Using a Total Landed Cost Model to Foster Global Logistics Strategy for Electronics Industry

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Summary: This project developed a total landed cost model to analyze the cost from raw material to the customer for one sample Electronics Company, Tel Co. The total landed cost model was also used to predict the impact of global supply chain risks. The result assists firms make a strategic decision on selecting manufacturing locations, and distribution strategy.

Apichart holds a Bachelor in telecommunication engineering from KMITL. Prior to MIT, Apichart worked as a consultant with Kaiser Associates. Apichart has over 5 years of experience in logistics and IT project management. Apichart will be joining Thailand Ministry of Commerce following the completion of his degree.

KEY INSIGHTS

1. A total landed cost model assists business make a better decision on selecting manufacturing locations and distribution strategies

2. Air transportation can reduce total landed cost for products with high demand variability and requiring high customer service level.

3. In the electronics industry, the increasing labor cost drives volatility to supply chain decisions more than the fluctuation in oil price.

Introduction

Today’s global business environment operates across demand and supply points spanning the world. This environment allows firms to consider manufacturing in and sourcing from anywhere in the world. Accordingly, many businesses often move many production activities to low-labor cost countries in order to take advantage of lower operating expenses. However, when selecting production countries, many companies only consider the direct labor costs. There are several additional costs incurred with manufacturing overseas, such as international transportation costs, inventory holding costs, and import taxes. Incurred these costs is a trade-off for lowering the associated labor costs. Due to the neglect of these additional costs in sourcing models, in some instances, overall costs may not be reduced.

Furthermore, going globally means that businesses expose themselves to more risks and other uncontrollable factors. For instance, labor costs in many developing countries are likely to increase. The oil price in the work market is also likely to increase. If these uncertainties become true, the initial assumption that production in low-labor cost country will be benefit to the firms is false.

Accordingly, the key questions emerge: What costs besides labor should be considered in implementing a global logistics operation? How much will the total cost will be impacted from the risks and uncertainties in global supply chain? This research use a total landed cost model to help businesses answer the questions above. The total landed cost model incorporates many additional relevant costs in the supply chain beginning with sourcing raw materials through the transportation to the final customers. The result from the total landed
Cost model will assist businesses in making better decisions in supply chain and logistics design.

**Applying a total landed cost model to the business.**

I selected one sample electronics manufacturing company, TEL Co., which has manufacturing plants and customers around the world. I focused on the connector product in the South America market. Currently, all TEL Co. connectors for South America customers are produced in TEL Co. Brazil’s plant. However, the Brazil plant has high labor costs. So, TEL Co has proposed moving production to other plants in low-cost countries: China, Mexico, the Czech Republic, and India. However, each potential sourcing country incurs different total costs, such as transportation costs and inventory holding costs. The total landed cost model is developed based on the sourcing, manufacturing, and distribution operation of the TEL Co. Six cost factors are incorporated into the model.

**Cost factors:**
1. Raw material sourcing cost
2. Manufacturing costs
3. Transportation costs
4. Warehouse costs
5. Inventory holding costs
6. Taxes and duties

**Analysis and Result:**

The first objective of this thesis is to use the model to show the total landed costs for each five manufacturing plants. The result will serve as a guide for TEL Co. to select a production country. To do so, I used a total landed cost model analyze and set the scenario as follow.

**Assumptions:**
1. 80% of finished goods are transported by ocean and 20% are transported by air
2. Raw materials are procured from the same location.
3. TEL Co. requires 97% of customer service level

![Total landed costs and Lead time](image)

**Table 1: Cost Percentage**

<table>
<thead>
<tr>
<th>Cost Breakdown</th>
<th>Brazil</th>
<th>China</th>
<th>Mexico</th>
<th>Czech</th>
<th>India</th>
</tr>
</thead>
<tbody>
<tr>
<td>Raw material</td>
<td>56%</td>
<td>64%</td>
<td>60%</td>
<td>49%</td>
<td>71%</td>
</tr>
<tr>
<td>Manufacturing</td>
<td>36%</td>
<td>15%</td>
<td>22%</td>
<td>28%</td>
<td>10%</td>
</tr>
<tr>
<td>Transportation</td>
<td>0%</td>
<td>5%</td>
<td>3%</td>
<td>3%</td>
<td>4%</td>
</tr>
<tr>
<td>Warehouse</td>
<td>0%</td>
<td>1%</td>
<td>1%</td>
<td>2%</td>
<td>1%</td>
</tr>
<tr>
<td>Inventory</td>
<td>8%</td>
<td>9%</td>
<td>8%</td>
<td>11%</td>
<td>9%</td>
</tr>
<tr>
<td>Imported Taxes</td>
<td>0%</td>
<td>6%</td>
<td>7%</td>
<td>7%</td>
<td>6%</td>
</tr>
</tbody>
</table>

The result from the total landed cost model shows the total cost per piece of finished goods and lead time for each country. Current production in Brazil has a cost per piece of $0.2405 and the average lead time from manufacturing plant to customer is now two days. China has the lowest total landed cost of the five countries studies, which is 12 percent lower than Brazil. So, if TEL Co focuses only on total cost, China is the best choice. However, the lead time is long at 49 days. This might not be flexible. Therefore, if TEL Co, want to have lower costs sourcing from China than Brazil and also to retain more supply chain flexibility, Mexico is the best choice; the total cost is 9 percent lower than Brazil and the lead time is 32 days. The result in Table 1 shows the trade-off of oversea production transportation, inventory and import taxes. Brazil suppliers do not have imported taxes associated with intracountry customer delivery.

**Air or Ocean transportation?**

The next objective is to show which mode of international transportation TEL Co. should use. I used the total landed cost model to compare the cost of transporting by ocean and by air. The result shows that the total landed cost for ocean mode transportation is lower. Although air transportation would help TEL Co. save inventory holding costs, I found that these savings were lower than the increase in transportation costs. One driver for this is that the product value is small when compared to its weight. Accordingly, I suggest that TEL Co. use ocean transportation.

Additionally, I studied when the product should be transported by air. I assume that high demand variability and high customer service level will be factors that drive air transportation. To deal with high demand variability and to reach high customer service a level, TEL Co. needs to hold high safety stock, thereby increasing their inventory costs. I project that air transportation will help reduce the necessity for safety stock and may lower total landed costs. I performed additional analysis using the above method, where production was based in China for the TEL Co. customer in Brazil. Then, I studied when the demand coefficient of variation changes.

![Comparison of Air vs Ocean Transportation](image)

**Figure 2: the total landed cost comparison between air and ocean transportation from China to Brazil**

I found that at the 97 percent customer service level, TEL Co. should transport by air if the product has a demand coefficient of variation more than 4.3. Next, I test 25 scenarios of demand coefficient of variation and customer service level the result is shown below.
The result in figure 3 shows that Czech Republic is the most highly sensitive country to increased labor costs, which are increased by 41 percent. India shows much less of an impact from increased labor costs. My result can guide TEL Co. to be aware to the labor cost fluctuations if selecting the Czech Republic as a manufacturing location.

The result in figure 4 shows that China is the most highly sensitive country to increasing oil prices. The main reason is because the China has the longest transportation distance to Brazil.

However, comparing both risks, the increasing oil price has less impact on the total cost than the increasing labor costs do. The obvious reason is because of the inherent characteristics of light weight products (3 grams per piece).

When should Tyco move production back to Brazil?

The next part of the analysis is to address the question that, if the cost of labor cost and oil price keep rising, when should TEL Co, move production back to customer country? I select one sample comparing China to Brazil manufacturing location. The result is displayed below.

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![Figure 3: The impact of increased labor cost](image)

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![Figure 4: The impact of rising oil price](image)

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<table>
<thead>
<tr>
<th>CSL</th>
<th>Demand CV.</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.0</td>
<td>Ocean</td>
</tr>
<tr>
<td>2.0</td>
<td>Ocean</td>
</tr>
<tr>
<td>3.0</td>
<td>Ocean</td>
</tr>
<tr>
<td>4.0</td>
<td>Ocean</td>
</tr>
<tr>
<td>5.0</td>
<td>Ocean</td>
</tr>
</tbody>
</table>

Table 2: The suggested mode of international transportation for various conditions.

**Global supply chain risks**

Next, I used the total landed cost model to see the impact of global supply chain risks. For this study, I focused on two risk scenarios: increasing labor costs and the rising oil prices.

The impact of both uncertainties affected more than a single cost factor. For example, increased labor costs would not only increase the associated manufacturing costs but also the inventory holding costs and the import taxes. Inventory holding costs and taxes are calculated based on the product value. Thus, I need to use the total landed cost to accurately study the impact of these increased labor costs. I used the same condition. I assume that the labor cost and the oil price increase two times from the current position. The result is shown below.
Figure 6: Compare the transportation cost between China and Brazil

Unlike the rising of labor cost that may impact to individual country, the rising oil price is a global impact. Accordingly, both countries were considered at the same time. The result in figure 6 shows that, if the oil price keeps rising to 325 percent, the total landed cost of production in China and Brazil will be the same. Accordingly, Tel Co. should consider move the production to Brazil if the oil price rise more than 325 percent from the current position.

Conclusion

A total landed cost model is an extremely helpful tool to assist business in making a decision on developing their global supply chain. From the analysis of this industry case, the total landed costs can show the related costs, the lead time and the cost breakdown for each production country. Moreover, the total landed cost can also be applied to help firms develop the distribution strategy according to the demand characteristics and the customer service level. Additionally, the total landed cost can also be used to predict the impact of global supply risks.

Finally, my thesis did not only help Tel Co. make a decision on where should they produce and how should they distribute, but it also demonstrates the conditions of each scenario and shows the likely impact of global supply chain risks to their decision.