

**Financial Costs and Benefits of Sourcing from Factories with Different Risk Profiles**  
by

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B.S. Biomedical Engineering, National University of Singapore, 2009

Submitted to the MIT Sloan School of Management and the Engineering Systems Division in Partial  
Fulfillment of the Requirements for the Degrees of

Master of Business Administration  
and  
Master of Science in Engineering Systems

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May 8, 2015

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David Simchi-Levi, Thesis Supervisor  
Professor of Engineering Systems and Civil and Environmental Engineering

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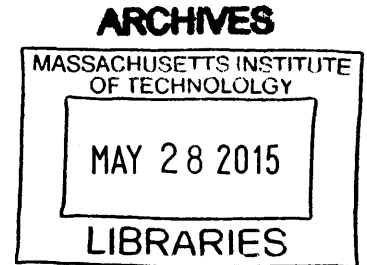
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**Xiaodi Sui**

Submitted to the MIT Sloan School of Management and the Engineering Systems Division on May 8, 2015 in Partial Fulfillment of the Requirements for the Degrees of Master of Business Administration and Master of Science in Engineering Systems.

## **Abstract**

Li & Fung is the leading consumer goods design, development, sourcing and logistics company for global retailers and brands. Its networks cover over 15,000 suppliers and 300 offices and distribution centers in 40 economies around the world.

Supply chains in the consumer goods industry are facing challenges due to volatile commodity prices, increasing labor costs and increasing social, political and environmental risk, particularly in the emerging markets. Suppliers, supply chain intermediaries, global brands and buyers are all affected. In such an environment, there is a strong case for understanding the costs and benefits of working with factories with different risk profiles, not only from reputation and risk mitigation standpoints, but also from financial and operational perspectives. The goal of this project is thus to quantify the financial costs and benefits to Li & Fung of sourcing from factories with different risk profiles.

The project introduces an end-to-end view of sourcing to quantify the “total cost of sourcing” based on business inputs such as customer, product type and factory performance. The total cost aggregates different costs such as: product cost, switching cost, merchandising labor cost, quality assurance cost and social compliance cost. A new variable – the Total Cost of Sourcing Multiplier - is introduced to allow comparison across a heterogeneous factory base.

The new approach will increase the transparency in sourcing process, allowing more informed decision based on business inputs and identify factories with negative financial impact to Li & Fung. The results showed:

1. The sourcing problem primarily lies within low-volume factories. However, a number of low-volume factories have low total cost of sourcing multiplier.
2. As a next step, business units should look into individual factories with low-volume and low cost multiplier and identify the drivers of low cost production.

For supply chain managers attempting to compete with demand with cost, quality, compliance and risk, the total cost of sourcing model can be used to evaluate supplier network performance.

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## **1. Introduction**

Li & Fung is the leading consumer goods sourcing company for global retailers and brands. Its networks cover over 15,000 suppliers in 40 economies around the world. Supply chains in the consumer goods industry face a challenging business environment in the climate of volatile commodity prices, increasing labor cost as well as social, political and environmental risks, particularly in emerging countries. In such an environment, there is a strong case for Li & Fung to understand the costs and benefits of working with factories with different operational and social compliance risk profiles and systematically integrate factory risks into its sourcing decisions.

This goal of this project is to quantify the financial costs and benefits to Li & Fung of sourcing from factories with different risk profiles. The project introduces an end-to-end financial view of sourcing to quantify the total cost of sourcing. Compared to the traditional cost model, where sourcing decisions are driven primarily by product cost, this new model translates key factory performance metrics and risk into financial variables, which are easily understood by sourcing professional. The cost model aggregates costs such as product cost, switching cost, merchandizing labor cost, quality assurance cost and social compliance cost. This study was piloted in two business units at Li & Fung.

This thesis will describe the total cost of sourcing approach at Li & Fung. The new approach will increase the transparency in sourcing process, allowing more informed decision based on business inputs and identify factories with negative financial impact to Li & Fung. For supply chain managers attempting to compete with demand with cost, quality, compliance and risk, the total cost of sourcing model can be used to evaluate supplier network performance.

## **Summary**

The rest of the thesis is organized in the following way: Chapter 2 provides a summary of Li & Fung history, organization structure and project motivation. Chapter 3 summarizes the research and study related to Total Landed Cost and supply chain risk management practices in other industries. Chapter 4 provides the details on current Li & Fung sourcing processes. Chapter 5 introduces the total cost of sourcing model and its input, outputs and data source. Chapter 6 summarizes the pilot test results of two business units at Li & Fung, and Chapter 7 provides the recommendations and conclusions.

## **2. Background**

### **2.1. Li & Fung History**

Li & Fung Limited is the leading consumer goods design, development, sourcing and logistics company, based in Hong Kong. It supplies high-volume, time-sensitive consumer goods for global retailers and brands. Its network covers over 15,000 suppliers and 300 offices and distribution centers in 40 economies around the world.

Li & Fung was founded in 1906 in the treaty port of Guangzhou, China by Fung Pak-liu, and his partner, Li To-ming. In 1937, the privately-held Li & Fung (1937) Limited was formally moved to Hong Kong, and Li To-ming retired and sold his shares to the Fung family.

Li & Fung became one of the largest exporters of Hong Kong-made goods, such as garments, toys, electronics, and plastic flowers between 1949-1979. In the early 1970s, the second generation of the Fung family, William and Victor Fung, joined the business after returning from the U.S. After earning his B.S. degree at MIT, Victor Fung completed his Ph.D. in

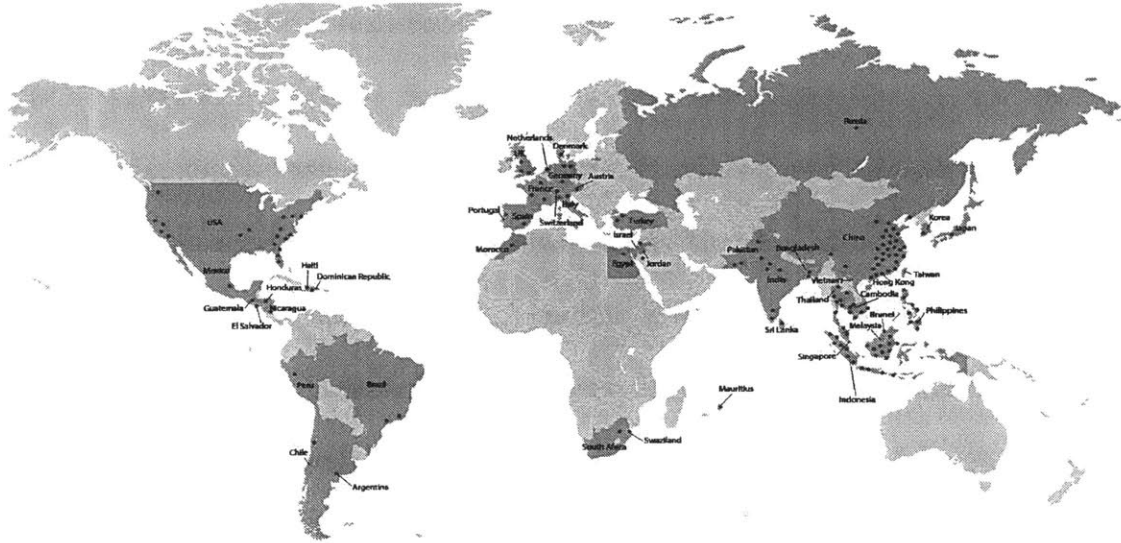
business economics at Harvard University, and William got his MBA at the Harvard Business School.

Li & Fung rode the wave of Asia's emergence, especially China's emergence as factory to the world. Li & Fung soon established a network of factories beyond Hong Kong and disaggregated the supply chain into component functions. During the 1980s, Li & Fung evolved into a supply chain manager, which oversaw the entire production process starting from design sketches to prototyping to scheduling, quality assurance and delivery tracking. The brothers also re-modernized and rebuilt Li & Fung. In 1992, they brought Li & Fung Limited public and the company was listed on the Hong Kong Stock Exchange.

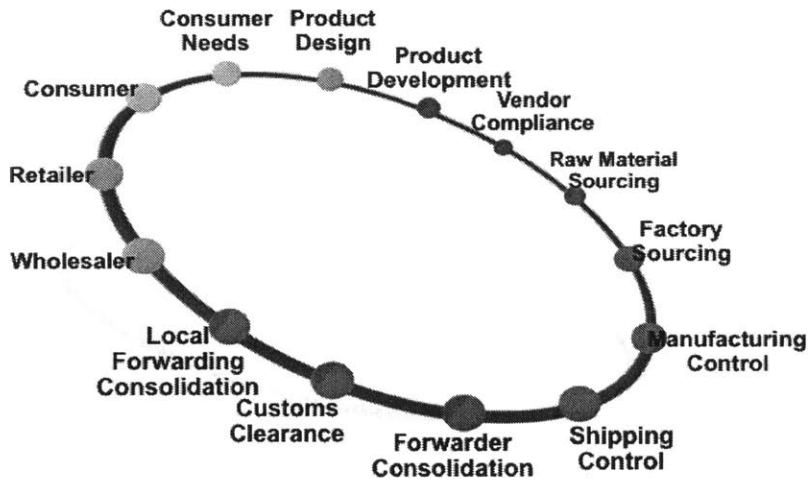
Li & Fung continued build and add new capabilities through acquisition. Between 1992 and 2010, Li & Fung made over 70 acquisitions. At the same time, Li & Fung achieved solid revenue growth with an annual growth rate of 21%.

In 2010, the Chinese government announced policies to lift workers' minimum wage by 13-14% annually during its Five Year Plan (2011-2015). That translated into an increase of 80% in five years. The change of labor policy as well as the RMB appreciation made labor-intensive low-cost manufacturing/exporting business less financially attractive in China. Li & Fung diversified its factory base from China to Southeast Asian countries and the other emerging markets. The push into frontier emerging markets helped to ease the pressure on cost, but created new risks in term of social, environmental and supply chain management. Thus, a more robust system for measuring and benchmarking these risks becomes necessary.

Today, Li & Fung's business has expanded to 40 economies around the world and provides service in every step of the consumer goods value chain, from product design and development to wholesaling and retailing.



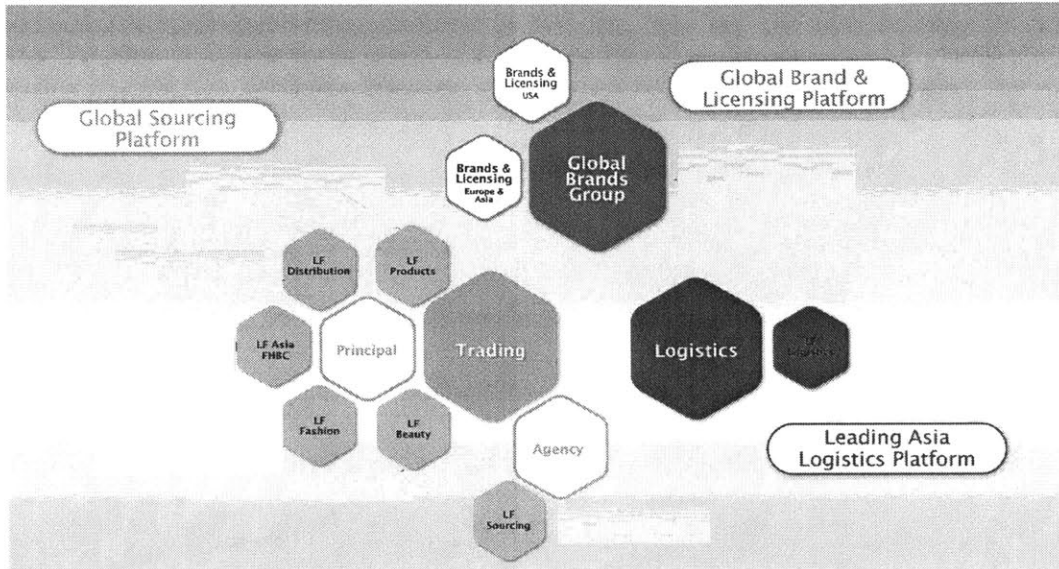
**Figure 1: Li & Fung Global Network**



**Figure 2: Li & Fung Integrated Supply Chains**

## 2.2. Li & Fung Organization Structure

Li & Fung has two major businesses: trading and logistics.



**Figure 3: Li & Fung Organization Structure**

### ***The Trading Network***

Li & Fung’s core sourcing–trading business encompasses a wide array of services that span the supply chain. Its value proposition is to find quality-conscious, sustainable and cost-effective manufactures to match the production needs of its customers worldwide. Through a network of 15,000 suppliers, Li & Fung customizes the production and supply chain needs of over 2000 customers in soft and hard goods. Soft goods are mostly garments, while hard goods include toys, home furnishings, sporting goods, footwear, and health and beauty products.

### ***The Logistics Network***

Li & Fung has expanded a global logistics network that offers end-to-end solutions, from the factory floor to the retail outlets. LF Logistics consists of two major activities: in-country logistics and between-country logistics. In-country logistics refers to the physical movement of goods within a country, including warehousing, transportation, and repacking. Between-country logistics focuses on goods moving across oceans and continents, often involving freight forwarding, custom brokerage, hubbing and consolidation.



### **2.3. Project Motivation**

The trend toward wider geographies and the commoditization of the trading and sourcing process, as well as the emergence of new consumer demands, has pushed the consumer goods industry to develop more precise tracking and metrics. Quality, delivery, cost and compliance have emerged as four areas of concern. Li & Fung has developed these metrics and the data reservoirs to reflect this trend. At the same time, the multiplicity of metrics over so many factories is difficult to manage, so there is a strong need to develop a method to cut through the density of data to drive towards better benchmarking. This project uses a financial lens to quantify the costs and benefits to Li & Fung of sourcing from factories with different quality, delivery, product cost and compliance profiles. This project is only one type of cost benchmarking and other benchmarking will be necessary in the sourcing process.

### **3. Literature Review**

After developing the project hypothesis that quality, delivery and social compliance risk have financial impacts on the cost of sourcing to Li & Fung, it is worthwhile to understand what academia and other companies consider those risk for strategic sourcing and how to quantify the risk into financial cost. In the last five years, the global sourcing environment has changed dramatically. Hackett Group indicates that the manufacturing competitiveness of China is eroding compared to lower cost geographies for a certain type of commoditized product [1].

Decreasing labor costs in the west, rising transportation costs and concerns about intellectual property protection, together with 13-14% annual growth in minimum wages in China, has caused companies to change their sourcing strategies. The trends include companies re-shoring their manufacturing capacity, moving products closer to customers to meet demand

fluctuation and moving additional production capacity from China to other low-cost geographies [1]. Companies need to stay abreast of these trends and to develop sophisticated analytical models to improve sourcing decision-making processes. Furthermore, supply chain competencies also lead to improved performance. Supply chain competencies appear to be employed in different ways to create performance advantages across the various business environments [2].

### **3.1. Supply Chain Risk Management**

There is a wide variety of method used by companies to incorporate risk into their sourcing strategies or try to quality the impact of disruptive events [3]. Companies are always looking for better ways to measure risk as a part of their investment and operations[4], [5].

Many risk management models attempt to predict or prioritize the risks and create a hierarchy structure. One model developed by Sarkis and Talluri suggests that a sourcing decision-maker should use pair-wise comparison of risks to determine which is more important [6]. On the other hand, the risk model developed by Simchi-Levi avoids guessing the likelihood of infrequent, high-impact events and instead concentrates on evaluating an organization's vulnerability to disruption, regardless of the cause and where it strikes [7].

Another challenge in managing risk is working with suppliers in low cost countries and understanding their capabilities. One of the most important steps in identifying capable suppliers is to have a set of criteria and qualifications that include historical, financial, operational, service and reference information that will help discover shortfalls, risks and strengths in the relationship [6], [8], [9]. By using such supplier information in a quantitative manner, Li & Fung can begin to establish its sourcing strategies.

Supply chain risk can be divided into sub-categories [10]. Feller identified six major risk categories with 19 sub-categories that are relevant to supply. For Li & Fung's industry, the

quality and on-time delivery of the product are viewed as potential risks. When working with a manufacturer, there is an inherent risk that a product may be defective, which will cause delays in getting the product to the customer. Therefore, product quality will be part of risk management sourcing criteria.

### **3.2. Total Cost Model**

The term “cost” often refers to the overall cost of acquiring a product or service. In consumer goods industry, the product usually is an amalgam of service, which can comprise the majority of cost or value. Too often, cost models include only the material and transportation costs. In order to create a more robust costing model, several studies use the concept of “landed cost”, which includes the cost of goods, transportation cost, inventory carrying cost and duty cost. On the other side, the concept of Total Cost of Ownership (TCO) is usually introduced along with total landed cost as a way to analyze the entire spectrum of value. With TCO, the entire product life cycle cost is expanded to include the on-time delivery, quality levels, risk factors, supplier innovation, technology and flexibility.

When using total landed cost as an input to sourcing strategy, the goal is to minimize total costs under various constraints. There are multiple mathematical programming methods that are viable for solving the minimization problem. Linear programming (LP) and mixed integer programming (MIP) are used to solve vendor selection problems in sourcing. Reducing cost is a core goal of model formulation. There have been multiple published studies [11]–[13] that have developed LP models with price, quality and delivery factors for solving the vendor selection problem. MIPs have predominately been used in minimizing the costs associated with purchasing, inventory and logistics costs given the constraints of vendor capacity and demand satisfaction. The sourcing selection problem is a multi-criteria problem at its core. The trade-offs

between conflicting goals of price, quality and delivery performance must be extensively analyzed and iterated [14]. Additionally, the ability to do “what if” analysis and compare relative total costs of different scenarios can be very useful when considering the impact of actual product requirement specifications and design thinking [15]. The cost model developed for Li & Fung will allow for different business scenarios to be evaluated.

One challenge in developing a total landed cost model is making the distinction between landed cost and TCO. Because TCO often takes a life cycle view of a product, many costs associated with production, quality, outbound logistics, maintenance and transactions would be included in understanding TCO. Historically, TCO models have relied heavily on activity based costing (ABC) analysis to properly attribute operational costs to specific parts or materials [16]. Given that many of the costs mentioned above are not attributable to the cost of sourcing, the model used by Li & Fung should consider only those costs relevant to selecting a supplier.

Li & Fung has a history of sourcing from low-cost countries. As Li & Fung considers low-cost countries, five key criteria must be evaluated: total landed cost, delivery reliability, supply chain flexibility, product design and development and sustainability (e.g. regulatory compliance) [17]. A study done by Bain & Co showed that sourcing from low-cost countries may offer material cost savings of 10-35%, but the additional cost incurred from lead time variability and operational delays may quickly erode the savings [18]. The model being developed in this project will help Li & Fung understand the trade-offs between product cost savings and other operational costs.

### **3.3. Chapter Summary**

After reviewing many sources and literature about supply chain risk management, total landed cost and total cost of ownership, a common theme has emerged. No single method for

evaluating cost and risk has proven to be more accurate or complete than another. Each organization using these tools must establish its own processes, measures and models for making sourcing decisions. Given the wide variety of applications and challenges in identifying costs, organizations that recognize the need for a structured approach in making strategic supplier selections will have an advantage over their competition. Thoroughly understanding financial impact and potential risk with a given supplier will provide insight and drive actions that create value for both Li & Fung and its suppliers.

## **4. Li & Fung Current State**

### **4.1. Sourcing Process**

In order to capture the total cost of sourcing from different factories, a process map was developed to build a baseline of sourcing process. Process mapping is one of the basic quality or process improvement tools used in Lean Six Sigma.

The process mapping was done through interviewing with different stakeholders including the product development team, the merchandizing team, the technician team and quality control (QC) team. The sourcing process is divided into three main stages: sample development, pre-production and production. In each stage, multiple teams are working on the same product simultaneously. An example of the time allocated in each stage is illustrated below.

**Table 1 : Preliminary Time Study on Sourcing**

Time Spent per Style (in min)	Product Development	Merchandiser	Tech	QC
Sample Development	251	1385	901	0
Pre-Production	40	599	29	0
Production	0	353	57	726
<b>Total</b>	<b>291</b>	<b>2337</b>	<b>986</b>	<b>726</b>

The overall process can be further broken down into 10 main steps as shown in Table 1. Since each functional team has different involvement at each stage of the sourcing process, a detailed task and time study was done to understand how the function teams work together. The time study is useful to understand the actual time spent to source a product.

**Table 2: The Overall Sourcing Process**

Three Stages	Process Flow
Sample Development	Factory Sourcing & Development
	Product Research and Development
	Proto Sample Development & Review
	Salesman Sample Development
	Line Opening
	Line Review
Pre-Production	Bulk Placement
	Fit Sample Development and Review
	Pre-Production Sample Development & Review
Production	Bulk Production
	Bulk Shipment
	Post Order follow up

In the following sections, the factory selection and new factory onboarding processes will be described in detail. Both of them are under the “Factory Sourcing & Development” step in the process flow above. Since the factory sourcing decision is made at this step, it is important to

develop a systematic approach to incorporate all the risks, which may be incurred at the later stages.

#### **4.1.1. Factory Selection Criteria**

Factory selection is not organized centrally, and each business unit has had high autonomy on where it sources from and how it sources. Factory selection criteria are normally developed based on merchandisers and customers' preferences. However, common metrics such as product cost, product quality and on-time delivery used for factory selection. The final sourcing decisions are normally based on one of the metrics or a combination of the three metrics. Some customers prioritize cost in the search for factories. Li & Fung develops a social compliance standard that is used across the entire business. Selected factories are supposed to meet the minimum social compliance standards set by Li & Fung.

#### **4.1.2. New Factory Onboarding Process**

Every year, Li & Fung is constantly bringing new factories to the network. Since Li & Fung expands into other emerging countries such as Cambodia, Bangladesh and Vietnam to provide customers with more choices, new factories from those countries are added into Li & Fung factory network constantly. When Li & Fung starts a business relationship with a new customer, the new customer often wants to continue sourcing from their existing factories. Those factories may not be part of Li & Fung's network; thus, Li & Fung has to add those factories in its network. In the hard goods category, the existing factories in the Li & Fung network often cannot produce certain product sub-categories. In order to develop those special products, Li & Fung is constantly searching for new factories with the capability of producing those products.

In those scenarios, Li & Fung faces many challenges in new factory onboarding processes, particularly with factories in emerging countries. Those factories usually have various issues related to social compliance, quality and delivery. Li & Fung has to invest more time and money to manage those factories.

Here is the list of activities involving a new factory onboarding process:

- Set up new factory code and profile in the IT system
- Arrange on-site visit
- Perform technical audit (optional)
- Send factory evaluation request to the vendor compliance team
- Have the compliance team perform factory social audit
- Review audit report
- Follow up on Corrective Action Plan (CAP)
- Send 3<sup>rd</sup> party factory audit request after passing Li & Fung audit
- Request 3<sup>rd</sup> party audit report
- Follow up on 3<sup>rd</sup> party audit Corrective Action Plan (CAP)
- Approve the factory in the IT system

The new factory approval process might take 1-3 months and it is a time-consuming and costly process involving multiple parties like the vendor compliance team, the quality team and 3<sup>rd</sup> party audit team. In fact, new factory onboarding process is part of cost drivers, it is necessary to incorporate the new factory onboarding cost when Li & Fung decides if it should or should not source from a new supplier.

#### **4.2. Quality Management**

Quality management is one of the cost drivers. Quality assurance is also part of sourcing service Li & Fung provided to its customers. The quality team is involved in all the main stages of sourcing: sample development, pre-production and production. The quality team can be divided into two subgroups: the technical (Tech) team and the quality control (QC) team.



The technical team is involved at the early stage sample development and works together with the product development (PD) team and the merchandizing (ME) team to ensure the samples meet customers' specifications. Once the customers approve the samples, a full production order will be placed. The QC team then takes over the responsibility, monitoring the production schedule and the production quality and performing inline and final inspections.

The technical team is typically co-located at Li & Fung headquarters with the merchandizing and the production development teams, whereas the quality control team is located in the production country.

### **Acceptable Quality Limit (AQL) standard**

There are inline and final inspections completed by the quality control team during the production stage. In both inspections, the Accepted Quality Limit standard, commonly referred to as AQL, is used to measure a production order sample and determine whether or not the entire product order meets the customers' specifications. The customers then have the data to support making a final decision to accept or reject the lot.

The quality control team uses the following guidelines in Table 3 to inspect the production. For every inspection, the result data are recorded in the system. The duration of quality control activities, such as time spent on the inspections, traveling, pre-production meeting and other quality related activities, is also recorded in Quality Management Control system. AQL approach to quality management was considered modern in the 1960's but that other approaches (e.g. lean six sigma) have supplanted the AQL approach in other industries.

**Table 3: Accepted Quality Limit (AQL) Table**

SAMPLE SIZE CODE LETTERS							
Lot Size	General Inspection Levels			Special Inspection Levels			
	I	II	III	S1	S2	S3	S4
2 to 8	A	A	B	A	A	A	A
9 to 15	A	B	C	A	A	A	A
16 to 25	B	C	D	A	A	B	B
26 to 50	C	D	E	A	B	B	C
51 to 90	C	E	F	B	B	C	C
91 to 150	D	F	G	B	B	C	D
151 to 280	E	G	H	B	C	D	E
281 to 500	F	H	J	B	C	C	D
501 to 1200	G	J	K	C	C	E	E
1201 to 3200	H	K	L	C	D	F	G
3201 to 10000	J	L	M	C	D	F	G
10001 to 35000	K	M	N	C	D	F	H
35001 to 150000	L	N	P	D	E	G	J
150001 to 500000	M	P	Q	D	E	G	J
500001 and over	N	Q	R	D	E	H	K

ANSI/ASQ Standard Z1.4 - 2008

SINGLE SAMPLING PLANS FOR NORMAL INSPECTION																																						
Sample Size Code Letter	Sample Size	Acceptable Quality Levels (Normal Inspection)																																				
		0.065		0.10		0.15		0.25		0.40		0.65		1.0		1.5		2.5		4.0		6.5																
		Ac	Re	Ac	Re	Ac	Re	Ac	Re	Ac	Re	Ac	Re	Ac	Re	Ac	Re	Ac	Re	Ac	Re	Ac	Re															
A	2																						0	1														
B	3																								0	1												
C	5																									0	1											
D	8																										0	1										
E	13																											0	1									
F	20																												0	1								
G	32																													0	1							
H	50																														0	1						
J	80																															0	1					
K	125																																0	1				
L	200																																	0	1			
M	315																																		0	1		
N	500																																			0	1	
P	800																																				0	1
Q	1250																																				0	1
R	2000																																				0	1

↑ Use first sampling plan above arrow, if sample size equals or exceeds lot or batch size, do 100 percent inspection.  
 ↓ Use first sampling plan below arrow AC : Acceptance number Re : Rejection number

### 4.3. Social Compliance

Social compliance is another important aspect of selecting a factory. The Vendor Compliance & Sustainability (VCS) team manages factories' social compliance and performs the social audits. The audit function takes place independently of the business units, with a separate reporting line and process. In other words, the business unit cannot influence the results.

The Vendor Compliance & Sustainability team conducts factory audits regularly over 15,000 suppliers worldwide. A typical audit takes 1-2 days, and will generate a list of issues that are graded by severity and which require appropriate corrective actions by the factory in order to

continue the sourcing process. The Li & Fung social compliance audit focuses on five areas: labor, safety, health, environment and security. Within each area, there is a list of criteria to evaluate the factory social performance. Each criterion is given a rating after the evaluation. Depending on the severity of the violation, a zero tolerance, critical, major or minor rating is given to each non-compliance item. Every factory is then given an overall rating as “ A, B, C and D”, whereas A is the best and D is the worst.

Through the years, Li & Fung has continuously increased its social compliance standard. Outside Li & Fung, several international organizations and NGOs are working together with companies and brands worldwide to improve the social compliance standard. However, the discussion of what the minimum of social compliance should be and how to evaluate it are beyond the scope of this study.

#### **4.4. Factory Rationalization**

Factory rationalization is part of the strategic sourcing process. Managing over 40,000 factories across 40 different countries has become the biggest challenge over the past few years. Li & Fung is constantly evaluating the sourcing base, reducing the number of factories and developing strategic partnerships with the selected suppliers. Another LGO internship project at Li & Fung primarily focused on identifying high performance factories using data analytics.

Most business units reduce the number of factories by removing the factories with the lowest number of the shipments. Since the number of shipments is primarily driven by low product cost, the approach could impose several potential problems:

1. Factories with low shipment volume could be high-performing factories in term of quality, delivery and social compliance.

2. Factories with high shipment volume could have various issues in quality, delivery and social compliance.

In order to address those problems, the model discussed in this paper can be used as a rationalization tool to systematically integrate quality, delivery and social compliance risk into the rationalization decision.

#### **4.5. Chapter Summary**

Li & Fung's current sourcing process can be summarized as follows:

1. Factory selection is not organized centrally, and each business unit has had high autonomy on where it sources from and how it sources.
2. Product cost has traditionally driven sourcing decisions, although that is changing for some product lines, customers, and special situations.
3. In terms of quality management and social compliance, Li & Fung is facing big challenges to manage its 40,000 factories globally.

### **5. Total Cost of Sourcing Model Development**

#### **5.1. Total Cost of Sourcing Input and Component Identification**

The goal of this project is to quantify the financial cost of sourcing from factories with different risk profile. An end-to-end of sourcing approach is used to capture the financial cost.

The initial discussions with the merchandisers suggested that the model should be able to capture different business environments and situations, so that the merchandisers can input the business scenarios. The model is able to include inputs such as product type, and factory and customer information. Based on those inputs, the model's algorithm draws the relevant data from the database and calculates the total cost of sourcing.

### **5.1.1. Model Inputs**

#### ***Product Type***

There are a total of five product categories at the top level: apparel, hard goods, footwear, food, and accessory. In each category, product type can be further broken down into sub-categories. Due to time constraints, this study is focused on the accessory category; however, the model's use can be extended to other product types.

#### ***Customer and Factory Code***

The model is designed to calculate the sourcing cost of existing customers and factories. The model takes both customer and factory code from the database as the user input.

### **5.1.2. The Total Cost of Sourcing Cost Components**

Since Li & Fung doesn't own any of the factories, the actual cost of sourcing is the time Li & Fung spent on managing the factories. Based on this, the total cost of sourcing breaks down into five cost categories: product cost, switching cost, merchandizing labor cost, quality assurance cost and social compliance cost. Except for product cost, the other cost categories capture the time Li & Fung spends on the activities related to switching factories, merchandizing, quality assurance and social compliance. The definition of each cost category and the data sources are described below:

#### ***Product Cost***

The product cost at Li & Fung is referred to as FOB. FOB stands for "Free on Board", a term used in international trade meaning the seller is responsible for the cost and risks of delivering the goods up to the point when the goods pass the ship's rail at the port of shipment.

At this point, the risk of loss passes from the seller to the buyer. In Li & Fung's trading business, all the transactions are quoted in FOB.

### **Switching Cost**

The switching cost in the model is the cost associated with switching factories. Adding new factories into Li & Fung network or using a different factory for existing customers is time-consuming and costly. Thus, it is necessary to capture the additional time spent on managing the new business relationship. In this study, switching is defined as an existing factory producing products for a new customer. If a factory has never produced goods for a particular customer before, the switching cost is allocated. The switching cost is calculated based on the business management overhead, which is from finance & administration system. The business management overhead is divided into three categories in this study: managing new suppliers, managing new customers and managing the employees. Based on the percentage of time spent on managing new suppliers, each business unit has a fixed cost on business management overhead to be allocated to factory switching cost. The percentage of time was collected based on leadership surveys from the two business units.

#### **Equation 1 Factory Switching Cost**

*Switching cost = The percentage of time spent on managing new suppliers X Management OH per year / Total number of switching per year*

### **Merchandizing Labor Cost**

Merchandizing labor cost is a major cost component to the business unit. The concept behind merchandizing labor cost is to capture the time Product Development team and merchandisers spent on sample development, pre-production and production stages. Estimating the merchandizing labor cost per product style is challenging. Both a bottom-up and top-down approaches were used and compared during this study. The bottom-up approach was done

through a time study on the each step of sourcing process and sum up the total time together. And the top down approach was using the total headcount information and estimated the labor hour per order. The bottom-up approach intends to overestimate the total time. A few assumptions are made to calculate the merchandizing labor cost based on top-down approach:

1. The number of styles per order =1, which is true for most cases. Customers seldom combine multiple styles in one order due to accounting reasons but several orders can be combined together for one shipment.
2. Since the merchandizers spend similar amounts of time to follow up on orders from the customer inquiry, sample development, pre-production to production, we can assume merchandisers spend same amount of time to manage an order for the same product type. This assumption was verified by the time study on 3 different product samples, which showed the similar time spent on the each step of sourcing process.
3. Customers can choose not to proceed with the order after the samples have been developed, so that the customer adoption rate is typically <1. Adoption rate is used to measure how many styles the customers adopt by the end of the season. It is calculated as the number of styles accepted divided by the total number of styles developed. This is an efficiency metric of a customer and a factory.

**Equation 2 Adoption Rate**

$$\text{Adoption rate} = \text{The total number of orders} / \text{Total number of styles developed}$$

Based on above assumptions, the merchandizing labor cost is calculated as:

**Equation 3 Merchandizing Labor Cost**

$$\text{The merchandizing labor cost per style} = \text{Merchandizers' hourly wage} \times \text{Merchandizers man-hour for one product type} \times \text{The adoption rate} / \text{The total number of orders}$$

### ***Quality Assurance Cost***

The quality assurance cost is divided into four components: inline inspection, final inspection, pre-production meeting and travel. All activity times are recorded in the quality management database. However, prior to this study, those data had not been used for making sourcing decisions. The quality assurance cost per order is calculated by the hourly wages multiplied by the total amount of time spent on quality management per order. The quality assurance cost will be different based on customer, supplier performance and order complexity. For example, supplier who has low quality compliance results requires quality management team to visit the factory multiply times to verify the corrective actions and the final quality results. The quality assurance cost would also vary by customers and order complexity. Customer with high AQL requirements requires quality team to inspect more items and thus spend more time on inspection.

### ***Social Compliance Cost***

The social compliance cost is calculated by the number of audits times the cost per social compliance audit, which is charged by the Vendor Compliance & Sustainability (VC&S) to business units. Since VC&S is a cost center, the cost of social compliance audit reflects the fair value of the actual social audit cost. Due to Li & Fung social compliance policy as described in Section 4.3, factories with different social ratings are associated with different social compliance costs. Factories with a low social compliance rating are required to have more frequent social compliance audits, incurring a higher cost of social compliance. The social cost per order is calculated by the total cost of social compliance audits per period (normally 1 year) divided by the number of orders per period. For D-rated factory, Li & Fung has to source from another factory; the cost of switching is captured in the switching cost in this model.



It is important to note that, as described in Section 4.3, Li & Fung Vendor Compliance & Sustainability runs independently from the business units, and sets a minimum social compliance standard across the enterprise. Business units have to operate above the minimum standard, which is C rating and above. Based on the current sourcing decision process, the merchandizers normally do not consider social compliance cost as long as a factory has a C rating and above. The total cost of sourcing model will be able to address this problem.

Table 4 summarizes the cost components of the total cost of sourcing model and the specific data used in the calculations.

**Table 4: A Summary of Cost Components and Data Sources**

<b>Cost Components</b>	<b>Data Sources</b>
Production Cost	Historical FOB cost from factory
Switching Cost	The number of products that require factory switching Annual merchandizing overhead budget
Merchandizing Labor Cost	Annual merchandizer headcount budget Adoption rate Total number of shipment
Quality Assurance Cost	Quality management database
Social Compliance Cost	Social compliance report

## **5.2. Total Cost of Sourcing Model**

In order to ensure that the model is effective in developing a sourcing strategy, it is important to have all the costs associated with managing the order from the factories' production lines to shipping to specific customers.

Other models may include, but are not limited to, the costs below that are excluded in the total cost of sourcing model:

- Bank Charges
- Customer Claims
- Transportation – cost of transporting goods into port
- Insurance
- Inventory Cost

It is assumed that the customers cover the insurance, transportation, freight and customs clearance costs and that the factories bear the inventory cost.

The key finding in researching the necessary cost components for the total cost of sourcing analysis is that Li & Fung has most of the costing data necessary to develop the model, but the company is not using that data for sourcing decisions. The costing model can help in the consolidation of data for costing analysis.

### ***Cost Model Development***

The primary function of the total cost of sourcing model is to incorporate all of the relative cost elements of managing an order and shipping it to the specific customer. Section 5.1.2 discussed the different cost components used to calculate the total cost of sourcing. In the next chapter, the calculation methodologies for two business units will be discussed in more details.

As mentioned previously, the strategic sourcing model being developed for Li & Fung is used as a factory risk and performance evaluation tool. The total cost of sourcing calculation will be based on manufacturing a specific product from a specific factory to a specific customer. The model is verified in two business units, which will be discussed in Section 6.

The model innovates by creating financial metrics behind quality, delivery, compliance which enable them to be compared and aggregated. In this model, the product cost, quality, on-time delivery and social complaint are equally weighted in term of dollar value. The merchandisers are able to make an informed decision.

### **5.3. Total Cost of Sourcing Multiplier**

The total cost of sourcing model uses absolute values to compare the cost among different suppliers. The total cost model includes product cost, switching cost, merchandizing cost, quality cost and social compliance cost. The majority of total cost comes from the product cost, which limits comparison to factories that produce a specific range of products. For example, the model cannot compare the cost and benefits of sourcing from two suppliers where one produces a high-value product and the other produces a low-value product. Due to that limitation, a new variable- **Total Cost of Sourcing Multiplier**- is introduced. It normalizes the total cost of sourcing as a percentage of the product cost. Thus it gives a better understanding of how the total cost changes across a heterogeneous factory base, especially for factories producing different types of products and serving different customers.

The **Total Cost of Sourcing Multiplier** is defined as the total cost of sourcing per period (normally 1 year) divided by Product Cost (FOB) per unit period. For example, if a factory has a total cost of sourcing multiplier of 1.15, it means for every \$1 spent on FOB, Li & Fung will incur another \$0.15.

#### **Equation 4 Total Cost of Sourcing Multiplier**

***Total cost of sourcing multiplier = The total cost of sourcing per unit period/ Product Cost (FOB) per unit period***

The advantages of using Total Cost of Sourcing Multiplier are:

- We can easily compare across a heterogeneous factory base and are able to identify underperforming factories.
- We can easily compare across different customers and charge different commission fees to the customers based on their sourcing costs.
- We can relate the cost multiplier to profit margin and identify negative financial impacts to the business unit.

The **Total Cost of Sourcing Multiplier** was piloted with data collected from two business divisions as discussed in Section 6.2. The results will be discussed in detail in the next chapter.

#### **5.4. Chapter Summary**

Chapter 5 introduces an end-to-end sourcing model to quantify the “total cost of sourcing” based on business inputs such as customer, product type and factory risk profile. The total cost aggregates different costs such as: product cost, switching cost, merchandising labor cost, quality assurance cost and social compliance cost. A new variable – the Total Cost of Sourcing Multiplier - is introduced to allow comparison across a heterogeneous factory base.

### **6. Total Cost of Sourcing Model Applications**

#### **6.1. Pilot Business Units Background**

Before sharing the results, I would like to briefly explain the rationale of selecting the two pilot business units. To validate the total cost of sourcing model, two business units were selected in this study and both business units’ primary product category is accessory.

**Business Unit A** had an annual turnover of \$40M in 2013. It serves about 100 customers and sources from 150 factories globally. **Business Unit B** had an annual turnover of more than \$400M in 2013. It covers more than 70 customers and sources products from 300 factories.

## **6.2. Total Cost of Sourcing Model Pilots and Results**

Both pilot business units share similar characteristics in term of factory sourcing profiles. In summary, Total Cost of Sourcing Model shows two interesting results:

1. Factories doing low volume business with Li & Fung may be burdensome for Li & Fung.
2. Relating the cost multiplier to margin can help to identify situations that need management attention.

### **6.2.1. Factory Selection Application**

The initial goal of this study is to systematically incorporate the product cost, quality, on-time delivery and social compliance for factory selection. In both pilot business units, a significant difference is observed between the product cost-focused sourcing approach and total cost of sourcing approach.

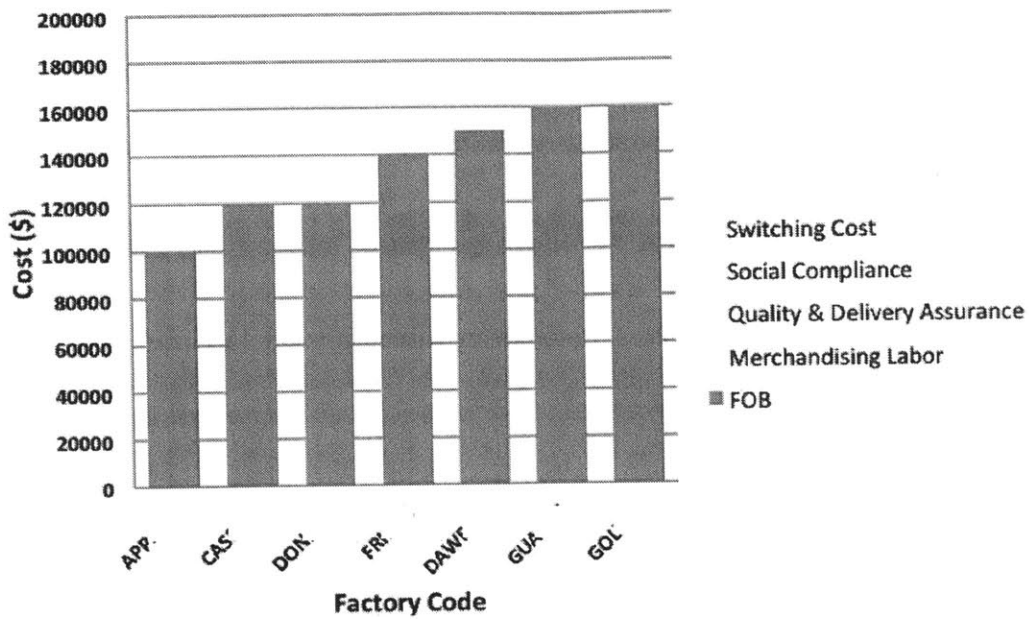


Figure 4: Business Unit A Sourcing Decision Based on FOB (Factory codes are masked)

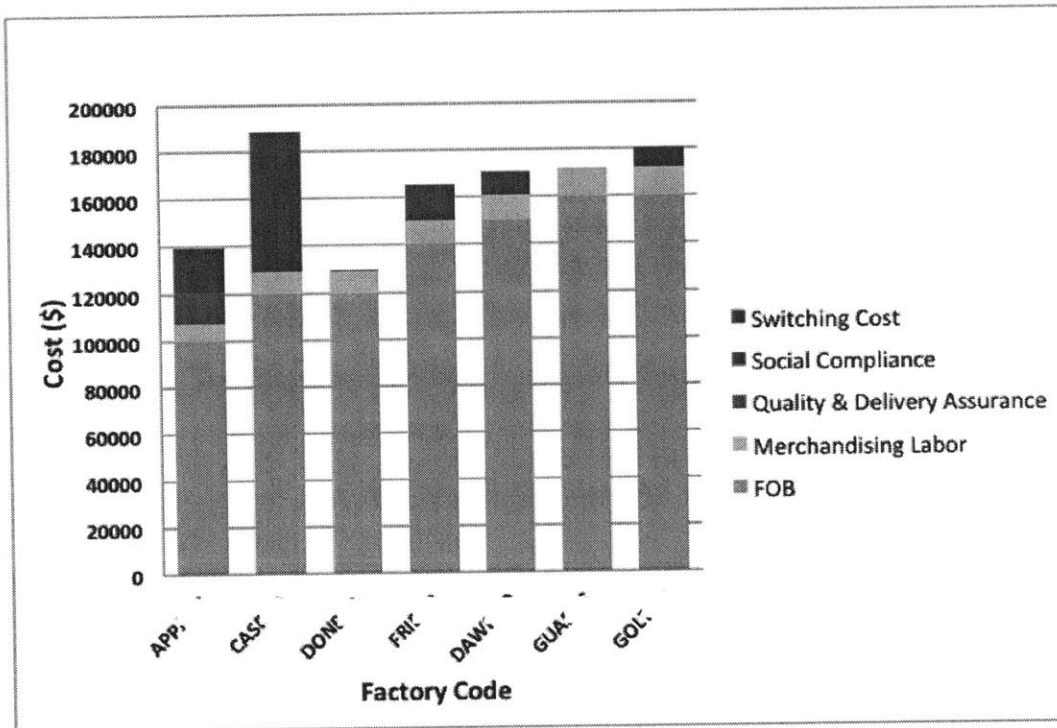


Figure 5: Business Unit A Sourcing Decision Based on Total Cost of Sourcing Model (Factory codes are masked)

Based on the cost-focus sourcing approach shown in Figure 4, Li & Fung sources from **Factory APP** because it has the lowest product cost. However, Figure 5 shows that adding switching cost, merchandising labor cost, quality assurance cost and social compliance cost causes both **Factory APP and CAS** to significantly increase their cost compared to **Factory DON**. **Factory DON** would be the best candidate in this case.

Similar analysis is done in **Business Unit B** and similar results are observed as shown in Figure 6 and Figure 7. **Factory ART, CHE and Factory DON** have the same cost in term of product cost. However, after adding the other cost components, **Factory DON** has a significantly higher total cost.

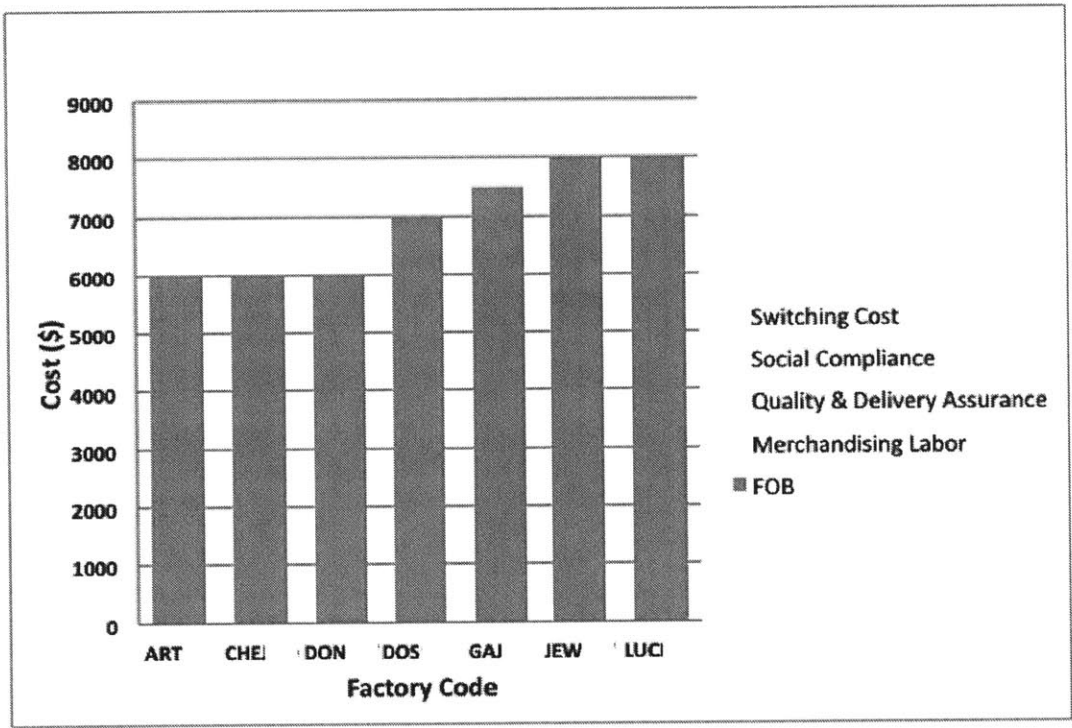


Figure 6: Business Unit B Sourcing Decision Based on FOB (Factory codes are masked)

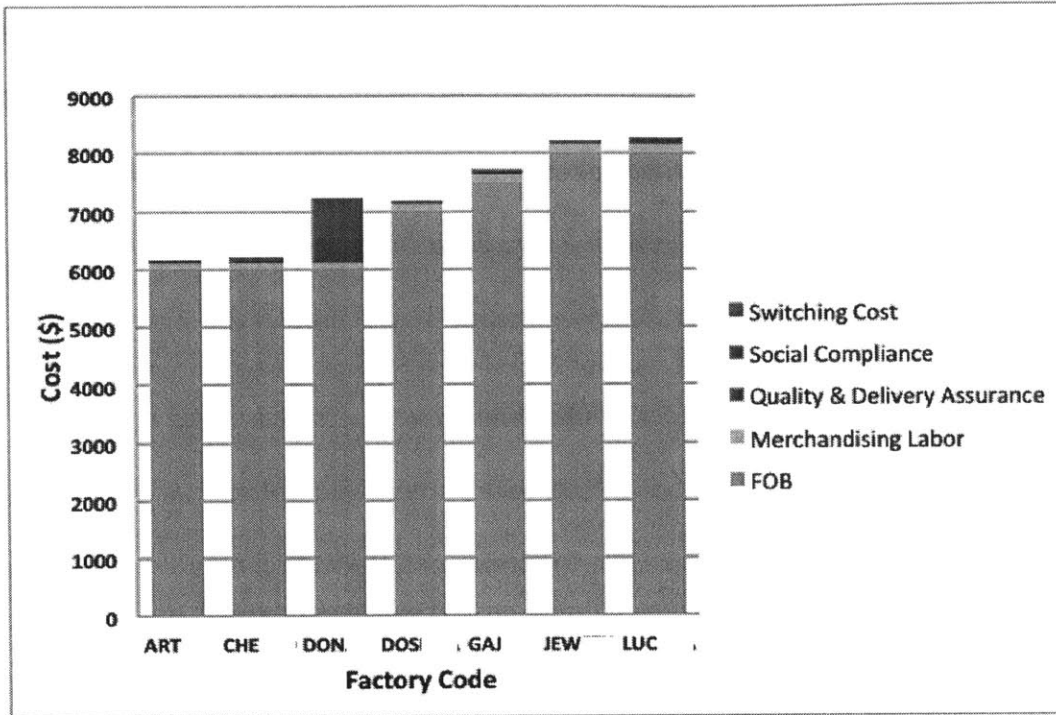


Figure 7: Business Unit B Sourcing Decision Based on FOB (Factory codes are masked)

After analyzing the data, there are a few factors contributing to the significant increase of the total cost:

1. Low social compliance rating

Factories with a social rating of C and below significantly increase Li & Fung’s cost of sourcing from them. Li & Fung spends additional time performing the social audits, re-audits and following up on the corrective action plan. In addition, due to the potential risk of not meeting Li & Fung minimum social standard, it may also impact orders’ delivery and customer satisfaction. The social compliance cost quantified in this category is the higher cost of more frequent audits.

2. Poor quality performance

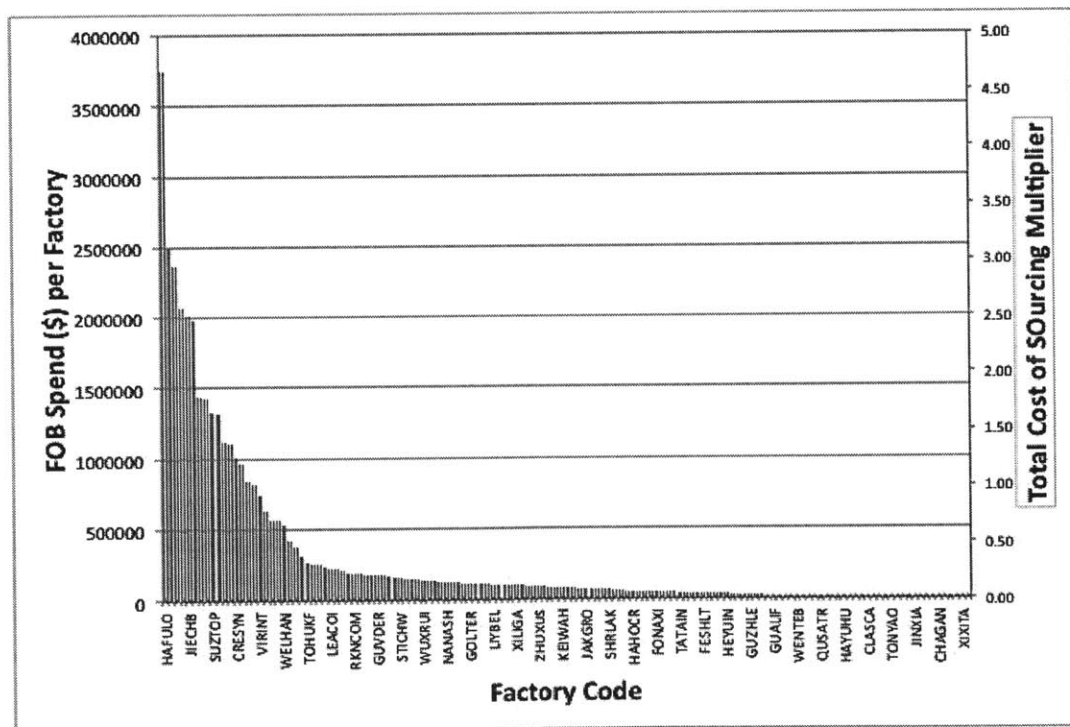
When factories have low inspection pass rates, Li & Fung needs to spend more human resources to manage the factory’s quality performance. It increases total inspection time as well as other quality activities time, such as following up on corrective action and travelling. The poor quality



performance can also impact on-time delivery and trigger customer claims. However, due to the inconsistency of on-time delivery measurement between business units, it was not able to test the hypothesis.

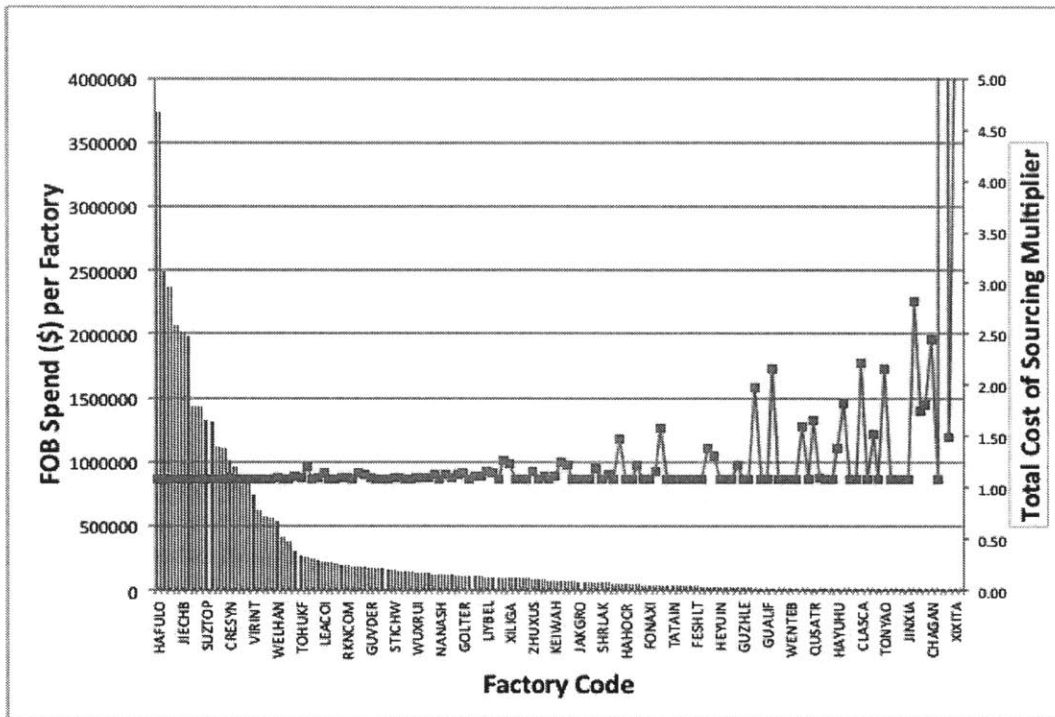
### 6.2.2. Factory Rationalization Application

One of the biggest challenges Li & Fung faces is how to manage over 40,000 factories across the 40 different countries. Li & Fung realizes that with rapid global expansion, it imposes a big challenge in terms of coordinating and managing all the suppliers across the world. As part of the company's operation strategies, Li & Fung has decided to decrease the number of factories it sources from and develop long-term partnerships with a few selected strategic suppliers. However, there has not been a clear operation process to execute the strategy. Business units may simply cut off small suppliers based on annual spending quantities. Figure 8 shows the distribution of the annual spend among the factories in Business Unit A. There is a large tail at the end of the distribution, and business units try to remove those factories at the end of the tail.

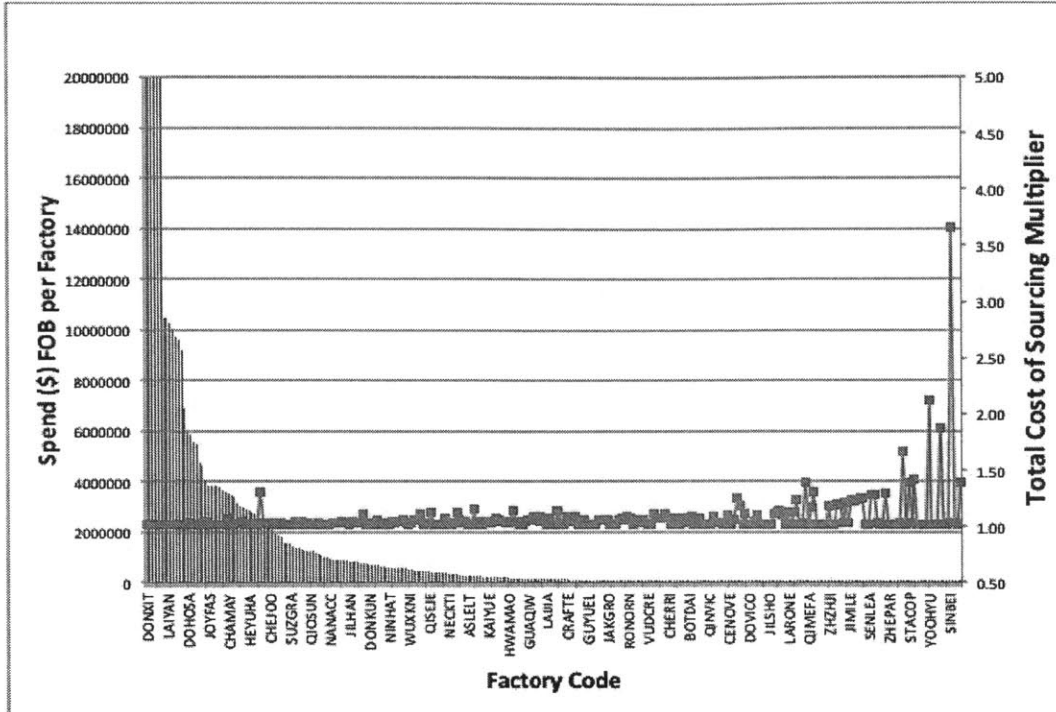


**Figure 8: Business Unit A Annual Spend Distribution Among the Factories**

Using **Total Cost Sourcing of Multiplier**, the business can easily identify factories with high total cost of sourcing multipliers in Figure 9 and Figure 10. Factories with high total cost of sourcing multipliers indicate operational issues within the business units.



**Figure 9: Business Unit A: Spend vs Total Cost of Sourcing Multiplier**



**Figure 10: Business Unit B: Spend vs Total Cost of Sourcing Multiplier**

The results show that factories doing low-volume business with Li & Fung most likely have a high total cost of sourcing multiplier, but this is not true for all factories. By simply removing factories from the long tail, it penalizes high-performance factories that have a low volume of business. Useful next steps would be identifying the drivers of those low-volume, high-performance factories and using those drivers as performance indicators.

Among factories doing high-volume business with Li & Fung, there are factories with high multiplier ( $>1.3$ ), which can cause large negative financial impacts to Li & Fung with their high-volume business spend. Managers should consider diverting production away from these factories or spending time on cost reduction efforts at those locations.

Business units can also relate the total of sourcing multiplier to the profit margin. By measuring the differences between the profit margin and the cost multiplier, the business units can identify situations that need immediate management attention.

### 6.2.3. Customer Evaluation Application

The third application of the total cost of sourcing model is to evaluate factory performances given a specific customer. For example, by inputting Business Unit A, Customer Code: ABCD, we can compare all the factories producing goods for customer ABCD. Identifying under-performing factories can help to consolidate the factory base for a specific customer and increase profit margin. Identifying the causes of factory under-performance can help Li & Fung focus resources and improve factory performance effectively.

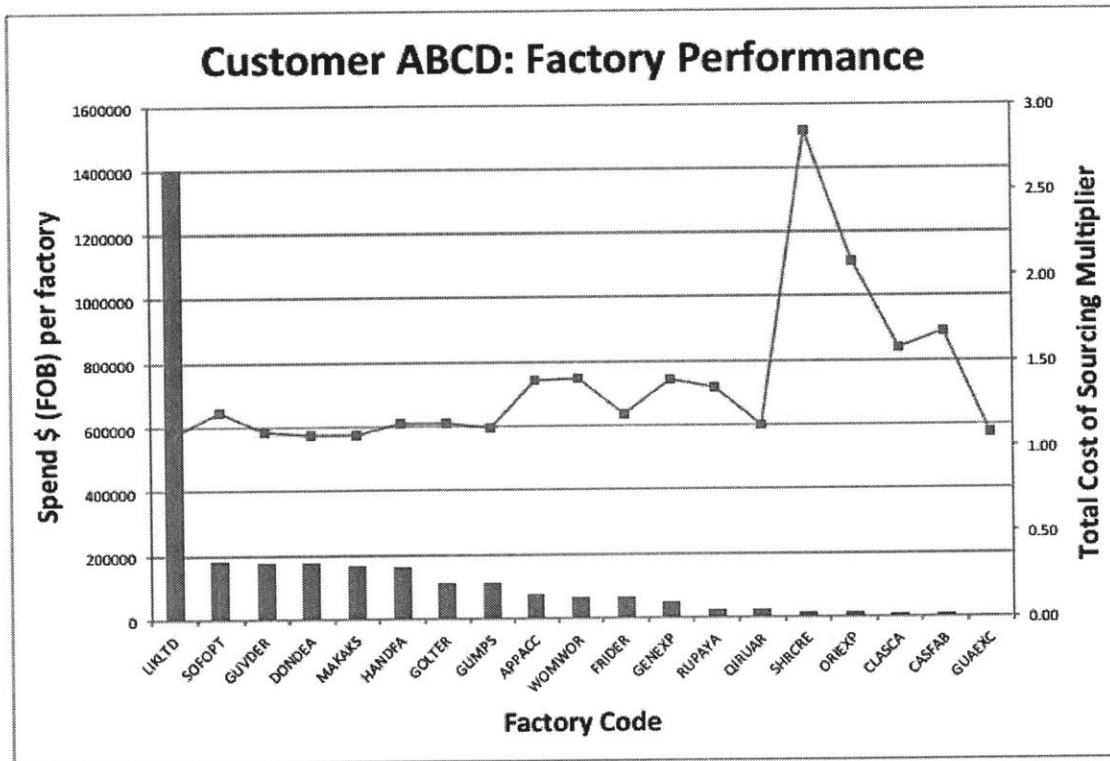


Figure 11: Business Unit A: Customer ABCD's factory performance

### **6.3. Chapter Summary**

The total cost of sourcing model was piloted in two business units. The new approach will increase the transparency in sourcing process, allowing managers to make more informed decisions based on business inputs and to identify factories with negative financial impact to Li & Fung. The results showed:

1. The sourcing problem primarily lies within low-volume factories. However, a number of low-volume factories have low total cost of sourcing multiplier.
2. As a next step, business units should look into individual factories with low-volume and low cost multiplier and identify the drivers of low cost production.

## **7. Recommendations and Conclusions**

### **Recommendations**

#### **Pilot the cost model with other business units**

This project is conducted in two business units. The next step would be incorporating the model into the existing IT system and directly pulling data from the database, enabling expansion of the model to the entire organization.

#### **Introduce “total cost of sourcing” concept to company training**

Li & Fung hired over 2000 merchandizers to manage the orders. It is important to enable them to use the tool and also understand the end-to-end view of sourcing approach. The total cost of sourcing can be included as part of merchandizers job training. Also, introducing the concept of total cost of sourcing to leadership training curriculum could enable the business leaders to develop a sustainable business plan.

## **Integrate the model into current operations**

- Incorporate the model as part of factory selection criteria

The goal of this project is to provide a systematic way to select factories with different risk profiles. The model is not designed to replace merchandizers' decision, but instead to improve the current process and to provide a holistic picture of the financial impact of the business decision. Factory selection should also take into account customer relationships, supplier relationships and business strategy. Incorporating the total cost of sourcing model will enable merchandisers to make an informed decision.

- Incorporate the model as part of factory rationalization process

The second application of this model will enable business leaders to rationalize the current factory base. The project is aligned to the business strategy to develop long-term partnerships with selected suppliers. The model will provide an easy tool to identify under-performing factories, which should either be removed or closely monitored.

## **Improve Data Integrity**

- Standardize quality data collection

Because sourcing decisions were not made with the quantitative data from the quality management data system, the quality data are collected in different ways at the different business units. For example, Business Unit A collects both inspection time and travel, whereas Business Unit B only collects inspection time. The non-standardized quality data will create a bias on the model. Standardizing the quality data collection requires efforts from the entire business.

- Systematically collect adoption rate

As discussed in Section X, adoption rate is a measurement of the efficiency of customers and factories. However, those data are not collected systematically. In both business units, they collected the data but stored it in a spreadsheet and only reviewed at end of season. However, in this model, adoption rate is an important variable in calculating the merchandizing labor cost. It is critical to systematically collect the adoption rate to scale up this model.

## **Conclusions**

In summary, this project at Li & Fung drew a lot of attention from top management and received positive feedback throughout the six-month internship. The important aspects are summarized as follows:

### **An end-to-end view of sourcing**

- A group of costs including switching cost, merchandizing cost, quality assurance cost and social compliance are introduced beyond product cost
- The sourcing problem primarily lies within low-volume factories. However, a number of low-volume factories have low total cost of sourcing multiplier.

### **Risk and Evaluation**

- The total cost of sourcing multiplier can be used to evaluate supplier network risk and performance.
- The model can be used for projects such as factory rationalization.

- The factory risk and evaluation can be broken down into customer, countries and product type.

### Sourcing Decision

- Higher spend could be correlated to factories with low cost multiplier.

For supply chain managers grappling with competing demands related to cost, quality, compliance, and risk, the total cost of sourcing model provide the framework to evaluate supplier network performance and ultimately to manage toward better results.

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