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**Research Report: ZLC-2016-3**  
**SAM: Procurement Strategic Solutions**  
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# SAM: Procurement Strategic Solutions

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**Summary:** The purpose of this thesis is to identify the best supply chain network of exploration barite for the South American (SAM) operations of a world-class oilfield service company in the market. We collaborated with the company's sourcing department by developing an optimization tool and providing recommendations for the demand countries. We focused on identifying the components of the landed cost, analyzed them, and considered strategic factors that can enhance the supply chain network design.



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## KEY INSIGHTS

1. Having a better knowledge of the landed costs involved in material procurement enhances the design of the supply chain network.
2. Network design models can be used for strategic decisions where quantitative analysis are combined with qualitative factors.
3. Complex supply chains should be carried with different elements in order to have decision making as reliable as possible.

## Introduction

Globalization and outsourcing are creating longer and more complex supply chains. Goods' procurement targets suppliers in countries that are often situated far from the demand, aiming to find more competitive prices. As a consequence, companies have multiple options to procure their raw materials and/or semi-finished products from different parts of the world.

Unfortunately, factors that allow companies to reduce their purchasing costs are the same that add complexity to procurement and oblige the enterprises to seek more efficient ways to select these sourcing options.

Sourcing departments shoulder the pressure of finding better acquisition alternatives while complying with requirements established by their internal customers in the company. Hence, the decision making process evolves from raw cost analysis into a strategic judgmental procedure.

The oil and gas industry has historically been known for the price volatility of the products traded; nowadays the crude oil price is suffering its lowest price in 14 years as seen in Figure 1.

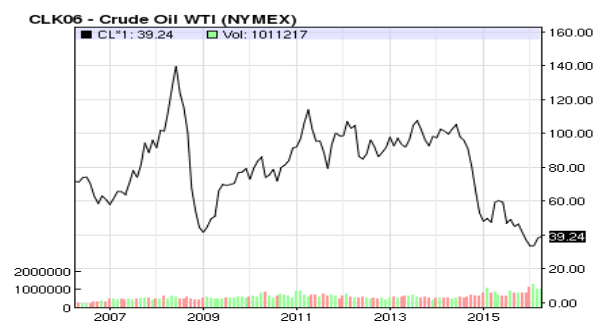


Figure 1: Crude Oil WTI price chart since 2006. Source nasdaq.com

At the same time, oilfield service companies are trying to survive the volatility of the market, and network optimization is the key. In times like this, when the crude is so low, service companies need to reduce costs considering that oil enterprises are less willing to invest in exploration activities, and their competitors are trying to do the same. Also, when oil prices are high, the companies are focused on being more responsive to the clients and maintaining their competitiveness to gain more market share.

## Approach

Barite is a mineral composed of barium sulfate ( $\text{BaSO}_4$ ). Most barite produced is used as a weighting agent in drilling muds. These high-density muds are pumped down the drill stem, exit through the cutting bit, and return to the surface between the drill stem and the wall of the well.

In order to understand better all the implications of acquiring barite, and at the same time identify the main components of the total landed costs, we started our project by reviewing the existing information related to the Oil and Gas industry available online and in previous investigations. We focused on barite characteristics and uses, worldwide suppliers available, frequent transportation modes, payments tariffs, and other relevant data for the material procurement process.

Then, to find the best procurement allocation across the different suppliers in order to minimize the acquisition costs, we developed an optimization tool that gives this output in terms of total landed costs. Afterwards, we made a supply chain network analysis of the current characteristics of the demand countries in the South American (SAM) region including a SWOT analysis breakdown attached to the material suppliers.

The data collection was made both with primary and secondary information. The first one was possible through constant communication with the company sponsor of the thesis. This primary information includes one year of SAM region's consumption and forecast, location of the distribution centers, available suppliers and their location, and current situation of the operations in SAM.

For the secondary data, we rely on data available from important organizations in trade, finance, energy, and governmental institutions like the World Bank, World Trade Organization, U.S. Energy Information Administration, USGS National Minerals Information Center, and other sources that are mentioned later on through this thesis report.

For the final sourcing decision-making, we made recommendations for the SAM region and for each demand country that was analyzed along with the tool results. Together the quantitative allocation results of the interactive tool and the recommendations support a more effective and reliable sourcing of decision-making.

## Problem definition

The globalized market, fluctuation of prices, and competitive players are included in the complexity of the oil and gas industry. At the same time, expenses to be included in the analysis are another layer of complexity to consider. It is a challenge for companies to estimate total costs because some costs can be hidden.

Our sponsor is a large oilfield service company with a complex sourcing organization. Due to the importance of the barite, the company is seeking the best supply chain flows for this drilling mud material, focusing in their South American (SAM) operations. The main concern of the company is to decrease their costs, and barite acquisition is key.

In 2015 our sponsor was facing administrative structure changes in South America. A relevant change for this project is that previously the company was organized with sourcing personnel in each country, making decentralized decisions in procurement. After the re-arrangement, the barite acquisition was assigned to a regional sourcing specialist that currently takes care of all South American demand for this material and that collaborated in the thesis. This new centralized decision-making is a great opportunity to organize the entire barite material flow. When making the sourcing decision, if all costs involved are not identified, the company might incur the risk of paying hidden costs, leading them to increase the total expenses. This situation is the exact opposite of what company needs, considering they are concerned about staying competitive. The sourcing specialist has limited time to identify all elements that are involved in an end-to-end supply chain and how these can influence the final sourcing decision or affect the operative performance.

Sometimes, the number of available suppliers are not appropriate in order to guarantee the correct material supply. If the decision-maker decides to select only a few suppliers, the supply chain may be jeopardized; on the other hand, the decision of having too many can lead to redundant supply costs.

Once all the decisions described above were taken into consideration, the supply chain network design has to be decided in order to minimize the total landed cost and also to reduce the material flow lead time.

The following are research questions (RQ) that we wanted to answer in the project:

- What are the main components of the landed cost in the barite supply chain?
- In what way should the barite procurement across different suppliers be allocated in a manner to minimize acquisition costs?
- What is the optimal network design if strategic factors related to sourcing countries are considered?

## Methodology

The steps of the methodology followed to answer the research questions of the project are shown in Figure 2. Starting from the top, we identify the current supply chain network and all the stakeholders in order to increase our understanding of how the barite material flow is developed. Then we collect the data we needed to do a quantitative analysis, seeking our objective of identifying the best supply chain network to acquire barite for South America. We can answer our first research question of identifying the components of the landed cost with these two first steps.

With the data on hand, the next step is the development of an optimization tool. We filled the interactive tool with the information gathered in order to find the combination of lower cost to assign suppliers to meet the demand. This way we answered our second research question of how to allocate suppliers minimizing cost.

Later, we analyzed the current situation of the supply chain and the results of the optimization tool. Here we identified which strategic factors should be considered to optimize the network design, answering our third research question.

The final step was the sourcing decision recommendation. Together, the quantitative results of the optimization tool and the analysis of strategic factors are combined in the recommendations section.

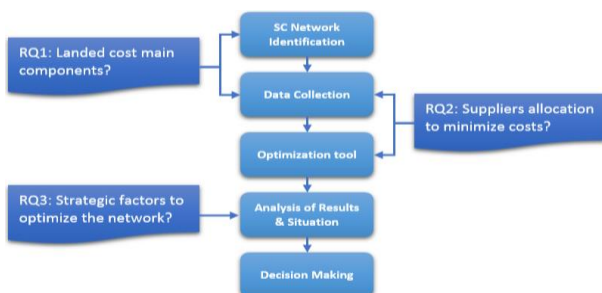


Figure 2: Flow chart for research questions

## Supply chain network identification

To have a better concept of the supply chain network of barite for exploring operations in South America, all stakeholders were first identified. With the sponsoring company's collaboration and secondary data, the location of barite suppliers and demand was gathered, as well as current transportation service modes. Components of the supply chain network that we wanted to identify were landed costs, demand data, information about suppliers and transportation, barite facts, company's sourcing process, and the organizational structure, and facilities capacities.

## Optimization tool

The optimization interactive tool combines multiple parameters with the aim of finding the best allocation distribution of purchase material in order to comply with demand's requirements. The data collection was very important to fulfill all the information of the suppliers. This tool saved the time of the sourcing specialist when calculating the cheapest source to purchase the barite.

## Decision making

It is necessary to take into account that the optimization tool output is the best allocation distribution in terms of costs, but there are other qualitative parameters that are important. The qualitative factors collected were analyzed altogether with the optimization tool output.

## Analysis of the current network

The demand for barite in 2015 was similarly distributed as in the expenses in Figure 3. The total cost per ton in SAM region was around 325 USD/ton, while in some countries like Chile and Venezuela expenses reached 500 USD/ton. Bolivia and Brazil expended the least per unit of barite.

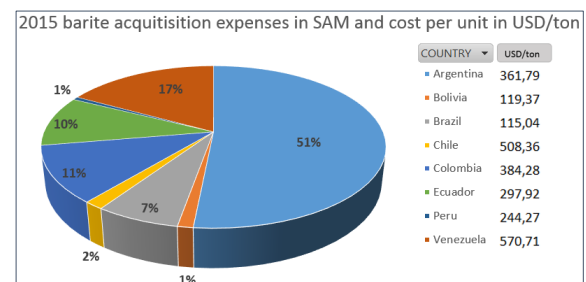


Figure 3: Company's expenses in barite procurement (sponsor)

The company forecasts that the demand in some countries will be lower than in 2015 as seen in Figure 4. It is expected that the exploration operations will diminish in those markets in which they could not

decrease their cost to stay competitive as did Argentina and Colombia.

At the same time, the sponsor company is making efforts to gain market in countries like Ecuador, while the other operations are still relatively stable.

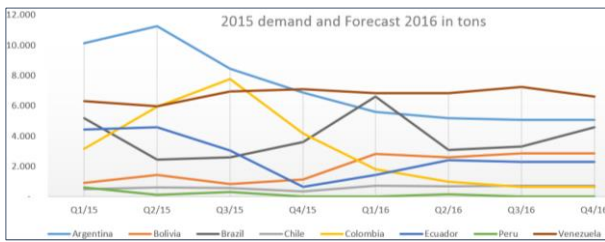


Figure 4: Barite 2015 demand and forecast 2016 in tons (company)

### Conclusions and Recommendations

Because each demand country has particular demand requirements, material allocation capacity and restrictions, we made an analysis for each of them in order to identify and recommend actions that can lead to reduced costs.

During the project we identified the difficulty of gathering the right information and the importance of keeping it organized. In this aspect the interactive tool will help the sourcing specialist to improve time management. The tool can give a decentralized view of the procurement, leading to misperception of capacity available. Yet the new centralized function of the company can use the tool simultaneously for all countries, overcoming the issue. Obviously the tool needs slight improvements in the future, the advantage being quantity discounts. The SWOT analysis provides a better picture of the local situation in each demand country.

Together the optimization tool and the recommendations from the SWOT analysis make up for the other's limitations. In this thesis, the importance of taking into account the entire supply chain and the possible implications, internal or external that can affect the material flow is explained. When the company is sourcing important materials, the decision maker needs to make a choice as reliable as possible because it is this area that manages the possible cost savings or losses.

The following are general recommendations that apply to the entire region of South America.

- Negotiation with ocean freight providers in order to decrease transportation costs. This considers that currently the company hires in the spot market.
- As started in 2015, continue with the centralized procurement process. This is due to the negotiation

power that the unit business earns for sourcing projects. At the same time, this area could have better contract management.

- Pool the demand of various countries. By doing this, the sourcing specialist can increase the order quantity and decrease the material costs.

- Maintain fluent communication with the demand countries' operation departments. This enables opportunities of continuous development with local suppliers and improvement of the requirements when sourcing materials and services.

- Internal provision between different distribution centers in South America. By adding this flexibility, the demand countries that have storage capacity can supply those that do not. This decreases the risk of stock-outs and the pressure to purchase barite at high cost.

- Develop substitutes for barite. It is important to decrease the dependence, and at the same time, it is an opportunity to find a less costly material.

- Improve the operational effectiveness of the owned facilities, barite mine, and mill. This will diminish costs and can generate opportunities to enhance channels of material flow.

- Keep track of oil market changes because these affect the drilling exploration and the barite demand.

The findings in this thesis can also be applied to materials other than barite. The optimization tool was prepared for the introduction of data for different materials, thus expanding its use in the industry.

### References

- Chopra, Sunil, and Peter Meindl. *Supply Chain Management: Strategy, Planning, and Operation* (5th Edition) Global Edition. 2014
- McBeath, Bill, and Colin Kessinger. *Understanding the True Cost of Sourcing*. May 2004. <http://www.chainlinkresearch.com/>.
- World Bank Group. <http://www.worldbank.org/>.
- World Trade Organization. <http://www.wto.org/>.
- Doing Business - Measuring Business Regulations - World Bank Group. <http://www.doingbusiness.org/>