DEVELOPMENT OF A PROCESS ANALYSIS METHOD TO DEVISE A LOCATION BASED TEXTILE PRODUCTION STRATEGY

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ABSTRACT

With rising costs in China and other Asian countries, textile and clothing manufacturing companies are looking at reshoring production to their original locations as an alternative. While there exists no standard approach to evaluate a production relocation decision. We developed a location decision model specific to the textile production processes based on factor rating method. The model identifies the most important factors and criterion to compare performance of concerned locations. Validity of the model is checked using a case analysis of weaving production process for countries of Germany, India and China.

Key Words: Location analysis, reshoring, textile production location

1. INTRODUCTION

Since 1980s an increasing trend in outsourcing of production activities to low wage countries and more specifically to China is witnessed. This has resulted in China becoming the manufacturing hub of the world. The share of China in global manufacturing output has increased from 3 % in 1990 to 25 % in 2015 [1]. However, recent increases in the cost of doing business in China, including rapidly rising labor costs, have put Chinese manufacturers in a much less favorable position. Competition from manufacturing based in very low-cost nations in Africa, as well as neighboring countries of southeast Asia is intense, and a large portion of apparel manufacturing formerly done in China is either moving to these areas or to back to original locations in developed countries [2]. The factors like rising labor costs in China and fashion companies' increasing need for speed to market as well as issues with overseas suppliers like industrial unrest and problems with product quality are making manufacturing back to origin countries more attractive [3]. This development in market has forced companies to reevaluate their strategy of out-sourced production of last few decades.
Such strategic evaluations differ in motives from case to case and effects of these motives in decision making are not clearly understood. The existing models for location strategy primarily talk about production or transportation costs and effect of non – cost parameters is not considered. Therefore, there has been an increasing need of incorporating parameters like supply chain, quality in such evaluation of locations. The complexity lies in comparing performance of locations for these parameters as they are not easily quantifiable like different costs associated with the production.

2. MARKET TREND OF THE INDUSTRY

The textile and clothing industry in EU has had a stable overall yearly turnover since 2011. However, the continuous increase in EU imports along with decrease in employment and company numbers clearly suggests the ongoing trend of offshoring. It has previously been shown that, the cases of reshoring have started to appear in the clothing industry whereas the textile industry is still stagnant with offshoring activities. A major reason for this development in the clothing industry, has been cited as increase in labor costs which has increased more than 3 times since 2000 levels in China even in the wake of global financial crisis narrowing cost

advantage of the companies [4]. One of the company official can be quoted saying, "the difference between the total cost of production in China and America, including the cost of shipping, customs duties and other fees, he was amazed to find that California was only about 10 % more expensive than China. [5]". Similar evaluation from different manufacturing firms from China (Figure 1) has led to increase in investments where Chinese firms are going to US to put manufacturing plants to save costs and be near to their customer.

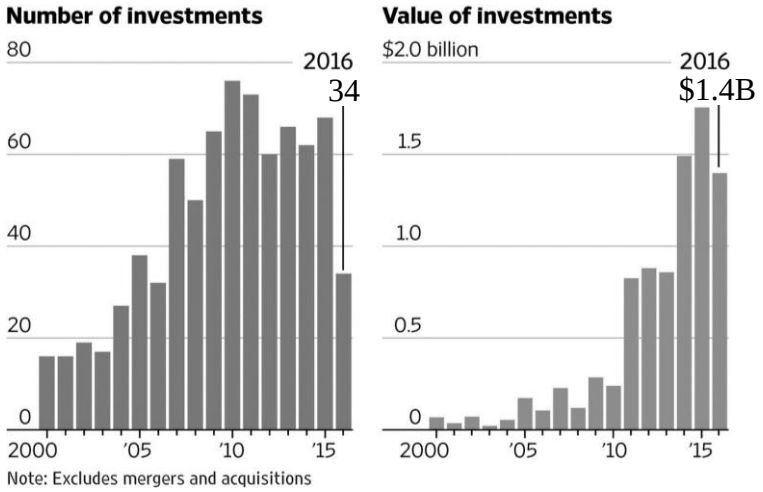

Figure 1: Chinese companies' investment in new production facilities in US [6]

[7] mentions that labor cost is the most important reason for the Chief Purchasing Officers (CPO) from apparel industries based on their industry survey. They also mention, these CPOs plan to shift sourcing value away from China to other nearby countries like Vietnam, Myanmar, Bangladesh and India. However, these countries have not been able to exploit the opportunity of export growth as well as China over the last decade and a half (Figure 2).

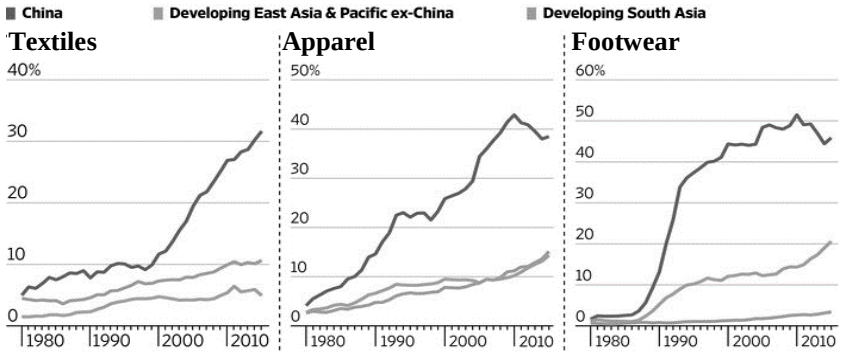

Figure 2: Export growth comparison of textile related industries in Asia [Mag16]

These interconnections of multiple factors make sourcing in the textile and clothing industries intriguing for the managers and the researchers alike. Therefore, focus of this work is to figure out the factors most important for the sourcing of textile production from various locations and propose a methodology to evaluate those factors for a few cases to create a location sourcing strategy.

3. METHODOLOGY AND CASE ANALYSIS

Amidst continuous discussion over benefits of offshoring and reshoring as production strategies, this chapter looks at some of the existing tools to make a location decision before developing a method for textile and clothing industry to evaluate attributes of several possible production destinations.

3.1 Existing location decision tools

Location strategy has been part of operations management studies which deals with the processes of transforming inputs into good and services with the goal of maximizing efficiency for the producer and effectively fulfilling customer needs [8]. Render and Heizer [9] illustrates Factor Rating Method, Break – even Analysis and Centre of Gravity Method as most prominent tools whereas Reid and Sanders [10] additionally explores Load - distance and Transportation methods.

3.2 Location decision criterion and factors in the textile and clothing industry

The reasons for a company to consider relocation of its production processes varies from case to case. The location decision factors are divided into 5 criterions namely costs, productivity, quality, supply chain and other factors as shown in Table 1.

Table 1: Location decision criterion and factors

Evaluation Criteria	**Contributing factors to the criteria**				
Costs	Material Costs	Capital Costs	Equipment Costs	Labour Costs	Logistics & Coordination Costs
Productivity	Production Rate				
Quality	Rejection & Damage Rate				
Supply Chain	Lead Time	Service Level (Delivery Reliability)			Delivery Flexibility
Other Factors	Proximity to R&D sources	Availability of skilled labour	Threats of losing know-how and intellectual property		

The model primarily uses AHP method to determine weightages of different criterions and factors to evaluate performance of various locations. The decision criterions and factors for the current work have been primarily chosen taking requirements of the textile and clothing industry and market results from the German manufacturing companies into account. The next step will be to use this model for a case analysis in the textile industry to substantiate its validity.

3.3 Factor values

The factors associated with criterion Costs, Quality and Productivity are quantitively obtained from the value stream method using the weaving production process chain. Whereas, supply chain and other factors are qualitatively assigned values based on market knowledge.

Table 2: Value of factors for the location alternatives

No.	Evaluation criteria	Unit	Share	Germany	India	China
1	Costs	€	100%	88.13	21.89	24.01
a	Material Costs	€		2.03	1.56	1.95
b	Interest Costs	€		0.2	0.08	0.1
c	Equipment Costs	€		48.07	18.69	18.77
d	Staff (Labour) Costs	€		28.64	0.82	2.02
e	Logistics & Coordination Costs	€		9.19	0.74	1.17
2	Productivity	#/hr.	100%	1.71	1.71	1.71
a	Productivity of the production process	#/hr.	100%	1.71	1.71	1.71
3	Quality	%	100%	5	8	7
a	Rejection & Damage Rate	%	100%	5	8	7
4	Supply Chain	[1-10]	100%	8.50	6.80	8.00
a	Lead Time	[1-10]	50%	8	7	9
b	Service Level (Delivery Reliability)	[1-10]	40%	10	6	7
c	Delivery Flexibility	[1-10]	10%	5	9	7
5	Other Factors	[1-10]	100%	9.92	7.54	8.49
a	Proximity to R&D sources	[1-10]	19%	10	6	8
b	Availability of skilled labour	[1-10]	73%	10	8	9
c	Threats of losing know-how and intellectual property	[1-10]	8%	9	7	5

Cost represented above is the total per piece costs of the product to the distribution centers at customer location. A difference in total cost can be seen across locations. Material costs are composed of cost of raw material and energy consumption and shows marginally lower values in India and China due to lower prices of corresponding cost drivers which shows that overall cost of a product is not majorly dependent on them. Simultaneously, interest costs for the capital employed is similar due to assumed same interest rates across countries.

Meanwhile, equipment costs and staff costs are the major difference - maker in overall costs among locations. Equipment costs are primarily consisted of space costs and depreciation per year. For the analysis, depreciation was considered a process parameter and remained same across locations. Therefore, the difference in equipment costs is caused by the space rental cost which were exponentially high in Germany. Similarly, the difference in staff costs is caused by the difference in wages as number of employees involved in process steps were kept same across the locations. The results show space costs and wages as two major cost drivers in overall costs of the clothing industry.

Logistics and coordination costs share a contribution to total cost of product when the production and customer location are far apart. In the current analysis, they are calculated for 5000 pieces of product per year with customer locations at Paris, New York and Hong Kong. However, the difference is primarily created by the wages of employee involved in the coordination of logistics services between production and destination locations. It substantiates the fact from Table 2.4 that the coordination costs are one of the prime motives for production reshoring. The method of transportation costs calculation is presented in Appendix 1: Logistics and coordination costs model with a sample calculation for India.

Productivity is considered same across the locations because all process and production parameters are kept identical for the analysis. It might not be the case in practice but it stems from the assumption of using same machines with identical number of employees and cycle times for process steps. The rejection and damage rates are chosen based on market experience as Germany has penchant for high quality compared to India and China.

Supply chain factors and other factors are subjectively assigned values based on market knowledge. Chinese producers have designed processes to handle a vast number of products yearly, therefore, they are always ready for new orders and their lead time to production start is minimal. Also, the logistics services in China are optimized for fast delivery to any part of the world. This is different from Germany where logistics services are excellent but a company should put its order in advance as production processes don't have extra capacity readily available because the production is planned in advance to use resources efficiently and costs associated with unutilized resources are relatively higher than China. On the other hand, Indian producers have free capacity to utilize but intra-country logistics services and infrastructure is not as good as other two. As German producers manufacture for planned production, they offer a higher service level. However, this impacts their delivery flexibility negatively. The producers in China and India, on the other hand, quick to response to any changes in demand. However, the Chinese producers require a higher number of minimum order quantity compared to their Indian counterparts.

Germany has many research institutes in the field of manufacturing. It is a world leader in industrial research which gives an easy access to the companies to latest technologies and process developments in manufacturing. China has invested heavily in R&D activities over the past two decades and world – class innovations are coming out of those research facilities. While, India still has a long way to catch up in R&D activities. Availability of skilled labor is directly correlated to percentage of population trained and educated for industrial expertise. Hence, it is easier to find skilled labor in Germany with respect to India and China. Germany also has strict intellectual property laws which makes it comfortable for companies to share their technology with producers readily, however, there have been cases of intellectual theft in India and China over the years and laws are not as stringent.

4. CONCLUSION

In this work, a location decision model has been developed based on the earlier value stream method for textile process analysis. The aim of the model is to assist the decision makers in a textile or clothing industry to make an informed decision about the production location after evaluating their production process.
The model provides a sample process for quantifying and evaluating costs, productivity and quality decision criterions based on the value stream method. The performance scores of various locations for decision factors are normalized based on the best score for the respective decision factor. This method has a shortcoming of possible devaluation of the sufficient performance scores due to relative normalizing. For example, 1 unit per hour is a sufficient productivity for the production process, however, if one of the location has productivity of 2 units per hour, the first location will only get half the rating points which can affect its selection as preferred production location.
The location analysis is used on the clothing production process of weaving for Germany, India and China which resulted in China and India outperforming Germany because of their low-cost production. This analysis assumes the constant process parameters across the locations which is not a practical scenario in most situations. A possible improvement to this analysis will be to find out values of process parameters for each location to compute location scores.
Some of the decision factors like delivery flexibility, availability of skilled labor etc. are not quantified in the current work. This qualitative scoring of factors can be erroneous due to lack of information on a location. In future work, a linear programming transportation model can be developed based on this model which will be able to consider these interactions between locations and find optimized solutions for the complete production process in the company.

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