



MIT SCALE RESEARCH REPORT

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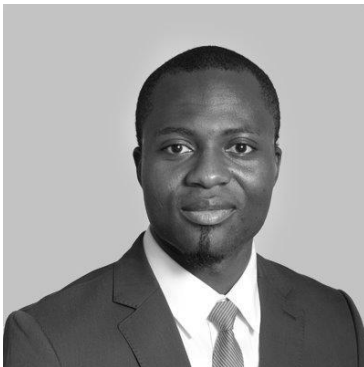
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SUPPLY CHAIN NETWORK DESIGN FOR SUB-SAHARAN AFRICA

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Summary:

This thesis tackles the question of whether setting up a hub in South Africa would allow a company to derive advantages in terms of lead time and cost efficiencies over its entire supply chain. We compare the status quo, i.e. what the company does at this point in time, to what we believe the system will look like using NPV. Upon completion of our calculations, we will draw our conclusion from those results.



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KEY INSIGHTS

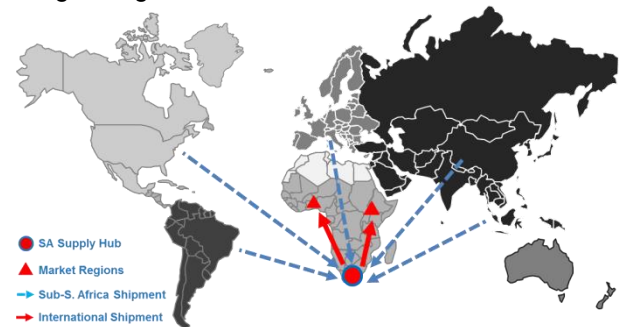
1. Lack of a track record, i.e. data for the past five to ten years, makes it very difficult to accurately predict future results.
2. Any logistics operation is at the mercy of fuel price volatility – carrier charges can change at any time without notice.
3. Every extra day that goods spend in transit can drastically increase expenses and decrease profitability.

INTRODUCTION

The key drivers behind a successful supply chain include quick point-to-point transfers, a solid operation on the ground and the knowledge of local collaborators. It is perhaps for this reason that firms are so keen to establish themselves in the African continent. As the self-styled 'Final Frontier', the opportunities available to those with the desire and acumen to succeed are endless.

This thesis aims to investigate the possibilities available to a company that would like to be the first in line and take a chance with breaching this barrier. The servicing part of the oil and gas industry has

become extremely competitive due to high profitability and the discovery of new reserves in burgeoning African economies.



QUALITATIVE

A look at the diagram above accurately illustrates the attractiveness of having South Africa as a supply base. Its central location means that countries in both hemispheres can be served with similar lead times and with equal ease of access.

Best of all, perhaps, the entire African continent can now be served from a single point if needed and not have to be served by a series of scatter-gun location in other parts of the globe.

However, this is not purely a hypothetical question based on pretty pictures. Our sponsor company is a major player in the oilfield services industry and does business in many of the financial centres of the world. Its concern at this point is directed towards the ease of doing business in South Africa.

An important consideration has to do with the demographical aspect of the equation. While breaking new ground is a highly exciting task, it is also one fraught with peril. Is there a satisfactory quantity of suitable personnel in the area of interest to merit starting up a sizeable operation? If not, what are the chances that the company's current workforce would accept transfers to the new location?

However, the main points of focus are the customs regime in that country as well as the country's rules regarding goods that were shipped to/manufactured in the country but were intended for sale overseas. From the interviews with stakeholders in South Africa and elsewhere within the company, we reached the following conclusions:

- 1) Duty would have to be paid on all goods destined for final use/sale *within* South Africa.
- 2) All goods that were to be sold in other countries did not have any duty attached to them. This included goods moved between cities so long as they were kept within designated Industrial Development Zones (IDZs).

QUANTITATIVE

An IDZ is South Africa's answer to free trade zones, an area where foreign companies can hold/manufacture goods while they decide where to send them.



The Google Maps image above highlights the five IDZs that currently exist in South Africa: (from west to east) Saldanha Bay, Port Elizabeth, Coega, City Deep and Richards Bay. One of our sponsor's requirements was that air and sea traffic from any chosen location had the same or better frequency to African destinations as their current points of origin.

We therefore recommended Richards Bay (furthest point in the east) based on its proximity to:

- 1) Johannesburg – one of the busiest airports in the whole of Africa, with a total of 61,817 international flights annually.
- 2) Durban – by far the biggest and busiest port in Africa, which handles 34% of all ships that dock at South Africa ports annually.

There are two main concerns: first of all, will the venture be profitable, and if so, what are the advantages, if any, that can be derived in terms of lead-time and cost efficiency? While these questions are somewhat intertwined, one does not really imply the other.

For instance, a profitable venture may be the result of other factors unrelated to the aforementioned, whereas simply improving them does not mean that the venture will be profitable. The goal is to determine whether there is scope for both to happen in the same instance.

CALCULATIONS

To compare the current situation to the one that we proposed, we used the following equation:

$$\text{Total Cost} = \text{Transportation Cost} + \text{Administration Cost} + \text{In-Transit Carrying Value}$$

It should be noted that we included several charges under each of the three 'umbrella' charges seen in the equation above. For example, 'Transportation Cost' includes charges for freight, fuel, inter-location movement (to and from warehouses). Furthermore, 'Administration Cost' is a by-product of transportation cost in that it takes into account tasks such as billing, documentation and other elements that are related to, but not directly involved with, transportation.

In-Transit Carrying Value (ITV) was calculated by a formula provided by our sponsor:

$$\text{ITV} = (11\%/365) * \text{Days Spend in Transit} * \text{Value of Goods}$$

RESULTS

As one would imagine, setting up the supply base in South Africa is not an investment that would reap immediate dividends, by our calculations. Rather, we prefer to term it an investment in the future; thankfully, this is something that our sponsor was aware of beforehand and was prepared to accept in the short-term so long as the future results showed some benefit in the future.

The project actually makes a loss in the first three years, does not turn a profit until year four and only

breaks even/starts producing a return in year eight. The NPV of the project based on a ten-year horizon is approximately **\$10.7M**.

This may not appear like a great return on investment (ROI) at first glance. Although there is no real up-front investment as far as our sponsor is concerned (they will rent space at an IDZ as opposed to buying it, while ground operations in South Africa and its other African locations are handled by third parties), our calculations suggest that they will spend around \$90.3M in present value over the course of the ten years we investigated, which equates to an ROI of about 11.8%.

Nonetheless, as we stressed earlier, this project is one for the future and most of the financial pain is over within the first three years. In addition, the economies of scale and advantages in lead-time (goods transported from South Africa to other African countries will arrive more quickly than from our sponsor's other bases worldwide) mean that more savings will be realised as time passes.

SENSITIVITY ANALYSIS

With regards to the financial calculation, it is extremely important that we run a fair test. For example, in order to make the situation as realistic as possible, we have to try to simulate the exact conditions under which the historical data was derived for the proposed scenario.

Therefore, while running a single NPV calculation is well and good for the purpose of establishing a baseline, a thorough sensitivity analysis is also desirable in this case because it allows us to test for weaknesses in the model and identify at which points, our sponsor may encounter difficulties. To do this, we will explore the effects of changing one variable while leaving all others consistent.

Labour strikes are a huge cause for concern in South Africa due to the crippling effects they have had on other companies in the minerals industry. Our sensitivity analysis focused on what would happen in the event of five, ten, twenty and thirty working days being lost due to strikes.

Annual COG	\$ 1,166,038,126.75	
Annual In-Transit	\$ 5,271,131.26	% of Total
10-day Strike	\$ 146,420.31	3%
15-day Strike	\$ 219,630.47	4%
20-day Strike	\$ 292,840.63	6%
30-day Strike	\$ 439,260.94	8%

This table shows what the additional annual cost to the company would in absolute and percentage terms with respect to the annual cost of goods in transit. This may not be such an issue in other countries where labour strikes are not so frequent, but in this case, it would not be an exaggeration to suggest that significant time could be lost annually.

Another point to be aware of is the volatility of fuel prices. This is more prevalent in sea cargo (where prices have increased by 17.83% annually in the period 2009-14) than in air cargo (an increase of 10.97% from 2000-13) but it is a major component of freight charges. In fact, it has been estimated that fuel prices account for 9.5% and a massive 70% of aviation and bunker (ship) fuel, respectively.

% Increase in Fuel Price	Resultant NPV
5	\$10,153,183.02
10	\$9,614,557.89
10.97 (average)	\$9,510,064.61
15	\$9,075,932.76

% Increase in Fuel Price	Resultant NPV
5	\$7,049,966.27
10	\$3,408,124.39
15	-\$233,717.50
17.83% (average)	-\$2,297,687.75

The tables above show the effect that each respective increase in fuel price would have upon the NPV we calculated (\$10.7M) before taking extraordinary circumstances into account. We decided to calculate the effects for a range of increases because the two figures we had previously calculated were both averages, so it is interesting to see the effects of each one.

RECOMMENDATIONS

Based on our results, these are the recommendations we made to our sponsor:

- Set up base in Richards Bay IDZ due to its proximity to Durban and Johannesburg, respectively.
- Rent premises/equipment at the beginning so that the cost of exit is not terribly high in the event that the company decides to discontinue the project after a while.
- Frequently benchmark our results against historic examples of the company's expansions in other parts of the globe.
- Consider more air freight than sea freight, especially for non-bulky items. Sea freight is highly dependent upon the price of bunker fuel, which increases at a much higher rate than aviation fuel.