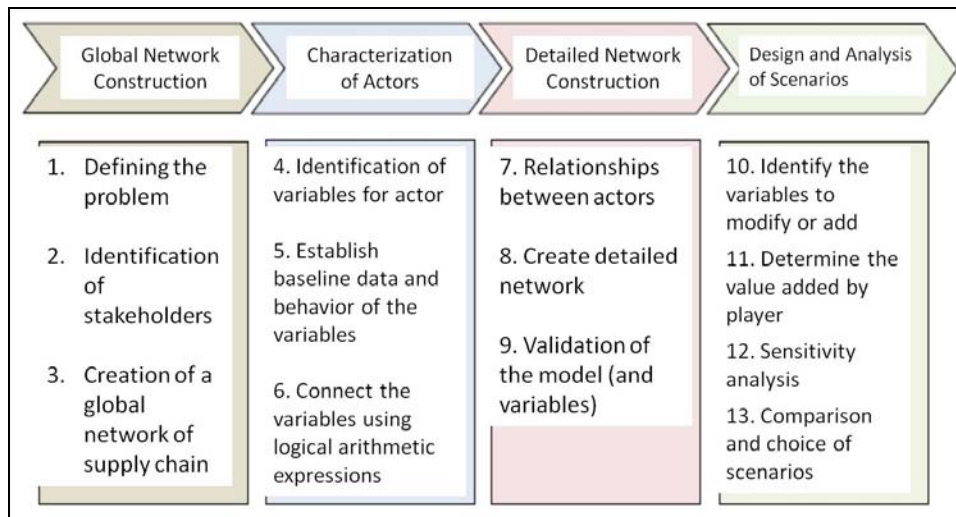


Figure 3: Definition Methodology for Supply Chain Using Dynamic Networks.

structured by following links from threads, as in Figure 4.

3.2.1. Source

This first link is set by the first two threads that are the provider of my provider and my provider, from the cultivation of castor to the delivery of the fruit as an input for production, on the following link. All these logistics operations are listed in Figure 5.

3.2.2. Make

The second link is made up of logistics operations for obtaining thread castor oil (Make) of Figure 6, which

is the main component in the production of biodiesel. In this thread, it takes into account the so-called operations co-products, as they represent an area of opportunity from the point of view of the implementation of operations in reverse logistics or reverse, from the detoxification of these, defining various kinds of co-products.

3.2.3. Deliver

The third link, Deliver, of the Figure 7, is the storage, shipping, transportation, distribution and delivery of biodiesel (biofuel) to the final consumer at the pump tanking.

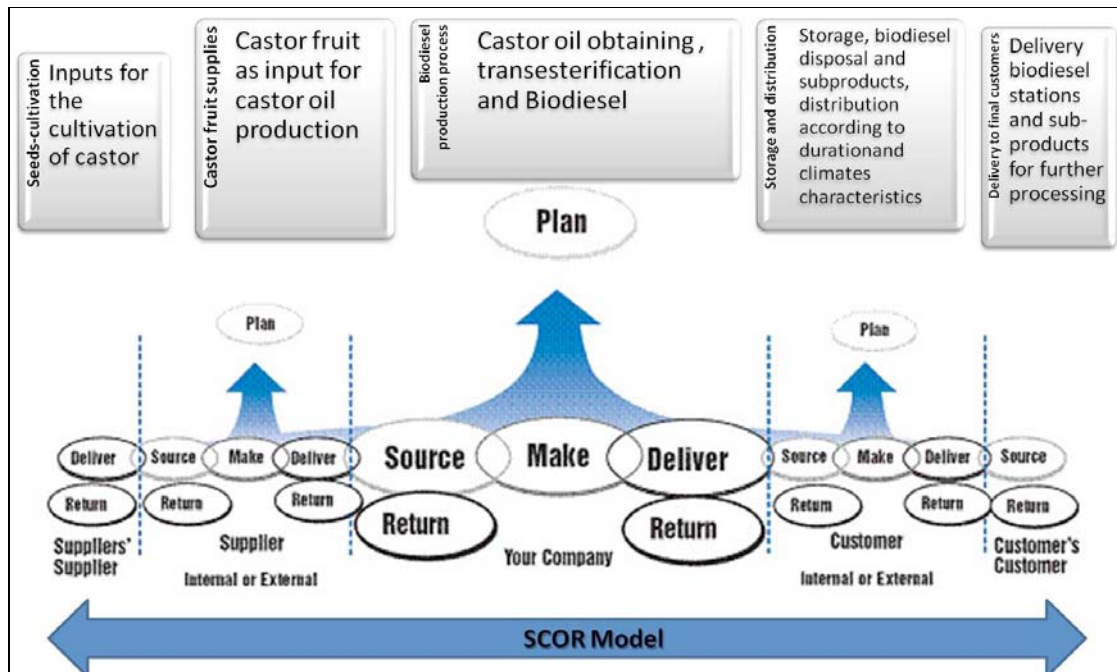


Figure 4: Supply Chain in the Production of Biodiesel from Castor.

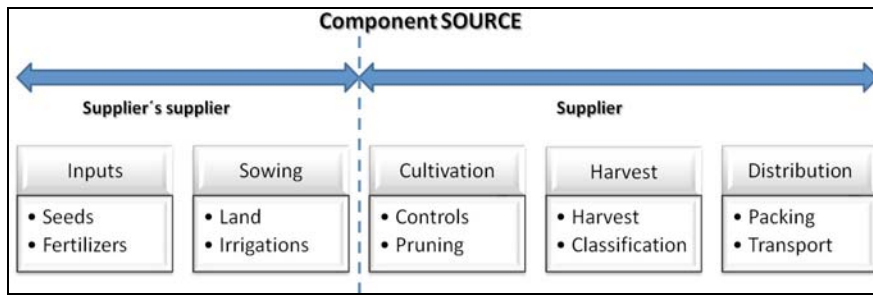


Figure 5: Logistics Operations Component Source.

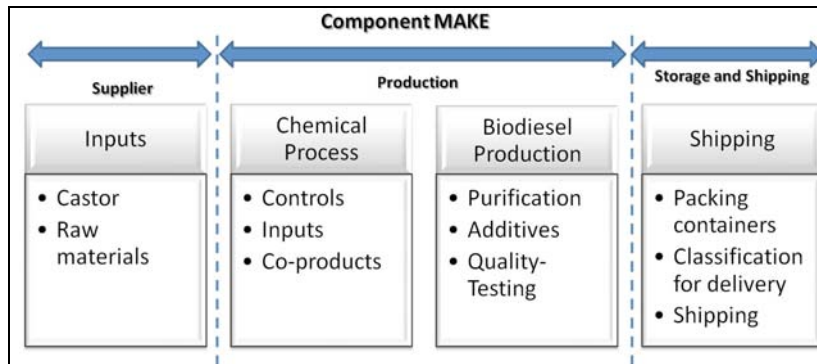


Figure 6: Logistics Operations Component Make.

The SCOR Model component, Return or returns, is located in the Source threads for cultivation of castor beans and the Make or production of biodiesel, as it is here in these two threads, where operations generate returns.

3.2.4. Plan

The fourth element of the SCOR Model, Plan, is present throughout the supply chain (Figure 8), from planning and control of crops, to delivery to the customer or end user, a process that is constantly fed

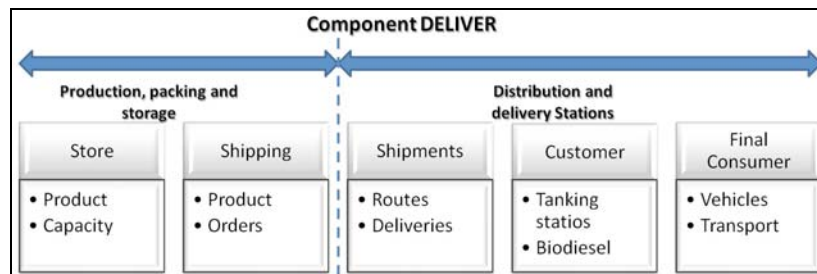


Figure 7: Logistics Operations Component Deliver.

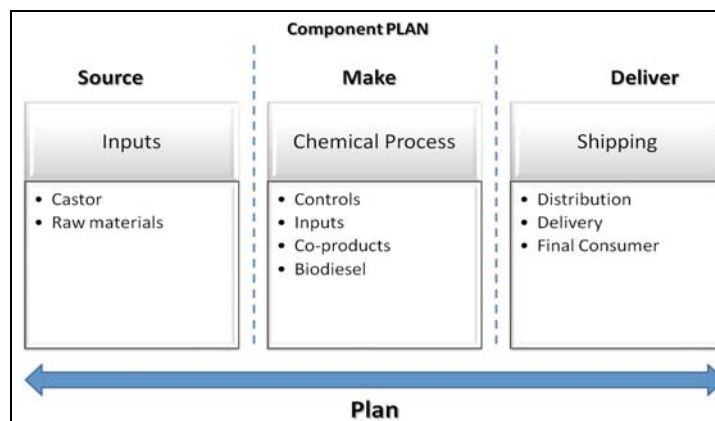


Figure 8: Logistics Operations Component Plan.

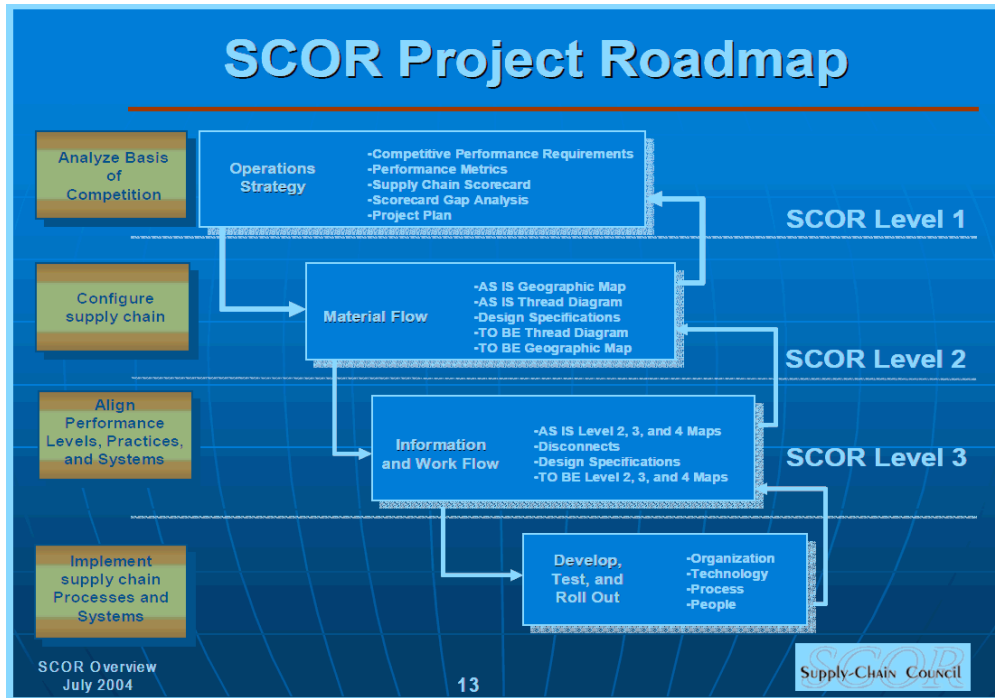


Figure 9: Project Plan.

back through evaluation of logistics performance indicators.

4. DISCUSSION

We applied the model structure for the different levels at which the SCOR Model is defined, according to SCC. For the three levels defined, we considered the operations, transactions, indicators and attributes that apply to the supply chain, as well as the process itself, as seen in Figure 9 [2], which defines the project plan according to the tools used.

To join the strategy of the biodiesel production process to the performance of the supply chain in a

competitive environment, we performed a SWOT analysis (Strengths, Weaknesses, Opportunities and Threats), bearing in mind that the strengths and weaknesses are internal characteristics of process, while the threats and opportunities are external or environmental characteristics.

After the results of the SWOT analysis (Table 1) and cost analysis, we identified competitive performance requirements that characterize the production of biodiesel from castor.

From the key performance indicators that suggests and defines the SCOR Model in the process are listed the directly affecting the supply chain, due to the

Table 1: Biodiesel from Castor SWOT Analysis

SWOT		External Factors	
		Opportunities	Threats
Internal Factors	Strengths	The obvious need to strengthen further research production processes and improve operations across the supply chain, from development in the rational use of renewable natural resources as sources of energy, because fossil fuels are being depleted and secondly the need to mitigate global climate change as a result of environmental contamination with the emission of greenhouse gases, produced by the combustion of fossil fuels like gasoline and diesel, and other causative agents.	National government policies that strengthen and support the cultivation and improvement of inputs such as Castor, tending to the development of the industry that makes Colombia a more competitive country in the region in the field of biofuels, particularly biodiesel from castor, compared development of Brazil, now a leader in Latin America.
	Weaknesses	Developing strong supply chains and defined in all its logistics operations, in light of the demands of global new energy environment.	Weak link in the supply, due to laws of supply and demand for raw materials, in this case castor oil, used for the cosmetic industry as its main competitor in this link.

relationship between different logistics operations and the impact they can have on the attributes, in terms of reliability, responsibility, flexibility, costs and assets. This section finally evidence that the model is based on performance measurement, providing a standard terminology and subordinating the use of performance indices to the attributes (Reliability, Flexibility, Speed / Capacity Service, Cost and Assets) to give Competitive Advantage to the S.C. [13].

The castor biodiesel, with interesting potential for production in several regions of Colombia, not meet some of the parameters, but research is being done by the national government and agencies as CORPOICA and universities, today forming a network, where evidenced the existence of the links that make up the supply chain, taking into account the different logistic operations that constitute the light of a dynamic system, such as that shown in Figure 10.

5. CONCLUSIONS

The main contribution of this research is the application of the SCOR Model methodology to identify the links and logistics operations in the supply chain of biodiesel production process of Castor, which particularly involved the application of the SCOR Model in all its stages of implementation, depending on the relationship level, identifying key performance

indicators for supply chain disruptions and identifying what causes them, such as the link in the supply or supply, related to the achievement of the basic raw material or input, the castor.

From the results, we concluded the following from this research:

- Identification of links that allow the production process Biodiesel Castor to strength the activity by making it more inclusive society for which this sector of the economy has become important. This project has allowed the process to be more competitive in the domestic market and the region is expected to have more trust in wealth-generating activities, making investment in technology, transport infrastructure and strengthening sectorial government policies.
- While it is true that there is a large base of research related to supply chains in the world and in Latin America, it is also true that in the field of biofuels, the region that has the highest strength is Brazil. There is little research models or methodologies such as SCOR and could not be documented for this study. Colombia is the second largest producer, with a significant gap from the first, and is looking to improve his processes, which gives meaning to this type of

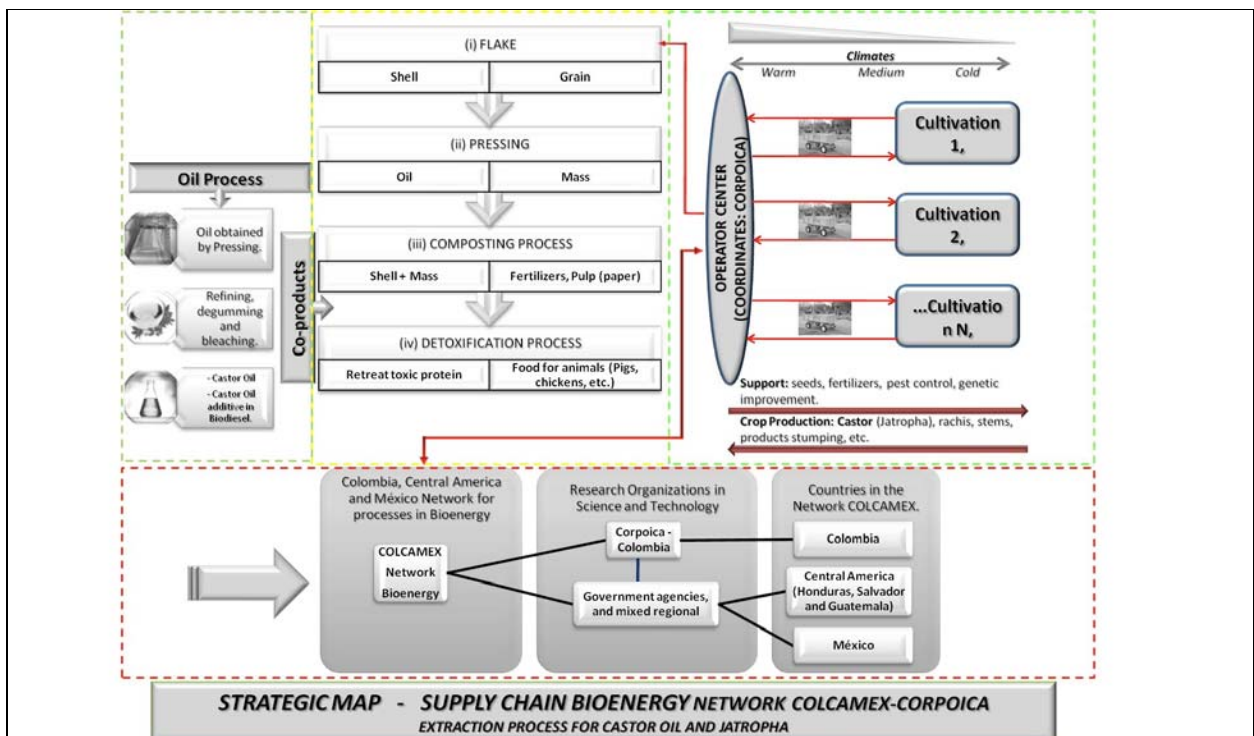


Figure 10: Project Plan.

research seeking to strengthen supply chains of castor biodiesel in particular.

Of the advantages found in the investigation concludes that:

As for the Management of Supply Chain, SCOR model is a strategic tool to get an overview of all the CS-specific and each of its elements and processes to analyze, measure, set performance targets, identify opportunities for improvement, identify best practices and systems and prioritizing projects.

Currently there is no other similar methodology that includes the operation of the supply chain from the supplier's supplier and customer to customer for any process, be it in the area of biofuels.

It is a methodology that educates players in the chain and the importance of optimizing, enhancing and strengthening the supply chain.

The SCOR model is a common communication language to members of the supply chain that uses it.

Conducts competitive analysis identified in research have helped to define clear business opportunities.

Of the disadvantages that were found is concluded that:

It is difficult to find information about the model, which is evidence of the results due to the lack of case studies have been published or released and where can exemplify the implementation of the SCOR model.

SCOR is a diagnostic methodology and design, but its reach does not extend to the implementation of change, which is important to introduce a methodology to any process.

Showed only SCOR processes and tasks to be carried out by members of the supply chain in the process of castor oil biodiesel, however did not submit a formal procedure to optimize only found errors, but did not indicate how to correct them.

The SCOR model implementation requires the involvement, support and leadership from the highest level of the company. It also requires the dissemination and training the CS concept of SCOR in the whole process, and the agreement with the other actors in the supply chain (at least Supplier and Distributor).

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