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Research Report: ZLC-2015-2
Strategic Sourcing in Complex Environments
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Strategic Sourcing in Complex Environments

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Summary: Our thesis proposes a mathematical model to solve the supplier selection problem over a multiyear planning horizon in changing regulatory environments. We also confirm that Brines, a subcategory of chemicals, is a good candidate for increasing local content in certain target countries.



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KEY INSIGHTS

1. The supplier selection process must take into consideration changing local content requirements.
2. In order to increase their local content, companies need to focus on expanding their supplier base in low complexity and high spend categories.

Introduction

Sub-Saharan Africa has been described as a rapidly developing market for the oil and gas industry. New discoveries in East Africa (Uganda in 2006 and Kenya in 2012) generated intense interest amongst investors and created opportunities for oil and gas service companies. In parallel, procurement decisions for these companies have become more complex. Governments in new as well as in mature markets in the region have adopted or are considering adopting policies aimed at maximizing the impact of the oil and gas industry on their economies. While quality and costs continue to be

important factors in sourcing decisions for the oil and gas industry, the introduction of local content requirements is rapidly reshaping the industry's regulatory environment.

The problem is that this complex business environment requires an in-depth analysis to ensure that procurement units deploy a supplier portfolio that takes advantage of sourcing opportunities in sub-Saharan countries.

This research was undertaken at the request of an upstream oil and gas service company active in sub-Saharan Africa. In order to meet the needs of the sponsor company this research focused on three countries: Angola, Kenya, and the Republic of Congo.

Suppliers in countries with limited industrial capacity are often unable to serve the oil and gas industry. Therefore, in order to reduce costs, maintain quality standards, and ensure the reliability of deliveries the upstream oil and gas industry relies largely on global

supply chains. In this context, increasing local content presents a challenge.

The concept of “local content requirements” (LCR) captures a broad set of government policies aimed at generating benefits to the local economy by increasing linkages between the oil and gas industry and other sectors. According to a World Bank report, LCR generally refer to the share of employment or of sales to the oil and gas sector locally supplied at each stage of the production process [Tordo et al., 2013]. For instance, local authorities might set minimum levels of employment of local workforce and determine training requirements. LCR policies might also promote local supplier development by requiring a minimum percentage of local purchases. For the purpose of this research, we primarily focus our attention on local content policies promoting supplier development, as these are most likely to impact the supplier selection process.

LCR policies can be difficult to interpret and implement for companies. The level of details and the scope of local content policies vary greatly between countries. As a result, companies are faced with a unique set of requirements in each country of activity.

Methodology

The methodology used for this research can be defined as a three-step process. First, we reviewed the local content policies in place in Angola, Kenya, and the Republic of Congo. We also examined the local content policies of Brazil, Ghana and Nigeria as they might serve as models for future regulations in the countries considered in this research. This process helped determine how local content requirements could be integrated into a mathematical model aimed at solving the supplier selection problem at hand.

Second, we analyzed the sponsor company’s average expenditures in Angola, Kenya, and the Republic of Congo. At the request of the sponsor company the analysis centered on the distribution of the expenditures in the chemicals category. In our analysis, we identified opportunities for increasing local content through the existing supplier base. We also performed a Pareto analysis to determine which subcategory of chemicals should be considered in priority to increase local content.

Finally, we presented an approach to include supply and demand risks into the total landed costs of a commodity sourced from a given supplier. We then used this formulation to develop a mathematical

model that could solve the supplier selection problem over a multiyear planning horizon and take into consideration changing local content requirements. Because the sponsor company sources chemicals worldwide, we formulated the supplier selection problem as an uncapacitated facility selection problem.

Local Content Requirements (LCR)

Local content requirements can be implemented through a wide variety of tools and mechanisms. In addition, local content requirements can vary in scope. Companies might be subject to minimum local expenditures imposed on the total value of a project or on specific categories of products. We have established that there is a high likelihood that the target countries will adopt new local content regulations over the next few years. In addition, our research has also shown that local content requirements can change unexpectedly. Finally, we have established that non-compliance with local content requirements can lead to escalating penalties.

As a result, the mathematical model we will propose must be able to handle the following elements:

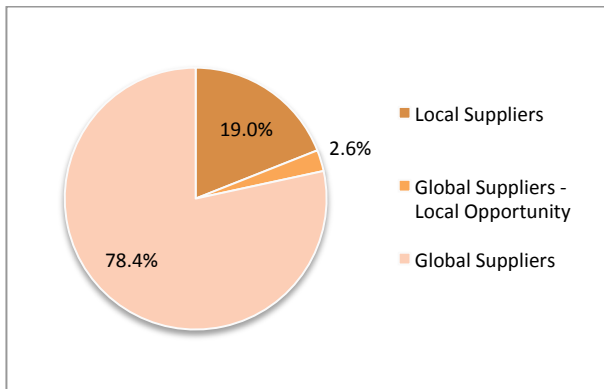
- Different LCR targets per category of product
- Multiyear planning with changing LCR targets
- Increasing financial penalties for non-compliance

Spend Analysis

We analyzed the sponsor company’s average spend profile on chemicals in the target countries. For each country we first established the distribution of the supplier base and identified opportunities for increasing local content by maximizing purchases from existing local suppliers. We then analyzed the distribution of expenditures per subcategory using a Pareto analysis. For each country we attempted to determine which subcategory is the best candidate for increasing local content.

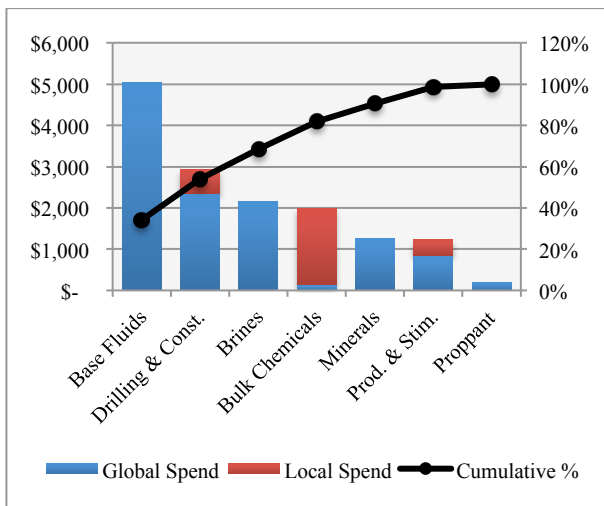
The pie chart below divides the average annual expenditures on chemicals in Angola into three categories according to the type of supplier base: local suppliers, global suppliers, and global suppliers - local opportunity. The *Local Suppliers* category captures all local expenditures. The *Global Suppliers* category captures all expenditures for which no local supplier is available in the sponsor company’s dataset. Finally, the *Global Suppliers – Local Opportunity* category captures the amount of money

directed to global suppliers for commodities where at least one local supplier is available in company's dataset.



The *Global Suppliers – Local Opportunity* category represents an opportunity for local sourcing amounting to 2.6% of the total amount spent on chemicals. The possibility of increasing local content through the sponsor company's current supplier base is therefore limited.

As a result, in order to significantly increase local content in chemicals, new suppliers must be identified or developed. To identify potential candidates for local sourcing, we performed a Pareto analysis of the expenditures on chemicals for Angola at the subcategory level. We ranked the subcategories of chemicals per amount spent and distinguished between local and global expenditures. The results of this analysis are shown in the figure below.

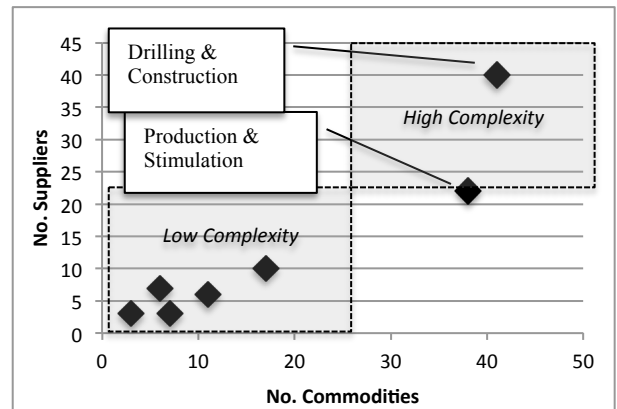


In terms of expenditures, Base Fluids are the most important subcategory. However, the sponsor company did not wish to consider local suppliers for Base Fluids because of their strategic importance. This decision removed 34% of the current spend from the pool of expenditures that could be considered for local sourcing. It also placed an

important limit on the maximum level of local content that can be achieved in the category of chemicals.

We can observe from the Pareto analysis above that local suppliers are available in three subcategories: Drilling & Constructions, Bulk Chemicals, and Production & Stimulation. Unfortunately, none of these categories is a good candidate for increasing local content.

Drilling & Construction and Production & Stimulation are very complex subcategories with large numbers of suppliers and commodities. In the case of Bulk Chemicals, local content appears to have already been maximized: local suppliers account for 93% of total expenditures in this subcategory.



As a result, Brines, with 14.6% of all expenditures on chemicals, appear to be the best subcategory for the company to start increasing local content. This subcategory has a low level of complexity with only six commodities and seven suppliers.

A similar analysis was performed for the expenditures on chemicals in the Republic of Congo and Kenya. The main findings are:

- Base Fluids capture an important proportion of expenditures on chemicals (between 34% and 41%), thus limiting the maximal local content that can be achieved in the category of chemicals.
- The current supplier base cannot support an increase in local content of more than a few percentage points. The sponsor company must expand its local supplier base to meet large increases in LCR.
- In Angola and Congo, the subcategory of Brines is a good candidate to increase local content because it presents low levels of complexity and high levels of spend.
- To increase its local content in Kenya, the sponsor company should expand its local supplier base in other subcategories.

Mathematical Model

Using the findings of our research on Local Content Requirements, we developed a model that can account for evolving LCR and escalating penalties for non-compliance in the framework of a multiyear planning horizon. In addition, the model used to solve the supplier selection problem accounts for two costs: (1) the costs of starting business with a supplier and (2) penalty for changing the supplier base.

In order to support the implementation of this model, we developed an approach to calculate the total landed cost (TC) of a commodity. We proposed to define the total landed cost as the sum of four elements:

- (1) Additional logistics cost of expedited shipment,
- (2) Purchase cost including normal logistics cost,
- (3) Pipeline inventory cost, and
- (4) Customs and tariffs.

We believe that the proportion of expedited shipments is an adequate proxy for the supply and demand side risks faced by the company when using a given product-supplier combination.

In order to verify the validity of our mathematical model we used the expenditures on Brines in Angola as a test case. The test revealed that the model could successfully make tradeoffs between realizing local content and incurring penalties. However, the results showed that the modeling of penalties and of other parameters, such as inflation, have a significant impact on the behavior of the model in a multiyear scenario. Therefore, careful modeling of these costs is essential to ensure that the supplier portfolio proposed by the model is optimal.

Conclusion

It is clear from the spend analysis of chemicals that the sponsor company's current supplier base does not allow it to significantly increase its local content. To increase local content in chemicals beyond a few percentage points, the company must expand its existing supplier base. For its operations in Angola and Congo, the subcategory of brines appears to be a good candidate. The relatively low level of complexity of this subcategory combined with high level of expenditures will ensure a sizable impact on local content while minimizing the number of changes in suppliers. However, in the case of Kenya

other subcategories, such as Drilling & Construction, should be considered.

An important contribution of this research is the development a methodology to integrate the supply and demand risks into the total landed cost of a commodity. We achieved this by suggesting that these risks can be factored in as a percentage of expedited orders. This approach can be used as a standalone procedure to evaluate the cost of sourcing a commodity from a given supplier or in combination with the mathematical model suggested.

This research also provides the sponsor company with the capability to evaluate the impact of changing local content requirements on its supplier base. By changing the levels of local content requirements considered by the model, managers can explore the financial consequences of different scenarios. The model developed can help procurement units determine the optimal portfolio of suppliers over a multiyear planning horizon. This model can suggest a portfolio of suppliers that takes into consideration evolving local content requirements. In addition, the model proposed is generic enough to be applicable to the company's operations in multiple countries. Even though the results are based on the analysis of a single subcategory of product, our model can be applied to multiple categories of products simultaneously. However, beyond a certain number of commodities, the computational burden of the calculations will become problematic.

An important limitation of this research is that important variables, such as the cost of changing supplier and the penalty for non-compliance, were set arbitrarily. As we have shown, these costs can have a significant impact on the behavior of the model. Therefore, careful modeling of these costs is essential to ensure the accuracy of the model's results. Additional research is needed to determine the cost to the company of setting up and changing suppliers. In addition, our model currently does not take into account the inventory holding cost of commodities. Future efforts could therefore explore how to integrate this cost into the mathematical model suggested.

References

Tordo, S., Warner, M., Manzano, O. E., & Anouti, Y. (2013). *Local Content Policies in the Oil and Gas Sector* (World Bank). Washington, DC: The World Bank. <http://doi.org/10.1596/978-0-8213-9931-6>