

Fuyao Glass faces a sourcing decision dilemma for the supply of windshields to a new North American automaker in Ontario, Canada. Presently, it can assign the production to Tianjin plant in China which has advanced automated installation, multiple production lines, latest technology and low-cost labor. And then ship the glass from China to Plymouth, Michigan (finishing and distribution midpoint). On the other hand, it can assign the production to newly bought Moraine plant in the United States itself, which is highly automated and in close proximity to customers. Both the locations have their own opportunities and obstacles related to the supply cycle. As Moraine is a newer plant with low production yield, there is room for improvement in its cost learning curve as compared to the Tianjin plant which is much saturated over the years. After collation of all the possibilities and cost derivations, major factors such as advantageous distance to Plymouth leading to low packaging and transportation rates, less inventory carrying costs, improvement scope in production yield; Moraine plant can be recommended as a better sourcing destination to consumers in Canada. Our proposition is weighted on the basis of primary factors such as raw materials, labor, packaging and transportation, repair, yield rate, output per shift and inventory carrying. We also considered external risks and influences such as duty rates, labor wage rise, strikes and political imbalance.

Production yield (raw materials, labor, SG&A and other manufacturing costs) is considered as the main cost driver for Fuyao. Both the plants have wide-ranging differences in the production cost per unit.

Raw materials per windshield at Moraine plant costs much higher than Tianjin plant (~53% higher, Tianjin - \$13.01 and Moraine - \$19.90). Tianjin has a lower material cost due to the supply of raw materials from two of its own float glass plants in China (Tongliao and Shuangliao). These float glass plants are capable in cost-cutting with higher margins due to Fuyao's supply from its own sand quarries, production of own molds and tooling equipment. Vertical integration technique is widespread to Fuyao's China-based plants leading to lower costs across various parts of production, tighter quality control and better flow. While in the case of Moraine plant the float-glass is supplied from Mt. Zion, where the purchase price of sand, mold and tooling equipment might be high due to outsourcing. Even importing float glass from Tianjin to Moraine is not feasible because it would incur high or similar packaging and transportation costs as finished glass windshields (refer appendix table 1a). Thus, for Moraine sourcing raw material from Mt. Zion plant is a suitable option.

A huge difference can be observed for the **labor** cost per unit at both the plants. Labor factor is the major cost driver for Moraine plant with an additional 20\$ per unit (Tianjin - \$2.28 and Moraine - \$23.93) as compared to a fraction cost at Tianjin plant. On the contrary to this low-cost advantage in Tianjin plant, labor wages are continuously rising in China, almost 30% per year (Wallace, 2015). Wages in U.S. auto part market are steadily declining (9.45% from 2003 to 2013). Increased automation can be a key to minimize labor cost at the Moraine plant. Moraine plant holds a vision of high automation; they have automated cutters. So, if the number of workers per line can be decreased from the 63 to 50, the cost per windshield is reduced to \$16.54 (refer appendix table 1a). Leading skilled technical people from Chinese operational plants can visit and train the local Moraine labor with high degree of expertise while dealing with the manufacturing process. Also, U.S. based employees can visit Chinese plants to benchmark quality, company core values and pace balance (Liu, 2016).

The gap between the U.S. and China *electricity* prices is expected to remain consistent over the next few years. Electricity rates in China has grown 17.5% over the past ten years but at the same time, U.S. prices are either stable or have seen downward pressure over the past two years (Comerford, 2016). Electricity rates in China are highly regulated, subsidized and controlled centrally by the National Development and Reform Commission (NDRC). Thus, the electricity prices in the Moraine and Tianjin are almost similar. Since Moraine consumes large amounts of electricity during final annealing steps and high automation it can invest in a thorough analysis of power costs before making production line and tool usage decisions. This analysis might lead to lower electricity consumption.

Finished glasses from both the locations are shipped to the distribution center in Plymouth, Michigan and then distributed further to the customers hence the sales, administration and general cost (*SG&A*) for both the places remain almost similar. Other manufacturing costs inclusive of tools and consumables such as gloves, safety equipment, cleaning pads etc. will remain similar due to country specific product price variations.

Apart from production yield as a major cost contributor; *packaging, transportation and inventory costs* also drive the windshield production supply cost variations between Moraine and Tianjin.

For Tianjin plant these factors play a major role in cost per unit increase.

Tianjin, China supplies the finished good containers to Plymouth in around 40-day period. Overseas container rates fluctuate based on demands; logistics team at Fuyao requests quarterly bids with best rate and service selection from various shipping companies. Also, transportation from China includes tariffs and custom clearances. Thus, the overall supply from China to the U.S. becomes a complicated, costly and risk concern. On the other hand, Moraine transported the finished goods to Plymouth through truck route at much lesser packaging and transportation cost due to proximity advantage (\$13 saving per unit at Moraine, Moraine - \$2.13 and Tianjin - \$15.33). Also, inventory carrying cost varies in both the locations; Moraine has low inventory carrying days (one week of inventory stock) and costs (\$0.46 per unit) as compared to Tianjin which has to keep a high inventory stock (50 days) and costs (\$1.10 per unit) in order to avoid failure to deliver auto parts during adverse environments and strike risks. Thus, for supply to the Canadian customers, Moraine is a potentially stronger location with respect to transportation and inventory ease and cost saving.

Along with associated costs, both Moraine and Tianjin have their own unique challenging risks. Some of these risks are highly unpredictable and may possess the power to upset the whole sourcing process. Major risk factors that can be considered for each location are:

For Tianjin plant, it is difficult to rely upon the fluctuating container rates for shipment from Tianjin to Plymouth. There is always a risk of cost variations in shipment. Also, shipment risk becomes worse since once the production site has been decided it is not possible to change the site due to commitment for six-year production lifecycle and 10-15 years of replacement spare part supply. Also, China struggles with increasing energy and labor risks. Overseas supply is likely to develop transit time, inventory stocking and currency exchange rate risks.

China and the U.S. trade relations, policy uncertainties and tariff rate volatility also increase the risk of healthy overseas supply between the two nations. On the other hand, if units are produced at Moraine plant in the U.S., this commercial relationship will benefit both the countries. For the year 2017, US-China trade relations supported roughly 2.6 million jobs in United States across a range of industries (Oxford Economics Report, 2017).

However, Moraine is an abroad functional plant of Fuyao group, major associated risks such as cultural difference, labor-oriented strikes, adverse weather and US Canada relationship might affect the cost of production and supply. The main purpose for the set-up of Moraine plant was to serve U.S. based automotive companies. If Moraine supply capacity is used to serve Canada and Fuyao falls back to China for its U.S customer base, then they might end up paying higher costs and duty rates (U.S Canada border). This risk might severely affect Fuyao costs if Moraine production line is not sustainable to support high production rate or fluctuating demands. Moraine is currently the world's largest single-site auto glass production factory and it can be assumed that Fuyao can expand it to meet the demands of both U.S. and Canada based auto customers base.

Summary of risk analysis at Tianjin and Moraine

| Risk | Tianjin | Moraine |
|--|-----------|---------|
| Increase in the cost of labor and electricity | High | Low |
| Transportation pricing and schedule fluctuations | Very high | Low |
| Commitment of production location | High | High |
| US Canada trade relations | Low | Low |
| US China trade relations | High | NA |
| Currency exchange rates | Low | NA |
| Strike, adverse weather | Low | High |
| Political Adversity | Low | High |
| Training of inexperienced labor | NA | Low |

There were certain parameters and sourcing information which are unknown, if available they would have improved the overall exactness of this supply sourcing analysis.

Raw material information for float glass production at Mt. Zion (sand sourcing/specific location/distance/pricing) is unknown. This information will be valuable in determining the true cost of production and margin saving structure at US float glass production factory. Detailed selling, general and administrative expenses (SG&A) for major sales offices and subsidiaries in the US and China will be valuable in deriving the individual location associated costs. Also, for Moraine, the probabilities or cost associated with disruptions caused by strikes, adverse weather, or things beyond their control is not available. Direct route interest from China to Canada rather than via Plymouth can be explored, if necessary, information is available.

Based on all the cost factor and risk analysis along with improved cost calculations given in Table 1a, Moraine's productivity yield can be increased from 81% to 93% and the labor strength can also be reduced with automation. Moraine expands Fuyao's glass distribution by bringing it closer to its foreign customers, reduces the tariff, duty and political imbalance risks arising from international trade volatility. Moraine plant at Fuyao's end is an investment in the United States, which brings them business and global growth but at the same time is a stimulus that supports U.S. jobs and economy. Fuyao should, therefore, source the windshield glass from Moraine.

Appendix

Calculations:

Assuming that for Moraine, the output per shift increases from 650 to 800 and yield percentage for increases from 81% to 93%, the cost calculations are given below.

Raw materials cost for producing 650 pairs with yield rate of 81% is \$19.90 per unit

Actual cost of raw material = $\$19.90 \times 81\% = \16.119 per unit

So, Raw material cost for producing 650 units with yield rate 93%

= $\$16.119 / 0.93 = \17.33 per unit

Similarly, the cost per unit has been calculated for electricity, SG&A and other manufacturing costs has been calculated.

Further, for the labor, the number has been reduced from 63 to 50, so the new cost is

$20.84 \times 50 / 64 = \$16.54$ per unit

Table 1a.

| | Tianjin | Raw materials from China and production in Moraine | Moraine with current productivity yield of 81% | Moraine with productivity yield of 93% | Moraine with current productivity yield of 93% and reduced labour |
|------------------------------|---------|--|--|--|---|
| Raw materials | 13.01 | 13.01 | 19.90 | 17.33 | 17.33 |
| Labor | 2.28 | 23.93 | 23.93 | 20.84 | 16.54 |
| Electricity | 1.55 | 1.58 | 1.58 | 1.38 | 1.38 |
| Depreciation | 1.55 | 3.17 | 3.17 | 3.17 | 3.17 |
| Other manufacturing costs | 0.88 | 1.73 | 1.73 | 1.51 | 1.51 |
| SG&A | 6.00 | 8.00 | 8.00 | 6.97 | 6.97 |
| Packaging and transportation | 15.33 | 15.33 | 2.13 | 2.13 | 2.13 |
| Total | 40.60 | 66.75 | 60.44 | 53.33 | 49.02 |

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