TAMPEREEN TEKNILLINEN YLIOPISTO
TAMPERE UNIVERSITY OF TECHNOLOGY

LIINA LAUTAMÄKI

RESHORING OF LABOR-INTENSIVE PRODUCTION WITH SPECIAL FOCUS ON APPAREL SUPPLY CHAINS

Master's Thesis

Examiner: Professor Heikki Mattila
The examiner and topic of the thesis were approved by the Council of the Faculty of Engineering Sciences on 3 June 2015

ABSTRACT

LIINA LAUTAMÄKI: Reshoring of Labor-Intensive Production with Special Focus on Apparel Supply Chains
Tampere University of Technology
Master of Science Thesis, 72 pages, 1 Appendix page
October 2015
Master's Degree Programme in Materials Engineering
Major: Fiber and Textile Technology
Examiner: Professor Heikki Mattila

Keywords: reshoring, offshoring, clothing manufacture, supply chain, production

The aim of this thesis is to find possible outcomes and enabling factors for reshoring in the context of apparel supply chains through an extensive literature review. This thesis was initiated by the EU-funded FromROLLtoBAG project, which aims to create a new kind of production concept to enable bringing apparel production back to Europe.

During the last decades, most labor-intensive production has been moved to low-cost countries. This has resulted in the loss of jobs and changes in the job market structure in developed countries where labor costs are globally relatively high. Lead times have grown longer. Recently, a possibly growing reverse movement called reshoring has been observed. Companies have brought some or all of their production back to their home countries, from where the production originally left. Also labor-intensive production activities are being reshored. Changes in the operational environment of the manufacturing industry and perceptions of consumers have created a need for companies to re-evaluate their manufacturing location decisions. Companies have experienced problems such as quality issues, uncertainty, long lead times, large inventories and hidden costs with offshore production.

The most important reasons for reshoring cited in academic literature reviewed for the thesis are quality, flexibility, responsiveness, cost advantage changes, labor costs, transportation costs, control, monitoring and coordinating. The emphasis in product manufacturing and sourcing location evaluation has shifted from considering only purchase price, to taking into account the total costs associated with creating a product and delivering it to the end customer. The cost gap between low-cost country and developed country manufacturing has also decreased, as labor and transport costs have increased and exchange rates fluctuated. A long lead time can create mismatch costs originating from over-stock or lost sales. Supply and demand can be better balanced with a shorter lead time. The location of target markets is a key factor for achieving flexibility from reshoring. Reshoring is especially fit for time-sensitive products, which have a short selling season. However, as quality is cited as the most important reason for reshoring, there is also potential for reshoring products that are not time-sensitive. Quality is easier to control when production is local. Sustainable practices can also be better monitored with reshored production and transport distances are shorter. The research in this thesis indicates that there is potential for increasing profitability, quality and customer satisfaction in the reshoring of labor-intensive apparel production.

TIIVISTELMÄ

LIINA LAUTAMÄKI: Työvoimapainotteisen tuotannon siirtäminen takaisin Eurooppaan vaatteiden toimitusketjujen näkökulmasta
Tampereen teknillinen yliopisto
Diplomityö, 72 sivua, 1 liitesivu
Lokakuu 2015
Materiaalitekniikan diplomi-insinöörin tutkinto-ohjelma
Pääaine: Kuitu- ja tekstiilitekniikka
Tarkastaja: professori Heikki Mattila

Avainsanat: tuotannon siirtäminen takaisin, vaatteiden valmistus, toimitusketju

Työn tavoitteena on laajan kirjallisuusselvityksen avulla kartoittaa edellytyksiä ja mahdollisia seurauksia tuotannon siirtämiselle takaisin halpatuotantomaista, vaatteiden toimitusketjujen näkökulmasta. Diplomityö on tehty EU-rahoitteisen FromROLLtoBAG-projektin toimeksiannosta. Projektin tavoitteena on mahdollistaa vaatetuotannon tuominen takaisin Eurooppaan uudenlaisen tuotantokonseptin avulla.

Suuri osa työvoimapainotteisesta tuotannosta on siirtynyt halpatuotantomaihin viime vuosikymmenien aikana. Kehittyneissä maissa työpaikkoja on menetetty ja työmarkkinarakenteet ovat muuttuneet. Viime aikoina on kuitenkin ollut havaittavissa kasvava vastakkaissuuntainen ilmiö. Yritykset ovat tuoneet tuotantoa osittain tai kokonaan takaisin alkuperäiseen tuotantomaahan, josta lähtö halpatuotantomaihin on tapahtunut. Myös työvoimapainotteista tuotantoa on tuotu takaisin. Muutokset valmistavan teollisuuden toimintaympäristössä sekä kuluttajien odotuksissa ovat luoneet yrityksille tarpeen arvioida uudelleen tuotannon sijaintia. Yritykset ovat kohdanneet lukuisia haasteita valmistaessaan tuotteita halpatuotantomaissa. Esimerkkejä näistä haasteista ovat laatuongelmat, epävarmuus, pitkät läpimenoajat, suuret varastomäärät ja piilevät kustannukset.

Tärkeimmät syyt tuotannon siirtämiselle takaisin halpatuotantomaista ovat kirjallisuusselvityksen perusteella laatu, joustavuus, reagointinopeus, muutokset kustannuksissa, työvoimakulut, kuljetuskustannukset sekä valvonta ja koordinointi. Tuotannon ja toimittajien sijaintipäätöksissä painopisteen siirtyminen vain ostohinnan arvioinnista kokonaiskustannusten arviointiin auttaa paremmin huomioimaan kaikki kustannukset, jotka syntyvät tuotteen valmistuksessa ja toimituksessa loppuasiakkaalle. Valmistuksen kustannuserot halpatuotantomaiden ja kehittyneiden maiden välillä ovat pienentyneet. Pitkä läpimenoaika voi aiheuttaa kustannuksia, kun varastoa on liikaa tai liian vähän. Lyhyt läpimenoaika mahdollistaa kysynnän ja tarjonnan paremman yhteensovittamisen. Tavoitemarkkinoiden sijainti on avaintekijä joustavuuden saavuttamiseksi lähituotannon avulla. Erityisesti tuotteet, joilla on lyhyt myyntiaika ja jotka vanhenevat varastossa, soveltuvat lähituotantoon. Toisaalta myös pidemmän myyntiajan tuotteet voivat hyötyä lähituotannosta esimerkiksi laadun suhteen. Laatu on tärkein syy tuotannon takaisin siirtämiselle. Laadunvalvonta on helpompaa, kun tuotanto on lähellä. Kestävän kehityksen periaatteiden toteutumista voidaan paremmin seurata ja kuljetusmatkat lyhenevät. Tässä diplomityössä tehty selvitys osoittaa, että työvoimapainotteisen tuotannon siirtämisessä takaisin Eurooppaan on potentiaalia kannattavuuden, tuotteiden laadun ja asiakastyytyväisyyden parantamiseen.

PREFACE

This thesis was written for the EU-funded FromROLLtoBAG project, to support the execution and dissemination of the project. The experience gained taking part in the FromROLLtoBAG project has been valuable. I am grateful for the experience and for getting to meet all the project partners while attending the project meetings.

I would like to thank my supervisor and examiner Professor Heikki Mattila for all the guidance, advice and ideas. I am very grateful for getting the opportunity to conduct my thesis for the project and concerning such an important, timely subject as reshoring.

The co-operation with the FromROLLtoBAG project team at Tampere University of Technology (TUT) has been productive and delightful. I would like to thank the whole project team for the shared moments.

During this thesis process, I have received a great amount of support and encouragement from both my family and friends. Special gratitude is expressed to my spouse Teemu, who stuck by me through the whole process. My friends from both inside and outside TUT have been an important reserve of energy while doing my thesis and also during my whole studies.

Tampere, 27.10.2015

Liina Lautamäki

CONTENTS

LIST OF ABBREVIATIONS AND SYMBOLS

CAD	Computer-Aided Design
CDF	Cost Differential Frontier
CIT	Customs clearance & Inland Transport
CMT	Cut, Make & Trim
CNY	Chinese Yuan currency
EU	European Union
EU-28	The 28 member countries of the European Union
EUR	Euro currency
GDP	Gross Domestic Product
ILO	International Labour Organization
IP	Intellectual Property
IT	Information Technology
LCA	Life Cycle Assessment
MTO	Made-to-order
PAM	Purchase Activated Manufacturing
PLIPM	Private Label Importer Price Markup
QR	Quick Response
R&D	Research & Development
SME	Small and Medium-sized Enterprise
TCO	Total Cost of Ownership
U.S.	The United States of America
UK	The United Kingdom
USD	United States dollar currency
WTO	World Trade Organization
2D	two-dimensional
3D	three-dimensional

π	gross operational profit
C	unit cost
mi	mile
P	unit price
Q	quantity
X^D	dominant system
X^F	fast fashion system
X_s	sale price / quantity
X_u	unsold products

1. INTRODUCTION

1.1 Motivation

The motivation of this research is to find possible outcomes and enabling factors for reshoring in the context of apparel supply chains. During the last decades, most labor-intensive production has been moved to low-cost countries. This has resulted in the loss of jobs and changes in the job market structure in developed countries where labor costs are globally relatively high. Lead times have grown longer and made forecasting more demanding. Production in low-cost countries has also created issues regarding sustainability.

Recently, a possibly growing reverse movement has been observed. Companies have brought some or all of their production back to their home countries, from where the production originally left. Also labor-intensive production activities are being reshored. There are many reasons behind this phenomenon; changes in the operational environment of the manufacturing industry and perceptions of consumers have created a need for companies to re-evaluate their manufacturing location decisions. These reasons and the effects of reshoring from different aspects of the apparel supply chain will be analyzed in this thesis.

1.2 Research questions

Explanatory research questions usually explore causes and consequences (Eriksson & Kovalainen 2008, p.27). The following research questions are mostly explanatory and indicate what is attempted to be found out through this research.

Q1. Can companies generate more profit through reshoring clothing production and what is this based on?

Q2. Does local production create more customer value in the clothing sector?

Q3. How can virtualization develop the supply chain so that traditionally labor-intensive production is fit for effective reshoring?

Q4. Are there restrictions that apply to reshoring clothing production successfully back to Europe?

1.3 Research methodology

This thesis takes a qualitative approach to investigate the effects and enabling factors of the reshoring phenomenon. The target of qualitative data analysis is identifying, examining, comparing and interpreting patterns and themes (Hair et al. 2015, p.281). The qualitative approach was the best option for this research, as this approach is more suitable for achieving the objectives pursued. This approach best supports the research objectives when little is known about a research problem or previous research only partially or incompletely explains the research question (Hair et al. 2015, p.290) Also, not enough quantitative data was available on these research objectives to attempt a quantitative approach; expressing the issues with numbers.

The research in this thesis could be classified as business research, where issues are not narrowly focused (Greener 2008, p.11), so the theory and concepts will be considered from different angles. Also some elements from the quantitative research approach will be utilized in the forms of cost analysis and other numerical data to better understand the phenomenon. Combining elements from both qualitative and quantitative research approaches can be used to triangulate results with the aim of developing a richer picture of a phenomenon (Greener 2008, p.80).

First, as much data as possible was gathered, both academic and non-academic, as the subject of the thesis is not discussed broadly in purely academic literature, especially regarding apparel production. From these data, the formation of concepts and patterns will be attempted. This kind of approach is called the inductive approach, which involves the thorough investigation of a topic by various research methods, and then generating theory from the research (Greener 2008, p.14). Hair et al. (2015, p.276) describe inductive reasoning as a type of thinking that involves “identifying patterns in a data set to reach conclusions and build theories”; theory or conceptual framework is built from the data collected. They also state that the theory built through inductive reasoning is called grounded theory. Based on this assumption, also grounded theory methodology is used in this thesis. The aim of grounded theory research is to construct theories for understanding certain contexts and phenomena. (Hair et al. 2015, p.290)

As the outcome of the research will be best understood in a context (Greener 2008, p.11); the theoretical context related to the research topic will be considered. This theoretical background will include discussing the nature of apparel products, the specialties of clothing manufacture, offshoring, supply chain fundamentals and sustainability elements. This theoretical context will guide the researcher and readers to understand the perspective of the research.

Chapter 2 will focus on the background of the reshoring phenomenon. It will start with defining offshoring and the possible problems associated with the process. Changes in the factors affecting manufacturing location decisions will be analyzed. The current

environment in Europe regarding manufacturing will also be described. Chapter 3 focuses on defining reshoring and describing the current development of the phenomenon.

Clothing manufacture and important features of apparel products will be discussed in Chapter 4. The possibilities associated with virtual design and sales technologies for apparel are introduced in Chapter 5. Chapter 6 analyzes the different aspects of a supply chain, and what kind of effects reshoring could create in the supply chain. Costs are analyzed in Chapter 7, to examine the possibilities for increasing profitability by reshoring. In Chapter 8, the different aspects of sustainability will be discussed in relation to reshoring production. Chapter 9 will conclude the findings of the research.

1.4 FromROLLtoBAG project

This Master´s thesis is written for the EU-funded project called "Consumer Driven Local Production with Help of Virtual Design and Digital Manufacturing", which is coordinated by Tampere University of Technology. The project is also referred to by the acronym fromROLLtoBAG, which describes the project´s aimed production concept, where garments are manufactured and digitally printed through one single production line, straight from the fabric roll into the consumer´s shopping bag. The only stock consists of raw fabric rolls and possible trimmings and accessories.

This kind of production concept could make local production of garments more cost-effective and achievable. Clothing manufacturing could come back to Europe, from where most of it has left to offshore locations. This thesis will support the execution and dissemination of the project.

2. BACKGROUND

2.1 Offshoring

Offshoring as a term is used inconsistently with distinct precise meanings in different contexts. Jones (2006, p.176) defines offshoring as "the decision to utilize capacity in a country which is not the country in which the head office of a company is based". Chang (2012) adopts offshoring as "the relocation of jobs and production to a foreign country", but also states it can be referred to as the shifting of production overseas.

It is also important to make a distinction between offshoring and outsourcing, as offshoring does not necessarily mean outsourcing, nor does outsourcing mean offshoring. This is due to the fact that offshoring itself does not delimit ownership. Production relocated through offshoring can be the company´s own in-house production, or production that is outsourced to an external supplier at an offshore location. (Chang 2012; Gylling et al. 2015)

In this thesis, the adopted meaning of offshoring is to relocate production to an overseas location, to accentuate the geographical distance offshoring can generate. Offshoring is also defined neutral towards ownership, referring merely to the location of the production activities in question. Ownership of the production activities is not substantial to this thesis.

Offshoring is described by da Silveira (2014) as "the defining phenomenon of 21st century manufacturing". Companies have been tempted to go overseas especially by cheap labor (Simchi-Levi et al. 2008, p.314). In addition to wage costs, the local working time affects the value of labor; in many developing countries working days are longer than eight hours and there are more than five working days in a week. (Rosenau & Wilson 2006, p.374)

The global shift in apparel production has been dramatic due to large global differences in labor costs, particularly because of the remaining labor-intensiveness of apparel production. This has caused pressure for apparel companies to relocate to low-cost countries. (Jones 2006, p.69) Offshore sourcing has in fact become the dominant method for apparel production (Rosenau & Wilson 2006, p.372).

The removing of quotas among World Trade Organization (WTO) members in 2005 led to the rapid increase of China´s exports to the United States (U.S.) (Rosenau & Wilson 2006, p.372). China has also been the most important destination for the offshoring of European production (Needham 2014).

2.2 Offshoring problems

One of the motivators for reshoring is issues that have occurred with offshoring actions. It is not a platitude that offshoring creates extensive savings, especially in the case of producing customer-specific items (Horn et al. 2013). In their paper, Horn et al. present effects of cost-effective sourcing from China. According to their research, only 43 of 214 low-cost country sourcing projects in the automotive industry were entirely successful in terms of both savings and call-off ratio. The call-off ratio contains the relation of goods received versus the budgeted volumes, and can serve as an indicator of operational performance.

The challenge in offshoring is functioning on a global scale with many different countries and cultures. (Rosenau & Wilson 2006, p.374) Communication problems can cause difficulties (de Treville 2015). Offshoring may also prove to be a costly operation if the destination country does not have an adequate infrastructure for global production. The availability of quality raw materials, trim, findings and packaging supplies, the availability and reliability of electric power, materials suppliers and shippers, roads and transportation should also be considered, as raw materials and finished products need to be transported. (Rosenau & Wilson 2006, p.383)

Horn et al. also establish the phenomenon of the "ugly twins", where the failed low-cost country sourcing needs to be replaced by a high-cost country contract to keep production running; this also results in mitigating the savings achieved by low-cost country sourcing. In addition, Horn et al. conducted interviews with people from different functional areas to find general reasons why low-cost country sourcing was unsuccessful. The factors can be divided into external and internal reasons. For example when suppliers underestimate the importance of raw material and currency hedging, custom issues or logistical challenges they are forced to produce products with negative margins, and then deliver low quality products because new contracts are not able to be negotiated. This is an external reason as well as cultural issues. Internal organizational reasons can be grouped into differing incentives between for example purchase management and quality management and the lack of cross-functionally integrated decision making between different departments such as logistics, quality and procurement. (Horn et al. 2013)

Another problem connected to low-cost country production is quality fade. Coates (2010) even claims it to be the single biggest issue in low-cost manufacturing countries. Quality fade occurs because of the competitive situation between suppliers in China or other low-cost countries. Suppliers offer a price that is in fact lower than their actual production cost, "The China Price", to close a deal. When contracts are signed, the gradual degradation of quality begins in order for the supplier to start making profit. Even other lower-cost "shadow factories" with worse working conditions may be used parallel to the audited one in order to balance out the costs. Examples of this

phenomenon are labels becoming smaller, a 100ml product turning into a 99ml product or a 5/8 inch seam becomes a 3/8 inch seam. (Coates 2010) Fabrics might also get swapped at the last minute in factories to cut costs. Especially small labels can have a hard time, as they may not be considered as important as big customers; this can mean late deliveries and no control over quality. (White 2014) What foreign companies should do to avoid this is pay reasonable prices, monitor quality closely and specify as much of the production details on contracts as possible. (Coates 2010)

Exchange rate fluctuations affect income, costs and profits when doing international business transactions, such as offshoring. The prices of products sourced offshore depend partly on the currency cost difference, as well as the actual purchase price. Exchange rate fluctuations influence trade flows; if a currency´s value rises in relation to another, it is more cost-effective to import than to export, as the country buying the exported product has to pay relatively more. (Jones 2006, p.220) There are two types of exchange risk: transaction risk and translation risk. Transaction risk implies that the amount of receivables and payables may change. Translation risk means that the value of the balance sheet may change. Problems related to exchange rates occur when spending is done in a strong currency, but income is in a weak currency. (Jones 2006, p.225) For this reason, there is less risk when both liabilities and income are in the same, possibly domestic currency.

The changes in currency rates between the Chinese yuan (CNY) and the United States dollar (USD) and euro (EUR) during the years 2005-2015 are displayed in Figure 1. At the highest, one USD has been worth 8 CNY and at the lowest 6 CNY. The euro has been worth over 11 CNY at highest, and at the lowest value just over 6 CNY.

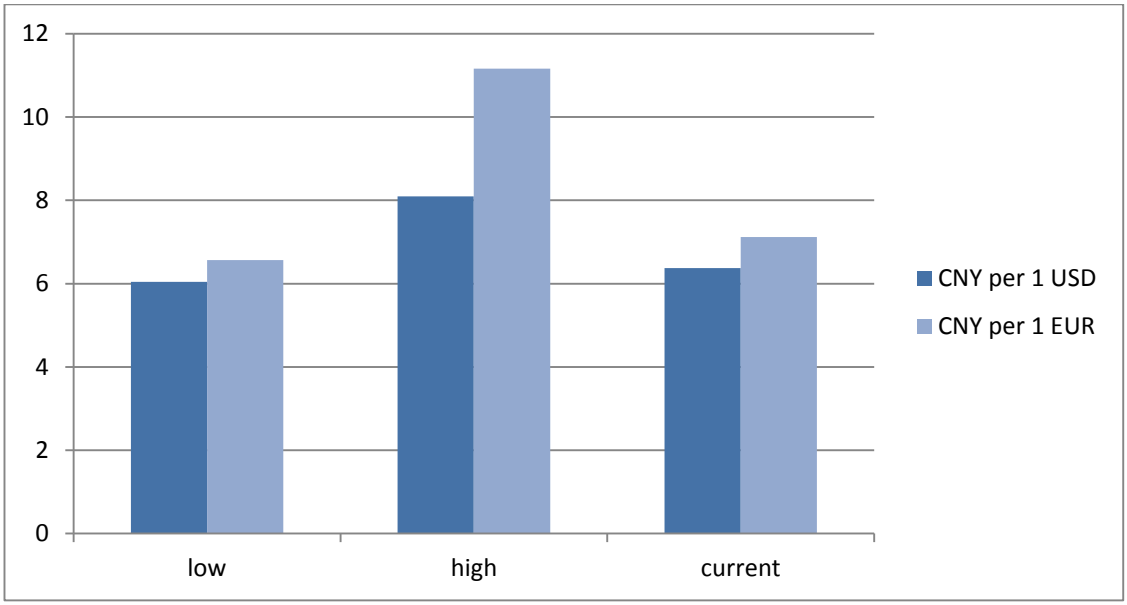

Figure 1. *The relative currency rate development between EUR, CNY and USD between 2005 and 2015. Data from XE Currency Charts (2015).*

Studies have also indicated that cost savings achieved by using factory locations with cheaper unskilled labor could have been in fact offset by other associated costs connected to operating in remote locations. The capital costs of building a new factory can exceed labor costs of higher-wage countries. (Simchi-Levi et al. 2008, p.314) Transportation costs have increased since the beginning of the offshoring wave; the price of oil has roughly tripled since 2000. (Needham 2014) Cheap oil was an enabling factor for the creation of long supply chains and offshoring. Some of the other costs that are often not appropriately acknowledged when calculating offshoring numbers are inventory carrying costs, quality, speed of communication, government policy and impact on innovation and travel costs. (Production´s coming home: what companies need to know about reshoring 2014)

Another issue with offshoring and traditional apparel manufacturing is that most offshore textile companies require a certain minimum order quantity for each style and color. (Rosenau & Wilson 2006, p.249) Chinese factories are designed to handle large production volumes, but companies increasingly need smaller volumes of a larger variety of products. (Knowler 2015) Large production orders reduce flexibility, increase costly inventory and also enhance the risk of over-production. Fabrics may have minimum order quantities as well, but this problem may be easier to mitigate as the same fabric can be used in multiple styles of the same collection (Rosenau & Wilson 2006, p.249)

When committing to order or produce a certain amount of specific products, the company sets itself in a position where supply risk comes from both demand and supply. When demand is lower than this amount, it generates losses, but even if demand is above this certain amount produced beforehand, it does not generate any more profit as more products are not available to be sold. (de Treville et al. 2014a) Mismatch costs are caused by having to make decisions on production quantities before knowing actual demand (de Treville 2015).

Companies have had problems with intellectual property (IP) rights in offshore locations (de Treville 2015). It is not a platitude that all companies around the world have the same respect for intellectual property rights, so product designs can be copied. This can cause financial problems for the owner of the IP rights. Piracy and lack of visibility can also be issues with offshoring. (Baldassarre & Campo 2014)

Innovation can suffer, when manufacturing is located far away from the research and development (R&D) department. When production is offshored, these facilities can be located across different time zones with no regular communication. Before the offshoring wave, when R&D and manufacturing were located close to each other, people communicated more and through this communication, manufacturing was reflected in innovation. (de Treville 2015)

2.3 Labor cost development

Labor costs in many of the former low-cost countries have risen as the wealth of the country has grown. For example in one of the main countries for low-cost production, China, the annual wage growth during the past decade has been very significant. As a consequence of this development, China is in fact becoming a middle-wage country instead of a low-wage country. It is also worth noting that Chinese wages have increased faster than the productivity, this further emphasizing the decrease of manufacturing cost advantage and making the labor even more expensive. (Li et al. 2012) China is also suffering from a shortage of laborers, which dedicates to the rise of wages as well. (Li et al. 2012; Yu 2014)

The competitiveness of the Chinese textile industry has mainly been based on cheap labor and also maintaining strict control of the labor costs (Wang 2011). Apparel production has worked as a passage for developing countries to move towards industrialization (Rosenau & Wilson 2006, p.360). In the case of China, the development of the Chinese economy has led to rising living standards and growing demand of materials. This has led to growing consumer price indexes. For the workers to maintain basic life, labor wage levels must increase to keep up with growing consumer prices. The three main reasons for rising wage levels in China are labor structure, economic growth and the labor law. (Wang 2011) The evolution of labor costs in China´s manufacturing sector during the years 2003-2013 is displayed in Figure 2. The rise in wage levels has been very significant, nearing 300% during the ten-year time period. The average annual wage in 2003 was 12 671 CNY and 46 431 CNY in 2013.

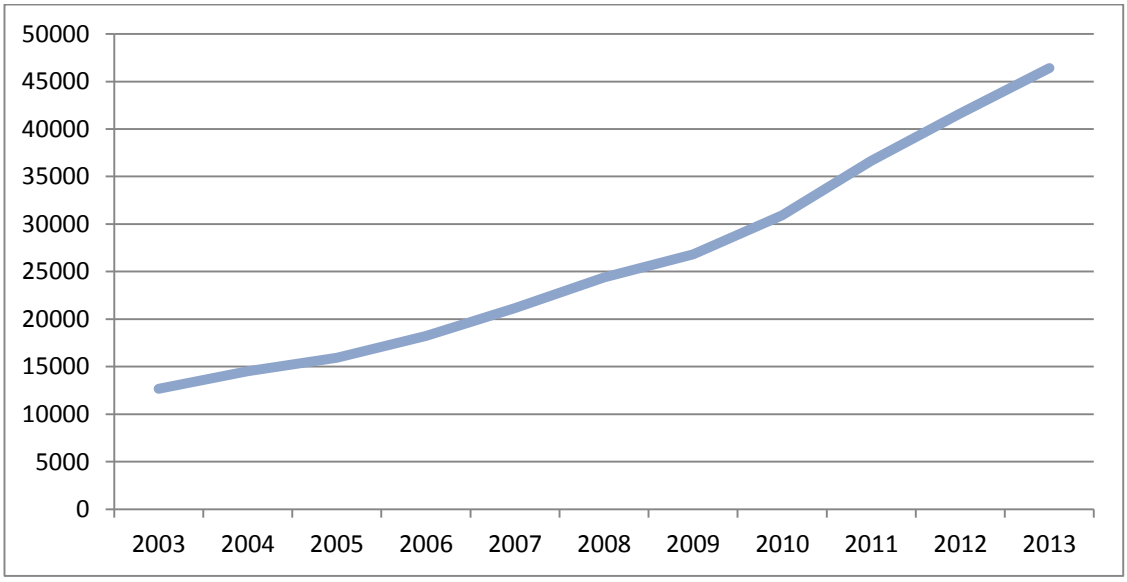

Figure 2. *The average annual wage of employed persons in urban units in the manufacturing sector during 2003-2013, displayed in the Chinese yuan currency. Data from National Bureau of Statistics of China (Average Wage of Employed Persons in Urban Units by Sector, 2015).*

As stated earlier, the rise of labor costs has not been limited to only China; it has been witnessed in other low-cost countries as well. Figure 3 displays the annual growth of mean monthly earnings of employees in eight developing countries during the years 2006-2013. The annual percentage growth in China is in its own magnitude compared to any of the other developing countries, though the growth rate appears to be slowing down. The Philippines and Thailand have a decreasing annual percentage growth rate as well. The growth rates for Bangladesh and Indonesia are steeply increasing at the end of the shown time period.

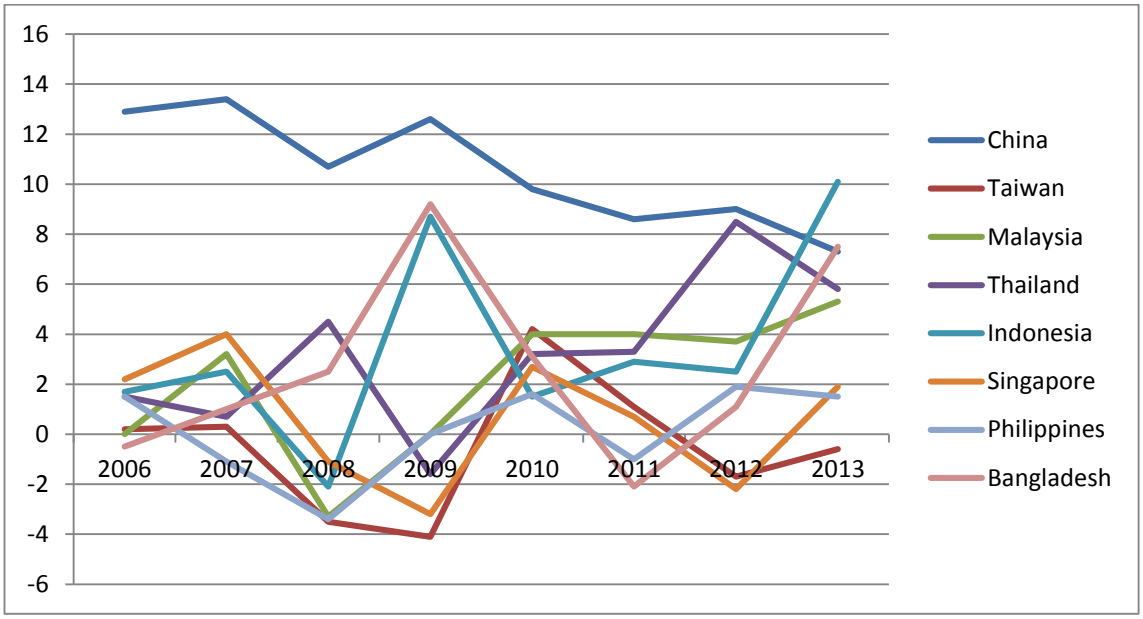

Figure 3. *Mean monthly earnings of employees, annual percentage growth. Data from ILO (Mean real monthly earnings of employees, annual growth, 2015).*

The top apparel exporting developing countries are China, Hong Kong, Bangladesh, Vietnam, Turkey, India, Indonesia, Cambodia, Malaysia, Mexico, Thailand, Pakistan, Sri Lanka, Morocco, Tunisia, Honduras, The Republic of Korea, El Salvador, Panama, Philippines, Peru, Egypt, Guatemala and Taiwan. All of these countries excluding Singapore have set minimum wages for garment production. Many of the countries have several minimum wage rates for the garment sector, depending on factors such as the industry and skill grade of the worker, work place, province or town. This complicates international comparisons of the minimum wages. (Luebker 2014)

The most representative rates for monthly minimum wages in the garment sector are gathered into Figure 4, indicating the range of minimum wages from the highest to the lowest value when there are several minimum wage rates. The values are valid as of 1 January 2014, and shown in United States dollars (USD). The highest minimum wages for the garment sector are in Hong Kong, Turkey, the Republic of Korea and Taiwan. The lowest minimum wages are in Bangladesh, Vietnam, India, Indonesia, Cambodia,

Pakistan and Sri Lanka. China's minimum wages are neither in the lowest or highest range when compared with the other developing countries.

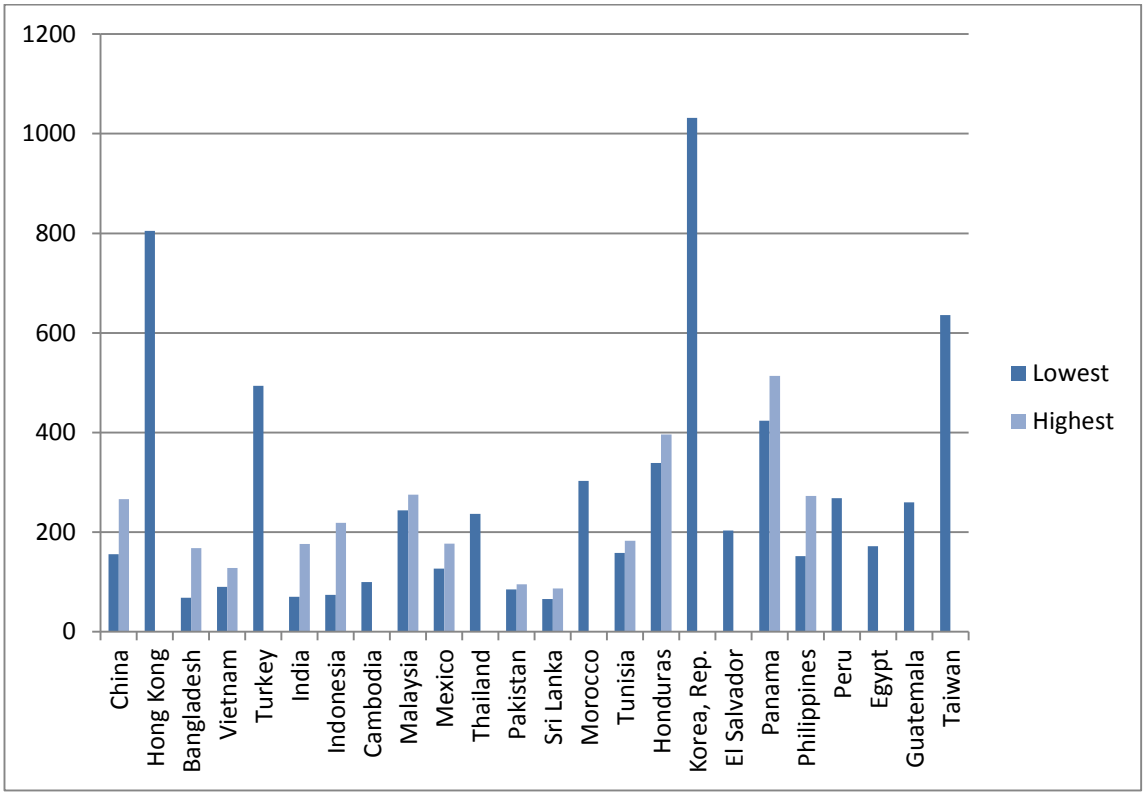

Figure 4. *Minimum monthly wage rates for the garment sector as of 1 January 2014, shown in USD. Adapted from (Luebker 2014).*

2.4 Current environment in Europe

The European economy was strongly affected by the financial crisis beginning in autumn 2008. Labor markets in the European Union (EU) started to weaken in late 2008, and further deteriorated in 2009. (European Economic Forecast Winter 2015) The economic recovery from the crisis only started during the last quarter of 2013. Restoring growth and prosperity requires better industrial competitiveness. (Europe 2014: Back in the game, 2014)

Recovery from the recession of 2008-09 is still slow. (European Economic Forecast Winter 2015) Unemployment rate in April 2015 was 11.1% in the euro zone, in March 2015 it was 11.2% and in April 2014 11.7%. The unemployment rate in EU-28 countries was 9.7% in April 2015, as opposed to 10.3% in April 2014. The unemployment rate seems to be slowly decreasing. An estimate of 23.504 million men and women in the EU-28 countries were unemployed in April 2015. Of these 23.504 million, 17.8467 million were in the euro zone. (Euro area unemployment rate at 11.1%, 2015) Even though the unemployment rate is expected to decline also in 2016, it will still remain significantly higher than the level before the financial crisis, also indicating

that high structural unemployment is persistent. (European Economic Forecast Winter 2015)

Private consumption has so far been the main engine of growth in the economic recovery process. Investment in the EU has not recovered; this would also be needed to support growth. There are some promising factors supporting future growth. Oil prices have come down steeply and this is expected to leave more income for consumers and widen corporate´s profit margins. This is because of the decreasing of energy costs for households and companies, and should lift gross domestic product (GDP) growth in the EU. (European Economic Forecast Winter 2015)

Manufacturing is a part of strategy for many countries, as it can help turn around slow economic growth. (Kazmer 2014) A strong manufacturing sector would be desirable in European countries, as one industrial job is estimated to create about two additional jobs in the supply and service sectors. The pay in manufacturing jobs is also generally higher than in the service sector. The manufacturing sector brings potential for high-value jobs through research and development and also potential for growing exports and reduced imports. The significant offshoring of European production happened between the 1980s and the 2000s, China as the main destination. (Needham 2014) The reshoring of EU manufacturing would help speed up economic growth and reduce unemployment.

The depreciation of the euro exchange rate should increase price competitiveness in both domestic and foreign markets. The modest degree of recent wage increases in the EU should support job creation as well. (European Economic Forecast Winter 2015) The labor costs per hour in euros, including the whole economy in the EU, excluding agriculture and public administration are displayed in Figure 5. The growth rate of labor costs has remained quite modest during the years 2004-2014.

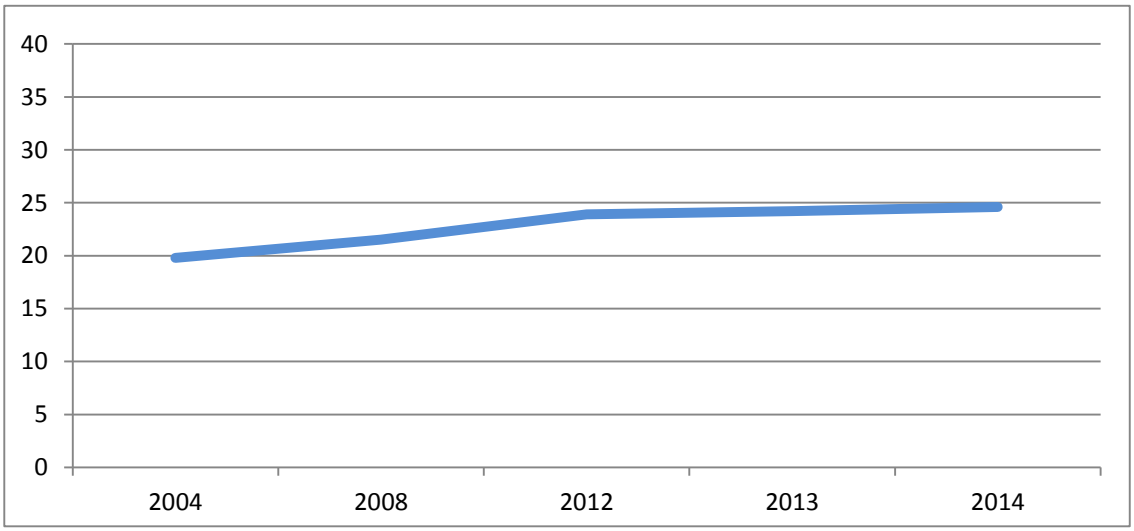

Figure 5. *European Union labor costs per hour in euros. Data from Eurostat (Labour costs in the EU, 2015).*

Figure 6 displays the annual growth percentage of mean monthly earnings of employees in some of the EU member countries during the years 2006-2013. A very steep fall in the annual growth of mean monthly earnings has happened in Latvia, Estonia and Lithuania during the years 2007 to 2009. At the end of the displayed time period, the countries have managed to turn the growth of monthly earnings to increasing values. These countries also had a relatively high percentage growth in earnings at the beginning of the time period. Greece has had a negative annual percentage growth since 2009, but the curve has started rising back towards a positive growth. When comparing the annual percentage growth values to the similar comparison for developing countries in Figure 3, it appears that the percentage growth values in developing countries are generally higher than in EU countries. Only two EU countries have percentage growth values over 4, as opposed to five of the developing countries with a value over 4. This indicates that mean monthly earnings are growing faster in the developing countries than in EU countries. The most important textile and clothing employers of the EU member countries are Italy, Romania, Poland, Portugal, Germany, Bulgaria, United Kingdom (UK), France and Spain (Euratex Annual Report 2014).

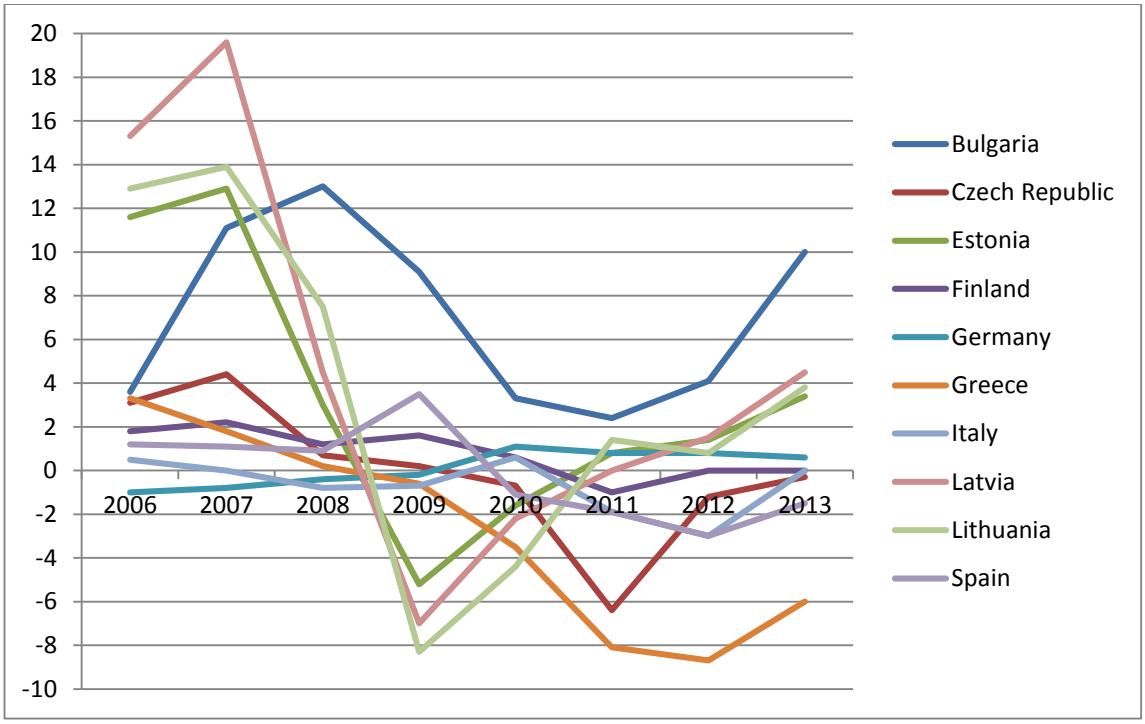

Figure 6. *Mean monthly earnings of employees, annual percentage growth. Data from ILO (Mean real monthly earnings of employees, annual growth, 2015).*

The average annual labor productivity growth in the clothing sector between 2007 and 2012 in the EU is positive, but only about 0.25%. Labor productivity is measured as output per employed person or per hour worked. Competitive edge could be gained by creating the ability to produce more or higher-quality manufacturing output with less input of labor, for example by the use of technological improvements or organizational reforms. (European Competitiveness Report 2014: Helping Firms Grow, 2014)

The productivity growth levels in both the European Union and China during the years 2007-2014 and a projection for the year 2015 are displayed in Figure 7. The productivity growth in China has been at a high level, but has slowed down after the year 2012. Productivity growth in Europe has been quite stable, around 1 %, but an increase in productivity growth is projected for the year 2015.

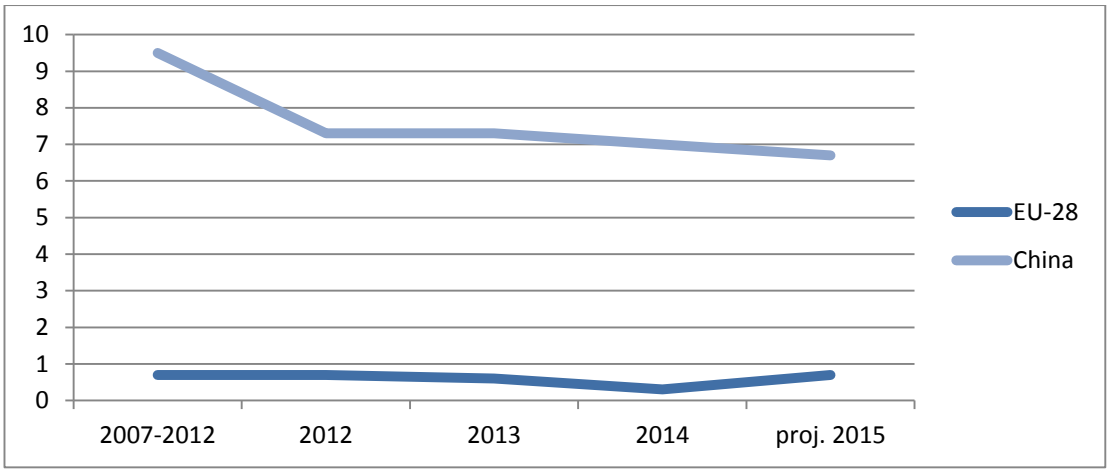

Figure 7. *The productivity growth levels in the European Union and China. Data from (The Conference Board Total Economoy Database: Summary Tables, 2015).*

The manufacturing cost competitive indexes for different countries shown in Figure 8 consist of four factors which affect manufacturing competitiveness; wages, productivity growth, energy costs and currency exchange rates. (How Global Manufacturing Cost Competitiveness Has Shifted over the Past Decade, 2014) The United States index 100 is used as the benchmark. In 2014, China is only 4 index points more cost competitive than the U.S. The UK and Netherlands are also close to the index 100.

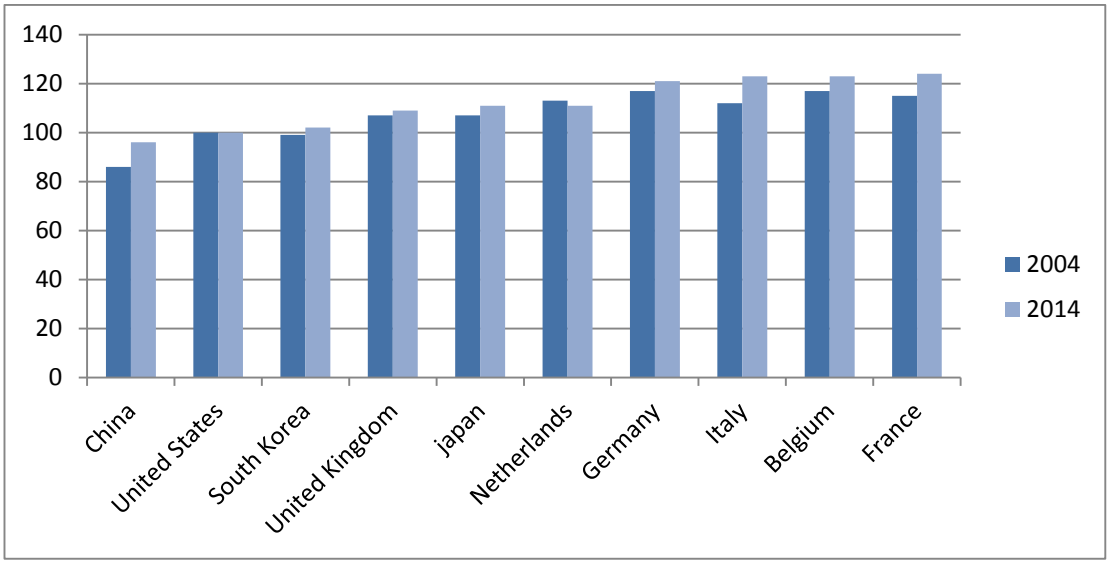

Figure 8. *Manufacturing cost competitiveness indexes. Adapted from (How Global Manufacturing Cost Competitiveness Has Shifted over the Past Decade, 2014).*

The development of extra-EU clothing imports and exports can be seen in Figure 9. These numbers have been calculated by subtracting intra-EU values from world trade values, in order to only acknowledge extra-EU values. Both the imports and exports of clothing have increased between 2003 and 2013. The relation between imports and exports has stayed approximately at the same level. The largest clothing exporters in the EU in 2013 were Italy, Germany, Spain, France, Netherlands, Belgium and the United Kingdom (WTO | International Trade and Market Access Data, 2015).

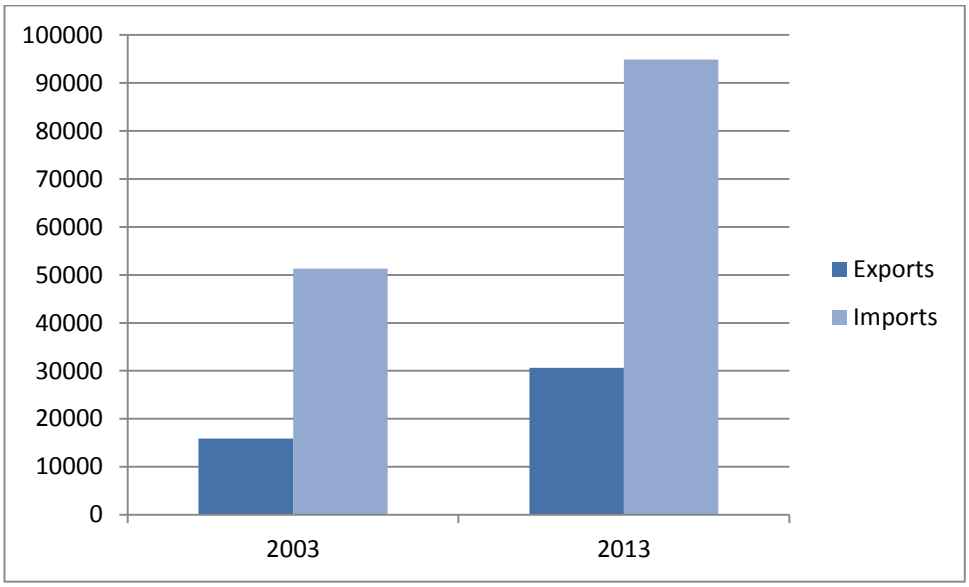

Figure 9. *Extra-EU clothing imports and exports, shown as millions of USD. Data from (WTO | International Trade and Market Access Data, 2015).*

The clothing manufacturing segment is an important industry in the EU, even though the economic situation in Europe has had an effect on the turnover of the segment. Based on the data from Statista, the annual turnover of the clothing segment of the textile and clothing manufacturing industry in the EU was 79.6 Billion euros in 2011, and 74.1 Billion in 2013. (Annual turnover of textile and clothing manufacturing industry in the European Union, 2015)

Participants of a survey to business leaders in UK, Germany, France, Italy and Netherlands referred to in (Reform EU to help reshore jobs - CBI European survey 2014) listed changes that are needed in the EU to bring production back to Europe. Among these actions were: less EU regulatory burden on business, more flexible European labor market, getting a better balance between regulation at the EU and Member State level and making progress to complete the EU digital Single Market.

3. RESHORING

3.1 Definition

The term reshoring generally refers to relocating once offshored production back to the country of origin. However, the term is used loosely in different associations. For example, the American Reshoring Initiative divides reshoring into three categories: reshoring, keeping from offshoring and transplant. (Reshoring Initiative Library: Advanced Search, 2015) Gray et al. categorize reshoring into four different types: 1.in-house reshoring where own offshored production is manufactured domestically, 2.reshoring for outsourcing where a company´s own offshore production is acquired from domestic suppliers instead of moving own production, 3.reshoring for insourcing where a company takes over production from offshore suppliers and starts own domestic production and finally 4.outsourced reshoring where a company relocates production from offshore suppliers to domestic suppliers (Gray et al. 2013). The fact most researchers agree on, is that reshoring is most importantly and above all a location decision. However, reshoring does not delimit ownership. The production reshored can be the company´s own or outsourced production; this does not affect the utilization of the reshoring term. (Gray et al. 2013)

The reshoring phenomenon can also be referred to as backshoring, onshoring, inshoring, and back-reshoring. Nearshoring is used to describe the action of moving offshored production back to the proximity of the company´s home country, for example to a country in the same region, but not the actual home country. (Fratocchi et al. 2013) An alternative definition is to emphasize the lower cost level of the close-to home location. Examples of near-shoring are Mexico for the U.S. and Eastern Europe for European countries. (Gibson 2014) The closeness of the location could also be in relation of key markets, not the home country of the company. (Production´s coming home: what companies need to know about reshoring 2014)

In this thesis, reshoring as a term is restricted to including production that has once been located offshore and then moved back to the company´s home country. The production may be either the company´s own production or outsourced production.

There are some similarities between the de-internationalization and foreign divestment concepts and reshoring, but as there is no complete overlap, they are considered as separate phenomena. (Fratocchi et al. 2013) Most researchers agree that reshoring cannot occur without previous offshoring, which makes reshoring a reversion from

offshoring. This is also what differentiates reshoring from a typical location decision. (Gray et al. 2013)

A separation should be made between manufacturing and service reshoring, as the nature of the activities are very different. It is more costly to reshore manufacturing operations than service operations, so the decisions regarding manufacturing reshoring are more complex and strategic. Manufacturing companies have also initially taken part in offshoring more. (Fratocchi et al. 2013) This thesis only concerns manufacturing reshoring, not services reshoring.

Reshoring is a result of changes in the economic environment or the market (Martínez-Mora & Merino 2014). According to a survey of managers on offshoring practices by Tate et al. (2014), the most important factors affecting the reshoring decision in U.S. companies are labor cost gap and stability, the improving ratio of U.S. labor and productivity per labor dollar, the availability of skilled labor, energy cost, currency exchange, tax structure, shipping time and customer proximity. Tate et al. have focused on the basis of reshoring manufacturing to the United States. According to Ellram et al. (2013) factors that affect manufacturing location decisions vary depending on the company´s region and also over time. The reasons for reshoring and their occurrence in academic literature are gathered together in Appendix 1, and the supply chain factors further analyzed in Chapter 6.

3.2 Current development

According to consulting firm A.T. Kearney´s 2014 Reshoring Index®, the top three reshoring industries in the United States are electrical equipment, appliance and component manufacturing (15%), transportation equipment manufacturing (15%) and apparel manufacturing (12%) at third place. The consulting firm holds a database of more than 700 reshoring cases and the top three is based on the number of cases from each industry in this database. The most important reasons for reshoring were better delivery time, better quality and company image. Even though manufacturing in the U.S. has grown, have the imports of offshore manufactured goods increased as well. (2014 A.T. Kearney Reshoring Index)

It is currently a trend to have a globally more balanced production environment and supply chain. Companies want to have production near their customers. (Deligio 2014) Some reshoring is already happening in Europe as well. Clothing, footwear and electronics companies are leading the reshoring movement in Europe. (The Lure of Cheap Chinese Manufacturing Is Fading For European Companies 2014) The amount of reshoring has grown significantly during the last few years. (Fratocchi et al. 2013)

Italy is reported to be the second most active reshoring nation after the U.S., especially in the textile industry. (Astarita 2014) Other European countries engaged in reshoring

activities are Ireland, Germany and Spain. The depressed wage levels in Spain since the euro zone crisis, along with the adapted flexible working practices and salary freezes due to high unemployment have increased Spain´s attractiveness for manufacturing. (The Lure of Cheap Chinese Manufacturing Is Fading For European Companies 2014; Knowler 2015)

Some reshoring has also been reported in the United Kingdom. An EEF survey shows that during the last three years, 1/6 of respondents have reshored production in-house and 1/6 have switched to a UK supplier from a low-cost country supplier. China is the most common location from which production is being brought back, Eastern Europe following behind. (Backing Britain: A manufacturing base for the future, 2014) In 2014, the UK Coalition government declared its support for the reshoring phenomenon in the UK. (Gibson 2014)

When comparing the U.S. with European countries, the U.S. has some additional pulls for reshoring. These include a larger domestic market and a lower cost of energy originating from shale gas. (Backing Britain: A manufacturing base for the future, 2014) However, these are slightly balanced out by considering the European Union as one large domestic market and the lowering energy costs discussed in Chapter 2.4, and could indicate an even more favorable environment for reshoring in Europe.

Academic attention on reshoring lags behind, beginning with the absence of shared terminology for the phenomenon. Recent empirical research on the subject relies mostly on survey data and is focused on motivation and host countries. (Fratocchi et al. 2014) It is difficult to obtain public secondary data on reshoring strategies, as these strategies and statistics are usually not publicized. (Fratocchi et al. 2013; Gray et al. 2013)

When handling the topic, it is important to focus on the differences between labor-intensive and capital-intensive operations. This is because the effect of the host country´s market is different in both cases. (Martínez-Mora & Merino 2014) However, when looking at the data base gathered by (Fratocchi et al. 2014), consisting of 294 reshoring cases in companies from both the U.S. and Europe, reshoring activities have been observed in almost all manufacturing industries. There has been no relevant difference in the amount of reshoring between labor-intensive and capital-intensive industries. Labor-intensive activities are likely to be repatriated with efficiency-seeking investments. The most common source countries, from which production was repatriated, were China and Eastern Europe countries. (Fratocchi et al. 2014)

Reshored manufacturing is not limited to only highly automated factories with few workers; also small, relatively manual and highly flexible contract manufacturers have reshored. There is currently a shortage of contract manufacturers in developed countries. (de Treville 2014)

3.3 Reshoring projects and organizations

Currently there are several ongoing projects and associations worldwide promoting the reshoring phenomenon. The Reshoring Initiative is an American initiative aiming to bring manufacturing jobs back to the United States. They work with companies and encourage them to consider the total cost of offshoring and whether it in fact is the most cost effective alternative. The initiative also gathers and shares information on companies that have reshored production. (Reshoring Initiative: What is reshoring? 2015)

The Alliance Project examines the potential for reshoring textile manufacturing to the United Kingdom. The project focuses on skills, investment, innovation and reconnecting supply and demand. It is based at New Economy, an agency owned by some Great Manchester authorities, aiming to create a better economy for Greater Manchester. (The Alliance Project, 2015)

Reshore UK supports companies reshoring operations to the UK and also SME (small and medium-sized enterprise) manufacturers supplying into reshored contract opportunities. The service provides strategic and technical advice before and after reshoring. SMEs may be able to also get financial help with improvement projects from Reshore UK. (Reshore UK, 2015)

Governments in several countries have started initiatives to encourage domestic production. Examples include French, Swedish and American initiatives to bring offshored jobs back. (Giannoulis 2013)

3.4 Reshoring considerations

Reshoring production is not a simple process, and it has its own hazards. Supply chains need to be reinvented and this can be both disruptive and traumatic, and also generate more costs than estimated. The changeover period will cause instability in the supply chain, and orders could be disrupted as suppliers may change as well. (Production´s coming home: what companies need to know about reshoring 2014)

Reshoring requires innovation, automation and possibly developing products that sell in local markets. The factories in the target country may need significant renovation and updating, as re-engineered products may need new types of production lines. Extensive automation of product lines is necessary to extract as much labor as possible from production costs. All stakeholders need to be involved in the decision making process for reshoring; some functions to consider are finance, engineering, manufacturing, purchasing, marketing, facilities, IT (information technology), human resources and government affairs. (Coates 2015) Reshoring requires management time and effort (Backing Britain: A manufacturing base for the future, 2014).

Leaving the foreign location is usually not as simple as packing your things and switching the lights off. For example ending employment contracts, paying exit taxes and obtaining government approval to leave should be acknowledged as these considerations may require effort, costs and time. (Coates 2015)

When evaluating the possibility of reshoring, it is important to acknowledge the location of the company´s possible suppliers for manufacturing. If reshoring production activities would mean losing supply proximity, could this turn out to be problematic as manufacturers can be heavily dependent on their offshore suppliers for component sourcing. (Chen & Hu 2014) There is typically a delay of a few years between companies moving and their supply base following. (Van den Bossche et al. 2014) A switch to nearby suppliers may be needed to avoid this problem. (Chen & Hu 2014) However, it may be challenging and time-consuming to find the needed local suppliers (Backing Britain: A manufacturing base for the future, 2014).

Market and supply proximities both enable different operational flexibilities. (Chen & Hu 2014) This is why the location of both customers and suppliers is important. (Van den Bossche et al. 2014) Reshoring manufacturers without supply proximity might have to order their components before knowing demand, so there might be an over-stock of components. At the same time, the inventory of components defines the maximum production quantity. Even though market proximity brings flexibility to production, it can be deteriorated without supply proximity, as the risk moves on to components. (Chen & Hu 2014) The distance of offshore suppliers may diminish the full benefits of reshoring, as the end-to-end supply chain does not actually get any shorter, and might be as vulnerable to disruptions as offshore production. (Van den Bossche et al. 2014)

One of the main arguments against reshoring is market access; many offshoring locations are fast-emerging economies with a growing middle class. China, for example, is likely to be a target market for many companies in the next 20 years with the growing middle class along with more income and desire for products. It should be thoroughly considered where growth is likely. (Production´s coming home: what companies need to know about reshoring 2014; Coates 2015; Coates 2014)

Availability of skilled and qualified workforce is one of the concerns in the reshoring movement, as previous offshoring has decreased the amount of available skilled manufacturing workforce.(Van den Bossche et al. 2014) Manufacturing jobs need to be attractive for people. In apparel production, skills for sewing and pattern making are important. Education and apprenticeship may be needed in the reshoring host countries, with the help of industry support. (Wang 2014) The company planning to reshore should make sure that there are enough skilled workers available in the geographic area attempted for reshoring. (Coates 2015)

4. CLOTHING MANUFACTURE

4.1 General features of clothing

The subject of textiles for dressing humans can be referred to by many terms: clothing, garments, apparel and fashion. Jones (2006, p.5) utilizes the words clothing, garment, fashion and apparel as interchangeable equivalents. This approach will be adopted for use in this thesis as well, with the exception of the word fashion, as there is another meaning reserved for this term, better described in Chapter 4.2.

All human cultures use textiles and apparel for the purposes of aesthetics, protection and nonverbal communication. (Kunz & Garner 2007, p.63, 82) When people purchase clothing, there are numerous factors to consider that could affect the purchase decision: feel, design, color, fit, comfort, size and material for example. These all contribute to the specialties of clothing manufacturing and retailing, whether online or in a brick-and-mortar shop. Major steps of the clothing consumption process are: acquisition, inventory, use, renovation and discard (Kunz & Garner 2007, p.79).

The clothing industry has different segments with differing features; low value added and high value added segments. In high value added segments, design, research and development are essential competitive factors. (Karthik & Gopalakrishnan 2014, p.155)

4.2 Fashion

Fashion is the defining component of clothing selection. Fashion is defined as “the style of dress accepted by the majority of a group at a given time”, so it has an effect on the types of garments people wear at a certain time. (Kunz & Garner 2007, p.63-65) Due to fashion, garment´s acceptability is only temporary, so those who can afford to, will continue to buy apparel whether they physically need to or not. Fashion is what makes the apparel business less predictable than other consumer products. (Kunz & Garner 2007, p.65) The fashion industry generally covers a various range of products; for example textiles, clothing, accessories, furniture, home goods, lighting, small electronics and automobiles (Ruppert-Stroescu et al. 2015). Regarding this thesis, particularly the aspect of the clothing fashion industry is relevant.

Kunz and Garner (2007, p.65) divide apparel products into two categories: fashion and basics. This segmentation will be adopted throughout this thesis as well. Basic goods have an extended selling period as opposed to the short selling period of fashion products. Basic goods can be restocked during a selling period, but usually fashion

cannot, especially if coming from offshore suppliers. Basic goods are standardized; demand for changes in style is infrequent, so the same styles, sizes and colors can be sold for a year or longer with consistent levels of demand. This also means large production quantities and mass production techniques. Basic products are usually bought only to replace a previously owned item and price is an important selection criterion. (Kunz & Garner 2007, p.65-66)

Fashion goods are individualized and differentiated by style, color and brand. Customers buy both the product and the fashion image it represents, and obsolescence follows demand peaks. Manufacturers need to able to produce small production lots. Appearance is an important selection factor. (Kunz & Garner 2007, p.65-66) The most important differences of fashion and basic goods are gathered into Table 1.

Table 1. *Basic goods and fashion products (Kunz & Garner 2007, p.66)*

	Basic	**Fashion**
Product characteristics	• standard • utilitarian • infrequent changes in styling • more common in menswear	• individualized • romanced with atmosphere • frequent changes in styling • more common in womenswear
Product presentation	• individual items • simple presentation	• coordinated groups • project a fashion image
Inventory control	• steady predictable demand • predictable selection • automated replenishment	• demand peaks followed by obsolescence • ever-changing stocks • selection limited by current fashion • zero to zero inventory
Selection process	• easy price comparisons • comparative shopping	• value difficult to assess • impulse shopping
Appeal to customer	• logical • tangible product • intrinsic value • meeting a need • replacement • price is a major factor	• emotional • intangible fashion image • extrinsic externally created value • creating or directing a need for additional variety • appearance is a major selection factor
Characteristics of firm	• large • automated	• small • labor-intensive

Three features that are specific to the fashion industry include: 1.”*Fashion requires a quick response*.” This implies that clothing technology has to allow versatility and responsiveness to market demand. (Tyler 2008, p.1-5) Fashion clothing´s time-sensitivity brings its own element to clothing production, as fashionable clothing does not sell if it arrives too late. 2. “*The clothing industry is labor intensive and has a relatively low requirement for fixed capital*.” The sewing process is the most important output of a clothing factory and it has remained labor-intensive due to the difficulties in the automation of sewing. (Tyler 2008, p.4-5) 3. “*The industry has developed global supply chains*.” It is common that when a product is developed and garment specifications are being determined, it has not yet been decided where the manufacturing will take place, as much of product development is retailer led. Reducing lead times is a challenge with global supply chains. (Tyler 2008, p.4-5)

Fashion trend life cycles have shrunken to just months; as opposed to a previous cycle of one year or longer. Fresh new styles are provided to customers continuously by progressive fashion companies. (Rosenau & Wilson 2006, p.454) This brings further challenges for the supply chains of fashion products, as products need to be produced faster and faster to keep up with the changing trends.

An alternative approach to clothing and fashion is that most garments are influenced by trend to some extent, and these trends originate from high fashion. This is based on the fact that though not all garments are fashionable at the same time; most people do change clothes before they are worn out and for this reason not suitable for use any more. (Jones 2006, p.5) However, as there are significant differences in the time cycles of trend changes among different types of clothing (Kunz & Garner 2007, p.65) this thesis will not adopt the assumption that all clothes are fashion.

4.3 Clothing production

The three main steps for manufacturing ready-made textiles are: separating, joining and forming. The separating step refers to the cutting of fabric. The joining phase can include sewing, gluing and welding. The final forming step can be performed with temperature, pressure, tension or humidity. (Wulfhorst et al. 2006, p.243)

The actions done in clothing manufacturing apart from sewing are called ancillary actions. Automating these ancillary actions, such as bundle handling, marking, folding and creasing, are usually the way to achieving productivity increases. The nature of fabric is what makes automating of the garment manufacturing process so difficult: bending in all directions, extensibility and various thicknesses. As about half of the garment´s wholesale price is in the material, cutting process consumes about half of the company´s turnover. About 20-25% of garment cost comes from labor, and 95% of that comes from the sewing room. (Tyler 2008, p.4-5) These numbers are examples and vary

between different clothing products. Costs of clothing manufacturing are further discussed in Chapter 7.

The sewing of two pieces is usually done as two-dimensional (2D), even though most clothing pieces are in fact three-dimensional (3D). This also contributes to the restricted automation possibilities of sewing. (Wulfhorst et al. 2006, p.243) Fabric handling and manipulating sewing parameters form two main problems in the automation of the sewing process. The actual sewing actually takes up only 15%-30% of the needed time for sewing, and handling takes up the rest. This indicates that automation of the handling of fabric would be sensible. (Wulfhorst et al. 2006, p.259)

The most defining feature of apparel production is its labor-intensity. The manufacturing sector in general is less labor-intensive than apparel production, as technology has reduced the need for labor in most manufacturing industries. (Jones 2006, p.92; Kunz & Garner 2007, p.53) Jones (2006, p.92) states that this is due to both the technical problems related to automating fabric processes, and the global availability of cheap labor so far. As cheap labor has been accessible, there has not yet been a true need for automation. (Jones 2006, p.92-93) Still, some part of textile production has already been automated, for example spinning, dyeing, weaving and knitting, but only in the case of high-volume basic fabrics. The challenge is to apply these technologies to small production lots that vary in fiber content, yarn type and fabric structure. Apparel assembly itself is still one of the most labor-intensive production processes in consumer products, as cut garment pieces are still mostly hand-fed into sewing machines. (Kunz & Garner 2007, p.53-54)

Apparel production in developed countries has been threatened by production in developing low-cost countries. However, an important issue with low-cost country manufacturing is that these countries are usually located far away from the major apparel markets. Proximity to market is an advantage as local producers can supply customers faster than offshore producers and because of this, the clothing company can maintain a price premium of their products as the timing is right. (Jones 2006, p.158-159)

The heavy involvement of labor has lead apparel producers to seek the cheapest labor. (Kunz & Garner 2007, p.54) The global cost advantage scheme changes constantly, as former lowest-cost countries develop, resulting in rising labor costs. Also political instabilities, trade barriers and exchange rate fluctuations can shift the relational cost advantage. Moving the location of production generates switching costs, so constantly chasing the cheapest labor to different countries may not be an economically wise strategy even though it might seem so when only considering labor costs. This kind of constant movement also has a negative effect on buyer-supplier relationships. (Jones 2006, p.179-180)

Jones (2006, p.180) lists 13 major factors to take into account when deciding a location for apparel manufacturing: labor costs, labor supply, material costs and availability, training costs, local labor laws, communications, political stability, ownership possibilities, local government aid packages, local tax and profit regulations, market access, cultural compatibility and exchange rate risk. Most likely some trade-offs are needed, as no location will be the best considering all factors. It is also stated, that the conventional wisdom for offshore production suitability depends on two factors: the sewing time and the complexity of the product. (Jones 2006, p.182) Some apparel products may require specialized sewing skills and equipment; this may also affect the preferred manufacturing location. (Rosenau & Wilson 2006, p.382)

Rosenau and Wilson (2006, p.422) also define a comparable set of factors affecting the apparel sourcing decision. These factors are listed below in Table 2. When compared to the list by Jones (2006, p.180), the list is quite different; Rosenau & Wilson emphasize the assessment of equipment, lead time and quality in addition to costs, regulations and ease of doing business, which were also included in the list by Jones.

Table 2. *Factors affecting the sourcing decision in apparel products. Based on the text by Rosenau & Wilson (2006, p.422).*

Costs	Cost and productivity differentials	support structure and delivery costs need to be acknowledged as well
	Raw material weight and bulk	shipping and possibly duty costs are related to weight; lighter fabric garments are cheaper to make far away
Equipment assessment		operators and technicians for maintaining the equipment and support, availability of spare parts
Throughput time (lead time)		must include buffers for shipping delays
Quality		specifications must be measurable
Government regulations		quotas, terrorism, duties
International Business Paradigms		to determine effect on negotiations and doing business in specific country

4.4 Fit of clothing

The fit of apparel products is what differentiates them from almost all other objects humans use. For example tools, furniture and buildings all impact the body less than clothing. (Ashdown 2014, p.18) Clothing appearance or aesthetics is one of the most important aspects of clothing quality. (Fan 2004, p.15) Clothing fit is seen as the most important element in clothing appearance for customers. The principles and definitions of fit are not static; they change over time and depend on fashion culture, industrial norm and individual perception of fit. (Yu 2004, p. 31) Consumers often have different

preferences for clothing fit. (Gribbin 2014, p.5) The apparel industry itself has a lack of agreement concerning the features which are responsible for a good fit. (Yu 2004, p.31)

Apparel fit is however connected to conversion rates in retail, full-price sell-through rates and mark-downs, returns, customer retention and brand loyalty. Objective evaluation of fit is difficult, but necessary for comparing differences in clothing appearance achieved through varieties in pattern construction and assembly methods and for the construction of a basic block pattern. (Yu 2004, p.86)

Different forms of apparel have different sizing requirements for achieving the wanted fit; wrapped apparel can fit many different shapes and sizes appropriately, but closely fitted tailored apparel has the greatest sizing issues. Clothing also needs to remain comfortable when the wearer moves. (Ashdown 2014, p.18)

When clothing is not made-to-measure and is bought ready-made at a retail location, the clothing needs to be made in a certain size. Sizing protocols in the apparel industry depend on two factors; first of all how many sizes a brand is willing to produce, and secondly the grading rules; the difference between any two sizes in a certain size range. The aim is to fit as many people with the smallest amount of different sizes as possible, to achieve the best possible return on investment and retail space productivity. (Gribbin 2014, p.5) Additional sizes will increase manufacturing and distribution costs, and also require extra floor space in bricks-and-mortar companies. It might also be difficult for the customer to choose a size if there are too many shapes and sizes to choose from. (Ashdown 2014, p.17)

Size protocols are often linear, and this is problematic as the size of people does not grade linearly. Missed sales occur when a customer is a different shape than the clothing or does not fit into the largest or smallest size of the range. (Gribbin 2014, p.7)

4.5 Mass customization of clothing

Apparel companies are seeing the need to address niche markets and meet the expectations of individual consumers through mass customization (Rosenau & Wilson 2006, p.454). Apparel mass customization has become common (Kunz & Garner 2007, p.53). According to Rosenau & Wilson (2006, p.462) customization in the clothing industry refers to “the process of personalizing a garment by manufacturing it to an individual´s specific body measurements or other specifications such as silhouette, fabric, color and embellishments”.

Mass customization is a method of producing products in a way that combines both craft and mass production. The best features of both production methods are utilized so that a wide variety of customized products can be produced efficiently with low costs. (Simchi-Levi et al. 2008, p.354-355)

Custom-made products give a valuable view on what customers currently really want and where the market is going. When customizing products, customers can define almost in real-time what will be produced. (The Economic Case for Reshoring , 2015) Customizing requires special flexibility from the supply chain. (Moser & Kelley 2015)

Mass customization is considered as consumer driven production, which means that products are produced only after orders are received. The demand for finished products is independent and no finished product inventory is held. However, the demand amounts for product components and parts are dependent on the demand for finished products, so an inventory of product components and parts is still likely to be needed. (Jacobs et al. 2011, p.36-37) Product components are less time-sensitive than finished products, and fast supplying of components can mitigate the need for component and part inventory.

Consumer driven production can be carried out with different degrees of customization. In the case of mass customizing clothing, it is most likely that the customer decides the wanted components and the manufacturing company then assembles the finished product. It is important for the company to conduct configuration management, where it is determined which components can go together and which in turn have to be used together to construct a viable product. The manufacturer knows what the customer could buy, but not when, whether if or how many products. (Jacobs et al. 2011, p.36-37)

Mass customization demands changes in the processes of manufacturing, distribution and delivery of products. The supply chain needs to be restructured, as mass customization requires a flexible and responsive supply chain, because of the increased product variety. This in turn creates complexity, which needs an agile supply chain. Customers get value as they are able to get customized products, and at the same time, manufacturers are allowed less excess inventory and markdowns. (Bhatia & Asai 2007)

It can be difficult to find reliable suppliers for making customized garments at reasonable prices, as customers do not generally want to wait weeks to get their product. (Gribbin 2014, p.15) Mediators such as wholesalers can be eliminated, if a direct channel is built from the manufacturer to the customer. Then manufacturers can also respond more quickly and flexibly to consumer wishes. (Bhatia & Asai 2007) Production of mass customized products needs to be fast, and this is achieved better when there are less intermediaries.

Fit is a key element of customized clothing. (Rosenau & Wilson 2006, p.464) Especially highly structured garments such as jeans, tailored suits and evening gowns are potential products for mass customized sizing systems, as they have demanding fit requirements. (Ashdown 2014, p.18) It should be noted that correct fit requires adequate critical body measurements that are taken correctly. (Rosenau & Wilson 2006, p.464)

5. VIRTUAL DESIGN AND SALES TECHNOLOGY

5.1 Online sales

Virtual technology plays an important role in clothing retail today, as consumers have access to nearly endless selections of goods through global e-commerce. The internet enables companies to sell products straight to end-consumers without third-party distributors. Business-to-business commerce is also easier and more cost-efficient through the internet. (Simchi-Levi et al. 2008, p.198)

Originally brick-and-mortar companies are adding internet shopping to their assortment. This kind of double-channel retailers may get an advantage against plain click-and-mortar retailers due to their already existing physical infrastructure. They can optimize their selection of goods by selling fast-moving, high-volume products with forecastable demand in-store and low-volume, slow-moving products online, as demand can be aggregated geographically with centralized stocking in the case of online commerce. (Simchi-Levi et al. 2008, p.201) This means that lack of demand for a certain product variation in a particular area can be balanced with demand in a different geographical area, as the inventory is shared. Aggregation of demand can decrease inventory risk.

In brick-and-mortar companies, retail space is allocated to a particular category. Each category must be productive to cover the resulting real estate costs. The offered size range is affected by the amount of retail space allocated to the certain product. E-commerce enables the offering of extra sizes online; for example special sizes from the smallest and largest end of the size range. (Gribbin 2014, p.12)

Price comparison has become easier and enables clients to make prince-conscious purchases. Prices can be compared worldwide, which adds transparency to product price setting. Smart pricing, meaning integrating pricing and inventory to influence market demand and improve profits, has been made more effective through the internet as well (Simchi-Levi et al. 2008, p.15, 401).

When purchasing clothing from online shops, customers are not able to feel or fit the clothing until their order is delivered. This results in high return rates; up to 30% of all online purchases and as much as 50% of specifically clothing purchases online are returned (Thomasson 2013; Banjo 2013). This can possibly result in only the generation of costs along with no profit for online shops, as customers may return all purchased products and still get free delivery and return.

To address the problem of unnecessary returns, many kinds of online applications have been created to simulate products sold online, so that the customer could form a realistic impression of the product and its fit. So far, many of the applications have displayed clothing in 2D. It is impossible to realistically simulate clothing in 2D, as clothing has so many aspects affecting the purchase decision. Gradually more and more 3D applications have become available.

Size protocols and therefore grade rules vary around the world; depending on the country the grade interval between two sizes can be somewhere between 1" and 2", or 2.5 cm and 5 cm. This sizing inconsistency can be problematic for global e-commerce, as customers may not be sure which size protocols are used in particular clothing lines and according to which one their usual size is. (Gribbin 2014, p.5-6)

E-commerce logistics creates its own challenge, as it needs individual shipments. Bulk shipments are not adequate when delivering straight to end customers. E-fulfillment requires short lead times, the ability to serve customers that are spread around the world and the ability to manage reverse flow when customers return products. Parcel shipping services are a way to achieve this, and even real-time tracking of orders is possible. (Simchi-Levi et al. 2008, p.202-203)

5.2 Virtual 3D design

Traditionally, clothing is designed either by sketching drawings or by the draping of fabric straight on to a mannequin, which is known as haute couture. In recent decades, the utilization of Computer-Aided Design (CAD), the use of computer programs for designing products, has become broadly used in the apparel industry. (Eberle et al. 2009, p.143; Meng et al. 2012)

Currently small production runs of possibly individually customized clothing are required; this brings challenges to the clothing design process, and adaptations are needed to fulfill the new dynamic requirements. (Olaru et al. 2014) The clothing design process can be improved by simulating clothing appearance in 3D form. Designers can evaluate the 3D clothing fit based on the 3D image. (Yu 2004, p.87) The simulation can be shown between the clothing product and the human body with wanted measurements in a 3D environment, and can include the effect of a certain body shape. Designers can make adaptations on patterns based on these simulations, without making physical prototypes. (Olaru et al. 2014) Solving fit issues with measurement and patterns in 2D is difficult; a 3D design platform with a simulated human body can make it easier. (Gribbin 2014, p.4, 14)

Clothing simulation enables more efficient and effective decision making in the product development and quality control processes. (Yu 2004, p.87) Apparel collections can be renewed quickly as clothing samples do not need to be sewn in between alterations.

(Olaru et al. 2014) Costs can be decreased, as the need for physical product samples is mitigated. The same 3D models of the products can be utilized in both the design and the sales and marketing process of the clothing. (Mustonen et al. 2013) 3D design technologies are an important tool for speeding up the time to market for clothing products and creating efficiency into the supply chain.

The 3D simulation of clothing is far from simple, as factors such as fabric drape need to be simulated. The drape refers to how the fabric falls down and shapes on a model or human body under gravitation. Different fabrics take different 3D forms, so the affecting parameters need to be determined for each fabric. (Frydrych et al. 2000) Typically it is impossible to simulate the absolute reality, but a substantial level of realism can be achieved. (Gültepe & Güdükbay 2014)

The main steps for body-product fitting simulation in 3D include visualization of cut parts, mannequin parametrization, simulation of sewing for product parts, visualization of the body-product system and the analysis of virtual correspondence. For example tension maps can be used to illustrate the correspondence. (Olaru et al. 2014) Traditionally designers have had to use real live models to understand how their clothes look on a human body; properties such as drape and reaction movement have an effect. The simulated clothing will realistically bend and change shape as the avatar poses. (Melendez 2013)

There are technologies available in 3D CAD systems for the automatic resizing of a designed clothing product to fit the varying body shapes of individual customers. This is needed when generating customized apparel products with personalized sizing. However, both the shape of the body and the intended shape and tightness of the clothing product need to be taken into account in the resizing process. (Meng et al. 2012)

5.3 Personalized avatars

Apparel fit creates a significant barrier to the growth of online sales; sales are restrained and amounts of product returns high. Different brands and different styles within a certain brand fit differently. As consumers consider themselves a certain size, it results in returns, lost customers, consumer frustration and dissatisfaction when the same size does not always fit correctly. (Gribbin 2014, p.3)

Clothing products are usually designed for bodies which do not represent the average body shape that the majority of people have. It is especially important how a brand communicates the intended fit of a product to the customer; for example classic, slim, and relaxed fit. An avatar is a virtual model, a 3D illustration of a human body. (Gribbin 2014, p.7) An avatar can be used to simulate clothing fit both in the e-commerce and product design environment. (Gribbin 2014, p.4, 14)

If the avatar is personalized to illustrate a certain customer´s body dimensions, the necessary measurements need to be obtained somehow. As it is difficult for customers to take and report accurate measurements of their bodies, a body scan may be a more precise way to obtain the wanted dimensions. These body scan measurements can then be turned into a 3D pattern that replicates the proportions of the scanned body. (Gribbin 2014, p.14-16) Body scanning, virtual fit evaluation and mass customization of products can change clothing sizing systems. (Ashdown 2014, p.18)

Trying on clothes is time-consuming, and not even possible in the case of online shopping. Virtual fitting rooms are being developed for both physical and online stores. The purpose of virtual fitting is to simulate the look and feel, and especially the size of a particular piece of clothing. A correct standardized size may be suggested based on the user´s measurements, or possibly simulated on a personalized avatar to help the customer choose the correct size. The avatar is scaled to reflect the body characteristics of the user, using data obtained from sources such as depth sensor cameras. (Gültepe & Güdükbay 2014)

A virtual fitting room usually has a virtual version of the product and a 3D avatar of the customer. These applications can help reduce the proportion of returns and increase the opportunity for customization, as customers can create and see their own customized products. Virtual fitting rooms in physical stores can enable customers to effortlessly try on many pieces of clothing. (Holte 2013)

6. SUPPLY CHAIN EFFECTS

6.1 Supply chain fundamentals

The supply chain typically consists of suppliers, manufacturing centers, warehouses, distribution centers and retail outlets, with raw materials, work-in-process and finished products flowing through these facilities. Supply chain management refers to the actions taken place to make the supply chain efficient and cost-effective across the whole system, from transportation and distribution to minimizing of inventories (Simchi-Levi et al. 2008, p.1). One of the challenges in the system wide optimization of the supply chain is that the players of the supply chain often have conflicting objectives, in terms of for example lead time or size of inventory.

Most importantly, the supply chain is a dynamic system; it is natural for it to evolve over time (Simchi-Levi et al. 2008, p.4-5). For these reasons, former offshoring should be seen as a certain phase of a supply chain´s development, not necessarily as an incorrect manufacturing location decision that is possibly corrected with the adoption of reshoring. Companies are now moving beyond cost savings on price, as supply chain – related factors are becoming more important in manufacturing location decisions. Companies are increasingly emphasizing product quality, profitability, total cost, brand, customer value creation and collaboration when making location decisions. (Ellram et al. 2013; Backing Britain: A manufacturing base for the future, 2014)

Based on the literature review conducted for this thesis, the most cited reasons in academic literature for reshoring are: quality, flexibility and responsiveness, manufacturing cost advantage changes, labor costs and transportation and logistics costs. A detailed listing of the occurrences for different reshoring reasons is shown in Appendix 1. The different factors in the supply chain are tightly tied together and have overlapping and interconnecting effects on each other, so accurately stating the most frequent individual reasons can be troublesome.

Reshoring is not generally expected from the apparel industry, as it is a particularly highly labor-intensive industry. However, it is no surprise that apparel is one of the top reshoring industries in the U.S. (as stated in Chapter 3.2), because it is beneficial for fashion companies to keep supply chains close to markets. New inventory and fashion can be brought to market more quickly than with overseas production. (Pasquarelli 2014) In many cases, the costs of labor-intensity and labor cost differences can be balanced with other savings or competitive advantages.

The top challenges in apparel retail are mostly supply chain –related. These challenges include: reducing out-of-stocks, lowering the cost of inventory, improving speed to market, enhancing customer satisfaction and maximizing sales. (Polvinen 2012) As much as 60% of garments are sold at a discount. (Wang 2014)

6.2 Uncertainty and risk management

Risk is defined as a calculation forecast emergence of negative events that cause loss of calculation forecast emergence of positive events which bring us benefits. When there is a risk, there is a possibility of negative deviations from the desired outcome. From a business perspective, risk is a failure of desired business objectives, including threats and opportunities. Risk consequences on the planned garment production are: exceeding estimated production costs, exceeding requested production dates and poor quality. (Colovic 2011, p.118-119) Supply chain disruptions can be costly, and the length of the supply chain increases the risk for these disruptions. (Bailey & De Propris 2014)

Uncertainty creates challenges for many supply chain operations; matching supply and demand, fluctuating inventory and back-order levels as distributor orders fluctuate more than retailer demand, forecasting precise demand is impossible. Also delivery lead times, transport times and component availability cause uncertainty. (Simchi-Levi et al. 2008, 5-6)

Cost reduction focused trends such as lean, offshoring and outsourcing increase the probabilities of risks as abnormalities can lead to shutting down production lines. Outsourcing and offshoring increase the geographical diversity of the supply chain (Simchi-Levi et al. 2008, p.5-6). A geographically diverse supply chain is more exposed to risks than local ones; the same risks are present as for domestic ones but in addition there are risks of global nature such as natural disasters, geopolitical risks, epidemics, volatile fuel price, currency fluctuations, port delays, market changes, supplier performance, forecasting accuracy and execution problems. Some of these risks can be controlled up to a certain extent; volatile fuel prices can be balanced by long-term contracts, and fluctuating exchange rates can be balanced with hedging strategies, where losses in one part of the supply chain will be offset by gains in another part. (Simchi-Levi et al. 2008, p.315-316, 320) A supply chain closer to the end market allows an increasing degree of control and security. (Repatriation of UK textiles manufacture, 2015)

Currency fluctuations create a significant risk, as they change the relative values of production and profit. These kinds of relative fluctuations can be witnessed domestically as well, because certain regions may be less expensive for production or storage. However, domestic cost differences are not as dramatic or frequent as global currency fluctuations. (Simchi-Levi et al. 2008, p.316)

Successful companies need three supply chain-related abilities. The first is the ability to match supply chain strategies with product characteristics, for example fast clock speed products and slow clock speed products need different supply chain strategies. Secondly, risk and uncertainty management is important. The third ability is to form globally optimized supply chains (Simchi-Levi et al. 2008, p.11).

Social and environmental risks should also be incorporated into risk management alongside economic risks. Companies are increasingly pressured by stakeholders to address social and environmental affairs. (Freise & Seuring 2015) These will be further discussed in Chapter 8 of this thesis.

6.3 Demand forecasting

Forecasting is not a good enough solution for truly balancing supply and demand. What forecasting can do three months in advance of demand is merely give an idea of how volatile demand might be, and what the range of demand values could be. (de Treville 2014) The three rules of forecasting and inventory management can be stated as follows (Simchi-Levi et al. 2008, p.57):

1. The forecast is always wrong.

2. The longer the forecast horizon, the worse the forecast.

3. Aggregate forecasts are more accurate.

The first rule implies that forecasts can never be correct. A forecast is solely an estimation based on certain factors. The second rule states that forecasting further away into the future makes the forecasting worse than forecasting to the near future. However, according to de Treville (2014), the lead time between make-to-order production and 30 days makes a relatively much larger impact on mismatch costs from faulty forecasts than the added mismatch costs from a lead time of 50-100 days. This is based on the cost differential frontier model for calculating mismatch costs; for more information concerning the CDF model, see Chapter 7.3. The third rule implies that it is possible to achieve more accurate forecasts with aggregating. In the case of demand forecasting, this means aggregating demand from for example several different geographical areas, so the demands that are higher or lower than expected can be balanced with demand from other areas.

Cooperative forecasting systems are utilized today to minimize the effect of bad forecasts. In this system, all the participants in a supply chain share and use the same forecasting tool and come to an agreed-upon forecast. (Simchi-Levi et al. 2008, p.164)

Due to the problematic nature of forecasting, it would be worth pursuing to minimize the time span between forecast and demand. The option of producing based on actual

demand, made-to-order (MTO), further minimizes the need for demand forecasting. Supplying parts for production still requires some forecasting.

6.4 Inventory

In many industries, inventory is one of the dominant costs. Inventory exists in different forms: raw material, work-in-process and finished product inventory. Inventory can be held to fulfill unexpected customer demand, balance uncertainty or long lead times or because of economies of scale from transportation companies. (Simchi-Levi et al. 2008, p.30-31)

Manufacturers aim for sales, especially without holding any storage or preproduction for a customer. Traditionally, the larger the production runs manufactured, the lower costs per unit of material are. The trade-off here comes from the growing costs of storage. (Colovic 2011, p.147-149) It needs to be determined, whether it is more profitable for a specific company to produce large lots of products and store them as inventory, or to produce smaller lots, even single products but with no storage phase. If products are made-to-order, there is no need for an inventory of finished products.

Working capital is tied up in inventory during slow and long ocean transit and in safety stocks. (Tate et al. 2014) It is problematic as the funds tied up in inventory do not provide any additional value to the company. (Hutzel & Lippert 2014) Inventory causes risk as it might lose its value. Usually forecast demand is wrong, meaning that some inventory will be left over or sales have been lost. (Simchi-Levi et al. 2008, p.57) Companies often leave out the calculation of inventory carrying cost when considering offshoring. (Production´s coming home: what companies need to know about reshoring 2014) When supply chains are close to markets, new inventory can be brought to shelves more quickly than in overseas production. (Pasquarelli 2014)

6.5 Customer value

In the consumer-driven market, the most important factor is not the product or service itself, but the way a customer perceives the entire company´s offerings, such as products, services and other intangibles. Most importantly customer value defines why the customer chooses a certain company´s product over another company´s product. This choice is also affected by the company´s image and brand. Creating customer value is actually the driving force behind a company´s targets. (Simchi-Levi et al. 2008, p.368-369, 385)

Supply chain management is an essential part of fulfilling customer needs and providing value. For example, when personal customization of products is offered to customers, the manufacturing company needs to have a supply chain that is flexible enough to offer this kind of products. The supply chain can provide competitive advantages that can

lead to increased customer value. Customer value can be measured for example through these three criteria: service level meaning the ability to satisfy a customer´s delivery date, customer satisfaction and supply chain performance measures. (Simchi-Levi et al. 2008, p.368, 380-381)

The manufacturing location can create customer value for customers in the same region. (Ellram et al. 2013) A study was conducted by Grappi et al. (2015) to research consumer stakeholder responses to reshoring strategies, for finding effects of reshoring on consumer reactions. The study suggests that reshoring should be considered from the perspective of the public in the home country, as well as the internal perspective of the company. The research group found that consumers see reshoring as morally commendable, and this motivates them to change behavior towards reshoring companies in a positive way. A boundary condition was consumer awareness of the beneficial returns of a reshoring strategy.

According to Grappi et al. (2015), reshoring can be seen as a way to enhance the company´s image with consumers. Consumers consider reshoring as a positive decision, and are motivated to reward reshoring companies. However, consumer awareness of reshoring should be raised. It is important for companies to develop efficient communication strategies to emphasize consumer emotional and behavioral reactions.

Consumer emotional reactions and behavioral reactions are affected by: perceived company motives for reshoring, the individual characteristic of consumer ethnocentrism and the degree of consumer awareness of reshoring. Consumer reactions can be shaped by the way in which companies communicate motivation about their reshoring strategy. The moral considerations consumers had towards offshoring and reshoring were: jobs in the home country, exploitation of labor in low-cost countries and taking advantage of lax environmental regulations abroad. (Grappi et al. 2015)

The improvement of a company´s brand is one of the benefits of reshoring, but it is not clear how much more customers are willing to pay for the additional value of a domestically made product. (Van den Bossche et al. 2014) For example, according to an industry report from the Made in USA Foundation, cited in (Goldman 2014), 75% of Americans are willing to pay an average premium of 16% for American-made products. Quality and sustainability are among the factors that encourage customers to buy domestically produced goods. (Pasquarelli 2014)

6.6 Quality

The definition of quality according to the American National Standards Institute is “The total features and characteristics of a product or service that bear on its ability to satisfy a given need”. Technical properties, user-friendliness, ease of maintenance, delivery agreements and packaging instructions are some quality aspects. Quality control aims to

objectively demonstrate and make sure that quality requirements are met. Quality issues can generate different kinds of unwanted costs that can be divided into three categories: prevention costs, assessment costs and correction costs. (van Weele 2005, p.192-193)

Consumers have different interpretations of quality. The consumer does the quality assessment of a garment in two phases: first when deciding whether to buy the product or not, focusing on aesthetics and second after the product has been used. The second assessment is based on durability, comfort, response to care and appearance retention. (Rosenau & Wilson 2006, p.282-283) Low price cannot compensate for poor quality and the effect it will have on a company´s reputation. (Rosenau & Wilson 2006, p.385)

In the case of apparel, quality conscious consumers require that their clothing satisfy their requirements and expectations in terms of appearance, fit and comfort, both when new and for an acceptable wear period. (Hunter & Fan 2004, p.89) An initially approved piece of clothing is often discarded when an unacceptable deterioration or change in appearance happens. These changes include loss of shape or fit, surface degradation, color change, change in handle and pilling. (Fan 2004, p.15)

Quality is the most frequently cited reason for reshoring in academic literature (see Appendix 1). High product quality is easier to maintain when producing locally. (Martínez-Mora & Merino 2014) In the case of offshoring production, quality control and coordination costs are high; the expenses for ensuring quality are often underestimated. (Kinkel & Maloca 2009) Research by Kinkel (2012) also nominates quality problems as the most frequent reason for reshoring in German manufacturing companies. Transferring the correct quality requirements to offshore manufacturers can turn out to be troublesome (Gylling et al. 2015). Possible quality claims are also less costly to deal with if the manufacturing location is in proximity to the demand location (Sarder & Nakka 2014). Returning manufacturing rejects for repairing can be difficult with offshore production. (Gibson 2014) Quality levels may start to fall compared to the original sample, and third party suppliers may be used secretly. (Gibson 2014; Coates 2010)

In manufacturing, quality is affected by both the materials and the processes used to manufacture a product. It is important to qualify acceptable vendors and make sure that purchased parts comply. (Hutzel & Lippert 2014) Control, traceability and assurance that activities are performed correctly every single time are an important part of quality as well. The proximity to customers also speeds up feedback from the market and can result in tighter quality control and therefore better quality products. (Ford 2014)

Domestically produced products in other than low-cost countries are often perceived as higher quality products by customers. This can result in consumers willing to pay more for these kinds of products. Quality control is indeed improved when a domestic

company produces locally, as opposed to the situation of producing offshore. (Goldman 2014)

6.7 Innovation

Local manufacturing is essential for innovation. (The Economic Case for Reshoring, 2015) The synergy between manufacturing and the research and development department should not be underestimated. Innovation has an effect on product quality, ability to innovate before rivals and speed to market. (Production´s coming home: what companies need to know about reshoring 2014) Innovation works best when the R&D department is able to collaborate with the production department.(de Treville 2014) When manufacturing and design operations are located separately, the physical and cultural distance can make innovation suffer. (Tate et al. 2014) Some ideas may be lost when there is distance between production and R&D (Hutzel & Lippert 2014). Samples can be reviewed and turned more quickly with local production in both apparel and other industries; this also speeds up the product design process. (Goldman 2014)

Innovation and R&D are important for developing new, improved or differentiated products or services, which can lead to increased demand for goods and services and act as a driver of non-price competitiveness. These efforts can also make the production process more efficient, for example with the help of new technology or organizational solutions. (European Competitiveness Report 2014: Helping Firms Grow) Innovation enables designing products that make suppliers able to solve their customers´ problem with exactly the product needed. (The Economic Case for Reshoring)

6.8 Lead time

Lead time refers to the time that elapses between the placement of an order and the receiving of the order. In competitive situations, both the length and reliability of the lead time is important. (Sürie & Wagner 2008, p.54) The delivery lead time is affected by the lead times of purchasing, manufacturing and transportation, which are triggered by a customer order. Competitiveness requires keeping the lead time short enough to please the customer. (Hammami & Frein 2013)

The increasing of lead time in offshore production is an important motivation for reshoring. A longer lead time reduces flexibility and creates the need for high inventories to prepare for uncertainty before the arrival of another order. (Sarder & Nakka 2014) There is a correlation between inventory and lead time, as inventory tends to increase when lead times are longer, as companies need higher safety stocks to preserve the same service level. (Baldassarre & Campo 2014) However, larger inventories increase costs, so there is a trade-off between inventory costs and the level of customer service. (Jacobs et al. 2011, p.36) The trade-off can be improved with better estimates of demand, more rapid transportation alternatives, speedier production,

more flexible manufacturing and therefore a shorter lead time. (Sarder & Nakka 2014; Jacobs et al. 2011, p.36)

Transportation time has a high impact on the total lead time. A long transport distance increases both the lead time and the transportation costs. (Sarder & Nakka 2014) When producing locally, companies can be more responsive to actual customer behavior. (Wang 2014) This can mean in-season trading to respond quickly to latest trends. (Repatriation of UK textiles manufacture, 2015) When the company is located close to the consumers, it is easier to pick up current consumer trends. (Gylling et al. 2015)

To demonstrate the kind of transport times associated with ocean freight, sea distances and transport times to Helsinki, Finland from different low-cost production locations are gathered into Table 3. Merely the transport time from Shanghai, China to Helsinki is almost 34 days. The lead time also includes for example product specifications and production, so the total lead time is much longer than only the transport time. The transport time alone is so long that forecasting is likely to be needed for estimating demand in advance, in order to achieve an adequate level of customer service.

The shortest transit time of the displayed times in Table 3 is the time from Mumbai, India to Helsinki; which is still as long as 21 days. As stated in (de Treville 2014), the most important difference concerning mismatch costs actually happens between made-to-order and the lead time of 30 days. The additional costs between a 50 and 100 day lead time are not relatively as significant. This cost generation will be further discussed in Chapter 7.3. Table 3 shows that solely the transit part of the lead time from low-cost countries approaches the 30 day limit. A long lead time is especially problematic for fashion companies with time-sensitive products. (Knowler 2015)

Table 3. *The transport times and ocean transit distances to Helsinki, Finland from the different low-cost locations presented in Desai et al. (2012). Distances shown in miles and kilometers. Data retrieved from Seareates.com (Transit Time, Distance calculator & Port to port distances).*

	Helsinki, Finland		
Shanghai, China	21007.40 km	13053.39 mi	33 days 18 hours
Dhaka, Bangladesh	16288.22 km	10121.03 mi	26 days 4 hours
Mumbai, India	13352.89 km	8297.10 mi	21 days 10 hours
Sihanoukville, Cambodia	18125.08 km	11262.40 mi	29 days 3 hours
Karachi, Pakistan	13007.88 km	8082.72 mi	20 days 21 hours

Consumers are demanding increasingly shorter lead times. Reshoring is especially worthwhile when short lead times are needed. (Repatriation of UK textiles manufacture, 2015) Shortened lead times reduce the complexity of monitoring a global supply chain and decrease the importance of long-term forecasting. Inventory turns are also improved

and the risk of supply chain disruptions decreases as well with shorter supply chain distances and lead times. (Moser & Kelley 2015) Managers can often underestimate the costs originating from long lead times. (de Treville et al. 2014b) The costs associated with longer lead times will be further assessed in Chapter 7.

The responsiveness of a supply chain describes the ability of the whole supply chain to react to changes in the market. Actions are needed in an appropriate time frame to react to essential changes happening in the operational environment to ensure competitiveness. Flexibility measures can be used to quantify the responsiveness of a supply chain. (Sürie & Wagner 2008, p.54)

Responsive supply chains are needed with high-variability products like fashion items. This is due to the fact that the demand associated with high-variability items can cause large costs when sales are lost or excess inventory is held. Responsive supply chains stress short lead times, flexibility and speed, over cost efficiencies. (Simchi-Levi et al. 2008, p.370) Operating in a highly uncertain environment also requires responsiveness from the supply chain. (Gylling et al. 2015)

Speed to market is a growingly important factor as customer-centric strategies are becoming more important; manufacturers need more flexibility to respond to customer requirements. (Backing Britain: A manufacturing base for the future, 2014) Flexibility is a strategic competitiveness factor, which is reduced by longer lead times. (Kinkel & Maloca 2009; Sarder & Nakka 2014) This means that shorter supply chains are becoming growingly important as well. Reshoring allows responsiveness to demand fluctuations through local production; the loss of flexibility and responsiveness in offshoring is one of the most important reasons and motivations for reshoring (see Appendix 1). Research suggests that local market products should be manufactured locally. (Coates 2014)

It can be impossible to fulfill 100% of customer orders when customer demand is uncertain. This is why an acceptable level of service needs to be determined. (Simchi-Levi et al. 2008, p.33) In the case of products being manufactured based on customer order, when there is no ready-made stock, the most important customer service angle is to meet promised delivery dates. The time from order placement to delivery, the lead time, is important. (Jacobs et al. 2011, p.416) Closer proximity to customers can increase the customer service level. (Sarder & Nakka 2014)

As lead times can be shortened through reshoring, this would enable a broader use of mass customization as a production method. Products can be produced locally based on demand, and also the benefits from mass customization to both customers and companies can be achieved. (Moser & Kelley 2015)

6.9 Production lot sizes

Chinese and other low-cost country factories are designed to handle to large volumes. (Knowler 2015) Small and mid-sized companies may have trouble reaching production minimums and on the other hand, gaining leverage with offshore factories. (Goldman 2014) The increasing need to tailor products to consumer demand, mass customizing, requires late-stage, near-market customization. (Rice & Stefanelli 2014)Reshoring allows the production of small production runs or individual products.

As a result of the economic down-turn, demand patterns have changed. For example shoe retailers do not order large quantities at once, but rather smaller batches more often. Retail stores do not order the total quantities they expect to sell; instead they order smaller quantities of different models and place additional orders if sales are favorable. (Martínez-Mora & Merino 2014) This kind of operating model requires the company to be able to either manufacture or hold inventory of replenishments. Due to the economic down-turn, also total demand levels have fallen; this has again created the need to reconsider the location for manufacturing due to production amounts. (Dachs & Zanker 2014)

A change in distribution patterns has been observed by Martínez-Mora and Merino (2014) as well. This is due to the emergence of the 3rd and 4th season in addition to an updated collection half way through a previous season, as opposed to the traditional two seasons in fashion. Manufacturing of the required production volumes is unfeasible in China, and short and frequent delivery times are needed.

Transportation of small production batches from overseas locations is not favorable, as shipping containers must be filled. As the shipping is longer than from local factories, it does not fit the new demand and distribution patterns either. (Martínez-Mora & Merino 2014) Long distances in the supply chain demand transportation in large batches, for example to achieve full container loads. (Baldassarre & Campo 2014)

Local production is appropriate for time-sensitive fashion products which require small production batches. Large batches can decrease unit production costs, but bring other potential costs to the supply chain. (Desai et al. 2012) Smaller batches of products that sell at full price are most likely better than large volume batches that need to be sold at discount. (Wang 2014)

6.10 Strategic applications

In (The Economic Case for Reshoring, 2015), de Treville suggests a manufacturing strategy combining time-sensitive and in-sensitive products to get the most out of reshoring and responsiveness, in order to achieve maximum profitability and competitiveness. Managers are willing to bring the production of time-sensitive

products to a local supplier after seeing the true mismatch costs of offshoring, but still keep the production of time-insensitive products at the cheapest possible supplier, albeit located offshore.

The alternative strategy consists of manufacturing both time-sensitive and time-insensitive products in the same local manufacturing facility. As being responsive requires extra manufacturing capacity, the time-sensitive product needs to be profitable enough to cover the fixed costs of the needed capacity buffer. When the extra capacity is not needed, it can be used to produce time-insensitive products into stock. As the fixed costs are already covered by the time-sensitive product, the local manufacturing of also the time-insensitive product is more profitable too. (The Economic Case for Reshoring, 2015) This kind of production mixing is suitable for companies that manufacture both kinds of products.

Reshoring can also be an important part of a lean strategy, which aims to improve design, eliminate waste, improve quality and increase productivity. (Moser & Kelley 2015) Producing locally in relation to the market contributes to a lean and agile strategy (Moser & Montalbano 2015). Lean philosophy is an attempt to eliminate costs by innovating to improve efficiency and reduce waste across the whole business system. (Cousins et al. 2008, p.17) It combines the elements of a low-cost strategy with the benefits of differentiation strategy (van Weele 2005, p.143), and involves producing goods and services utilizing significantly lower levels of input such as materials, time, labor and space, and at the same time avoiding all forms of waste. (Cousins et al. 2008, p.204) Lean manufacturing strategies can help achieve higher service levels for a given inventory investment. (Jacobs et al. 2011, p.36)

Offshoring has some negative effects on the seven Toyota wastes of the lean philosophy. These wastes include: overproduction (large batch shipment, filling containers), waiting (uncertain deliveries, inconsistent quality, port, and customs), transport (long distances, unfilled return boats), over-processing (more packing and unpacking, customs paperwork), inventory (in transit, safety stock, less ability to check and count), motion (repetitive motion injuries, additional labor to compensate) and defects (higher than local sources, extra inspection of materials and tolerances). (Moser & Kelley 2015)

Flexible manufacturing is often seen as a component of lean manufacturing and quick response (QR). In QR lead times and costs of labor, materials and inventory are minimized. Flexibility and production velocity are emphasized. (Jones 2006, p.158-159) As stated in Chapter 4.2, fashion needs a quick response strategy. Flexibility is one of the top reasons for reshoring (see Appendix 1), so reshoring could be an appropriate action for fashion production.

An agile supply chain is a step further from lean and responsive supply chains. A common view is that lean philosophy works best when demand is relatively stable and therefore predictable, and variety is low. When demand is volatile and variety high, elimination becomes a lower priority than responding rapidly to turbulence in the marketplace and maintaining consistent lead time. Speed capabilities are elevated in agile supply chains. (Harrison & Hoek 2008, p.203-205)

The most important components of agile supply chains are customer responsiveness, considering the supply chain as a network of partners who share a common goal, viewing the network as a system of business processes and the sharing of data between buyers and suppliers with the help of information technology, creating an information-based virtual supply chain. (Harrison & Hoek 2008, p.204-205) Reshoring production would contribute to achieving an agile supply chain through enabling shorter supply chains where manufacturing, engineering and customers are all located close together. (Moser & Kelley 2015)

The motivation for reshoring in the textile industry is strongest for high-end, mid-market apparel, fast fashion, luxury clothing and homeware. Products that can be manufactured through automation, for example hosiery and socks are also possible candidates for reshoring. (Repatriation of UK textiles manufacture, 2015) Some apparel categories can benefit more than others from reshoring; small or mid-sized contemporary fashion and premium denim and suits, accessories and specialized or localized products. (Goldman 2014)

The ViMA Alliance, with members such as AM4U, Monti-Antonio, Gerber Technology, Eton Systems, Optitex, ErgoSoft, Caldera, Allied Modular Build Systems, TC^2, SGIA and Cal-Poly Pomona Department of Apparel Merchandising and Management, has created a concept for incorporating an entire garment manufacturing capability from design to finished products into a fully integrated mini-factory. Order processing, design, pattern and marker generation, dual-sided dyeing, printing, labeling, optical cutting, robotic handling, sewing, finishing and shipping are all performed in a single automated and integrated mini-factory. (Manufacturing Technology Behind ViMA's PAM, 2015)

The mini-factories utilize the PAM (Purchase Activated Manufacturing) and Demand Manufacturing approaches. The PAM approach consists of manufacturing only after the order is placed and payed for by a customer. This means that there is no need for an inventory of finished goods. In the demand manufacturing approach, dyeing or printing of fabric is only done when needed, to replace retail consumption, not for stock. (Manufacturing Technology Behind ViMA's PAM, 2015) This is much quicker than placing forecasted orders overseas, first to separate dye houses and printing companies. (Grier 2013) The short production cycle time in the mini-factory allows manufacturing to happen on-demand. (Manufacturing Technology Behind ViMA's PAM 2015) These

mini-factories are especially suitable for domestic manufacturing in developed countries, near customers – hence suitable for reshoring production. The better gross margins from removing inventory costs, carrying charges, tariffs and transportation and most markdowns can compensate for the possibly increased cost of production in a domestic factory (Grier 2013).

Also the sportswear company Adidas has introduced the idea of a global network of mini-factories, in the form of the Speedfactory project. The increasing demand for different product variants and features is making shorter supply chains necessary. Adidas is aiming to react faster and with more flexibility through local production, near or within markets. The small factories would form movable production networks all around the world. Decentralized production structures could focus on regional demand, and bring better security against natural disasters and wars as all production is not at the same place. (Production goes to the customer, 2014)

Network production needs data streams for better communication, coordination and control. The target of the Speedfactory project is to find out whether this kind of production network with local mini-factories could work for Adidas. (Production goes to the customer, 2014)

7. COST ANALYSIS

7.1 Costs in general

The performance of apparel companies can be determined using indicators such as gross margins and sell-through rates. However, the prime determinant of success is in fact net income or earned revenue beyond the related costs - as in most business enterprises generally. Total sales are undeniably important for the generation of revenue, but it is often the costs that actually determine profit or loss. (Rosenau & Wilson 2006, p.241) This is the reason why the costs related to production and location will be analyzed in its own chapter in this thesis.

The cost of apparel goods is formed by combining the material costs + direct labor costs + manufacturing overhead + transportation costs. Manufacturing overhead costs can include indirect costs such as management, maintenance, support staff, designers and product developers, energy costs and building rental costs. Other costs that should also be taken into account are sales and administrative staff (about 10% of labor), material rejects (3%), agent fees (4% of total garment costs) and tariffs. (Desai et al. 2012) An example for the cost of manufacturing a women´s dress is displayed in Table 4.

Table 4. *An example of the cost formation for a women´s dress. (Rosenau & Wilson 2006, p.243)*

Women´s dress	
Fabric	$6.27
Trimming	$1.33
Labor& Overhead	$6.85
Cost	**$14.45**

If a company uses a domestic contractor, the cost is formed by the full package price charged by the contractor or CMT (cut, make, trim) + material cost. In the case of offshore production, the cost is formed by the Landed Duty Paid (LDP), which comes from (CMT + material cost) or (full package) + freight cost + import duties + brokerage expenses. (Rosenau & Wilson 2006, p.241)

7.2 Total Cost of Ownership

The total cost concept involves adding up all the costs that are created along the way when raw materials become finished products and are transported to the consumer. Sub-optimization of different stages is reduced when executing this concept, as actions that achieve cost reductions at one stage but form off-setting cost disadvantages in another, are excluded. (Jacobs et al. 2011, p.399)

The concept of total cost emphasizes that the purchase price should not be the only factor affecting purchase decisions. The decisions should be cost-oriented; this way logistics parameters such as inventory turnover, supplier delivery reliability and supplier reject rate can be taken into account. This leads to better integration between the logistics and purchasing departments. (van Weele 2005, p. 242) However, some supply chain professionals are rewarded based on the purchase price of the product, not the total cost considerations. This may have an effect on the willingness to make reshoring decisions based on total cost. (Deligio 2014; Asefeso 2014) This problem would easily be mitigated by changing rewarding bases in purchasing departments.

The savings that can be achieved on non-manufacturing costs when producing in the market where the products will be sold, can often overcome a manufacturing cost gap of 15-25%. The American Reshoring Initiative provides a Total Cost of Ownership (TCO) calculator, which takes into account all the relevant costs associated with making or sourcing a product domestically or offshore. (Moser & Montalbano 2015) The calculator incorporates 36 cost factors, and based on them, determines whether it is cheaper to manufacture domestically in the case of U.S. production, or to manufacture offshore. (Markowitz 2012) The cost factors include: current period costs and estimates of relevant future costs, risks and strategic impacts; for example transportation costs, travel and expense time, overhead, corporate strategy, opportunity cost due to delivery and quality, warranty, IP loss, impact on product innovation and supply chain risk. (Moser & Montalbano 2015; Markowitz 2012)

The American clothing company American Giant based in California reshored production from Asia to the U.S. They source materials and manufacture clothing such as polo shirts and sweatshirts, and then sell directly to customers. By operating in this way, whole sale costs are eliminated. The company´s cost comparison for manufacturing a hooded sweatshirt in the U.S. and Asia is displayed in Table 5. The company managed to find cheaper high-quality fabric in the U.S. than in Asia, yet there is a remaining cost difference of 21% in favor of Asian production. The company still considers manufacturing in the U.S. as the best overall option, as they do not compete solely on price. They faced other problems with production in Asia, including currency fluctuations, longer lead times, higher financing costs and inventory-management costs and also unclear communication. (Wren 2013)

Table 5. *The cost formation for a hooded sweatshirt manufactured by the company American Giant. Table adapted from two sources. (U.S. Textile Plants Return, With Floors Largely empty of People 2013; Wren 2013)*

	U.S.A.	Asia
Total time to market	30-60 days	90-180 days
Fabric	$17.40	$18.40
Trim & hardware	$3.20	$2.30
Labor	$17.00	$5.50
Duty	0	$3.50
Shipping	$0.50	$1.70
Total	*$38.10*	*$31.40*
Cost difference	***21%***	

Table 6 contains another cost and profitability comparison. It demonstrates the cost and profit formation of a pair of leggings manufactured and distributed both through the traditional demand and supply concept and through the concept of domestic Purchase Activated Manufacturing (introduced in Chapter 6.10) in the U.S. The PAM concept involves domestic manufacturing with no markdowns as there is no excess inventory when the product is manufactured only after it is purchased by a customer. As the product is manufactured domestically and delivered straight to the customer, there are no duty, freight, customs, inland transport or private label importer costs. This comparison indicates that there is special potential in domestic on-demand manufacturing.

Table 6. *The costs and profits for a pair of leggings manufactured and distributed using the traditional demand and supply concept and the Purchase Activated Manufacturing concept. (AM4U_PAM Profitability Comparison 2014)*

	Traditional Demand & Supply	**Purchase Activated Manufacturing**
Retail price	$50.00	$50.00
Fabric	$6.21	$6.21
CMT (Cut, Make & Trim)	$4.14	$7.43
Duty	$2.07	$0.00
Freight	$0.62	$0.00
CIT (Customs clearance & Inland Transport costs)	$0.29	$0.00
PLIPM (Private Label Importer Price Mark-up)	$6.67	$0.00
Wholesale	$20.00	$13.64
Wholesale markup	$29.00	$0.00
Average actual selling price	$33.33	$50.00
Gross profit	**$3.34**	**$36.36**

7.3 Cost Differential Frontier

Companies have started to question whether the offshore cost differential is big enough to compensate for the costs of an extended supply chain. Using offshore suppliers increases the time between order and delivery, therefore forcing the company to operate based on forecasts. Mismatch costs arise when companies end up with too much product or not being able to fulfill customer demand because of stock-outs. These mismatch costs are extremely hard to quantify and therefore difficult to incorporate into decision-making. Local manufacturing is justified when the mismatch costs are higher than the cost differential achieved with offshore production. (de Treville 2014; Helper 2014)

Forecasts are not an efficient enough solution to mismatch costs, as forecasting for example three months in advance can only give an idea of how volatile demand will be and what is the range of demand values the company needs to be prepared for. If the order has to be placed three months in advance, the range of demand values to prepare for, hence the demand volatility, increases as the time between order placement and demand occurrence increases. This adds to the risk of stock-outs or over-stocks. (de Treville 2014; Helper 2014)

The cost differential in this context refers to the lowest percent unit-cost reduction that compensates for risk exposure for the profit-maximizing order quantity. When several cost differentials are combined together into an indifference frontier, this shows the change in the cost compensating for increases in lead time. The cost differential frontier (CDF) helps decision makers see where and when lead time reduction pays off. (de Treville et al. 2014a)

Lead times affect exposure to demand risk; short lead times reduce and long lead times increase demand risk. A model for calculating the required cost differential to compensate for the risk exposure coming from lead time has been developed by de Treville et al (2014a). The model demonstrates the potential value of lead time reduction.

The value of lead time reduction depends on the term structure of the supply chain risk. The term structure of supply chain risk premiums has several determinants: the demand volatility, the volatility of demand volatility and the tail index of demand. The de Treville model concludes that the marginal value of time increases with demand volatility, and with the volatility of demand volatility. The greatest value of lead time reduction is achieved when lead time is reduced enough to allow made-to-order production. (de Treville et al. 2014a) However, as the de Treville model does not consider all supply chain costs, the resulting marginal value of lead time is even lower than in reality. (de Treville et al. 2014b) The model only covers mismatch costs, which are formed when the order decision has to be made before we know actual demand. (de

Treville 2015) Other additional costs could arise from the increase in supply risk, losing of process innovation and the risk of intellectual property loss. (de Treville 2014)

Table 7 presents calculations from (de Treville 2015), formed using the de Treville model to analyze whether the product should be manufactured locally or by a low-cost producer. The salvage value is the value that the company can get from the product if it is not sold during its selling season. The cost reduction refers to the offered percentage saving in production price, offered by the low-cost producer. Volatility refers to the volatility of demand, which describes how much variation is in the demand 10 weeks in advance of when the demand actually occurs. This variation represents the range of demand values the company needs to be prepared for. 10 weeks is the required lead time when using a distant low-cost producer. (de Treville 2015; de Treville 2014) The corresponding coefficient of variation is the volatility divided by the average demand. The coefficient of variation measures the degree of the variability of demand in relation to the average demand; how much demand varies compared to the average value. (Simchi-Levi et al. 2008, p.48)

The de Treville model calculates how much cheaper the distant low-cost supplier would have to be to compensate for the mismatch costs that arise from the increase in lead time and demand volatility. The required cost differential indicates the needed cost reduction from the low-cost producer. (de Treville 2015) The circumstances shown in Table 7 would favor local production, as the required cost differential is greater than the cost reduction offered by the offshore supplier.

Table 7. *An example of a cost comparison calculated with the de Treville model. Table formed based on (de Treville 2015). The required cost differential is greater than the offered cost reduction, so local production should be favored.*

	Local	Low-cost producer
Lead time	short (enough for MTO)	10 weeks
Selling price	$100	$100
Salvage value	$20	$20
Production cost	$44	$38
Cost reduction		15%
Volatility	34%	
Coefficient of variation	35%	
Required cost differential		>**18%**

In Table 8, it is shown that as the volatility and coefficient of variation increase, as could happen for example in the case of a fashion product, the required cost differential increases as well. As the volatility increases to 70% and coefficient of variation to 80%, the required cost differential rises to over 30%, as opposed to the cost reduction of 15%.

Table 8. *Increased volatility increases the required cost differential, emphasizing that the choice of local production is better. (de Treville 2015)*

	Local	Low-cost producer
Lead time	short (enough for MTO)	10 weeks
Selling price	$100	$100
Salvage value	$20	$20
Production cost	$44	$38
Cost reduction		15%
Volatility	70%	
Coefficient of variation	80%	
Required cost differential		**>30%**

Table 9 presents a situation where the salvage value for the product with the increased volatility is decreased to half of the original value, from $20 to $10. This also has an effect on the required cost reduction, increasing it to more than 40%.

Table 9. *When salvage value is decreased, the required cost differential is further increased. (de Treville 2015)*

	Local	Low-cost producer
Lead time	short (enough for MTO)	10 weeks
Selling price	$100	$100
Salvage value	$10	$10
Production cost	$44	$38
Cost reduction		15%
Volatility	70%	
Coefficient of variation	80%	
Required cost differential		**>40%**

The de Treville model has been applied into a publicly available calculator. The Cost Differential Frontier Calculator answers the question "How much cheaper does a longer lead time supplier have to be to compensate for the increase in demand-volatility exposure?" (OpLab | Cost Differential Frontier, 2015). The calculator works as a framework to estimate total inventory costs and risks. Users can quantify potential savings achieved with reducing lead time in conjunction with other factors; this demonstrates how long supply chains and uncertainty add hidden costs. (Helper 2015)

The CDF tool forms a curve incorporating the relative lead time and required cost differential. An example of this curve is shown in Figure 10. The relative lead time on the horizontal axis of Figure 10 refers to the proportion of the maximum lead time under consideration. (de Treville et al. 2014a) The vertical axis indicates the required cost

differential. The price refers to the price that is received when selling one unit of the product. The make-to-order cost is the cost of one product unit produced with a lead time that is short enough to enable production based on actual demand. The residual value is the value of a product that is not sold during its demand period and is therefore left in inventory. The leftover product must be liquidated at a salvage price that is below the cost of the product. The critical fractile is the service level that offers the best balance between over-stocking and losing sales. The minimum service level is the lowest service level that fulfills the wanted customer service objectives; this might be set to a higher level than the critical fractile. The customer service objectives are evaluated by the fill rate, which is the percent of demand that is fulfilled straight from stock. The CDF tool calculates the minimum fill rate achieved with all lead times. Also the critical fractile for the relative lead time 0 (make-to-order) is calculated by the CDF tool. The volatility parameter can be calculated based on the coefficient of variation of historical demand data. If historical data is not available, a separate volatility calculator is available attached to the CDF tool. It is used by filling in the peak demand as a multiple of median demand and the frequency of the peak demand during the demand period. (Oplab | Cost Differential Frontier)

In the example situation from the CDF calculator in Figure 10, the price is 100, make-to-order cost 44, residual value 20, critical fractile 0.70, minimum service level 0.7, fill rate 0.93 and volatility parameter 0.5. It can be seen that at a relative lead time of 1 (the longest considered lead time), the required cost differential from the vertical axis for the example case is 27%. (Oplab | Cost Differential Frontier) The CDF calculator is being taken to use by the U.S. Department of Commerce to complement other reshoring support tools such as the TCO calculator, mentioned in Chapter 7.2. (de Treville 2014)

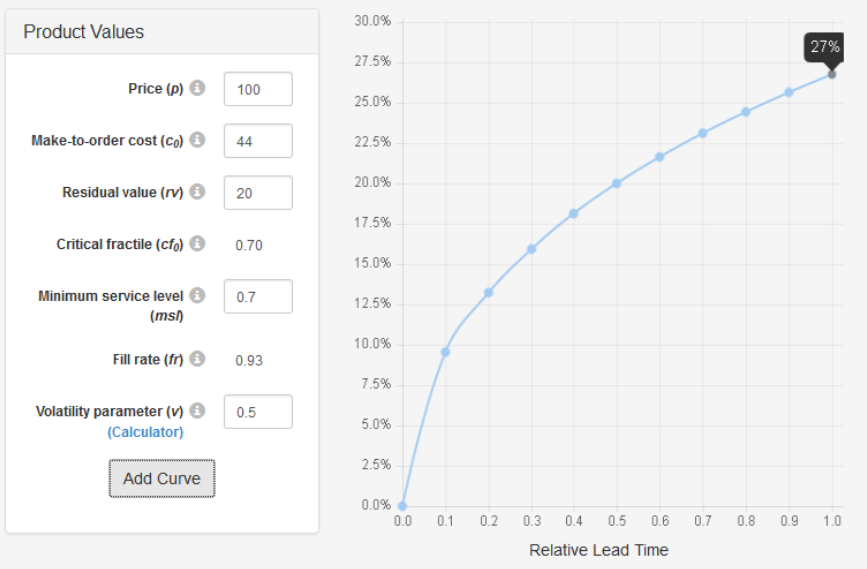

Figure 10. *CDF calculator, screen capture from (OpLab | Cost Differential Frontier).*

Savings achieved with offshore production need to be significant, at least 20% or more depending on the circumstances, to compensate for the mismatch costs that are created between supply and demand. (Helper 2015) The cost differential required to compensate for the increased demand volatility increases in lead time. However, there is seldom a large difference with mismatch costs between a 50 day and a 100 day lead time; the time that really matters in terms of mismatch costs is the time between made-to-order and 30 days, as this is when the most significant change in mismatch costs happens. (de Treville 2014)

In a further study the de Treville model was extended to incorporate additional factors: tender-loss risk (a production order is lost, for example a 10 month lead time but 2 month notice), demand clustering (clustered info on demand arrivals coming from campaigns and order batching) and target fill-rate. All of these additional factors increase the marginal value of time. (de Treville et al. 2014b) Using local producers and reshoring production can be a very competitive alternative to cheap offshore suppliers with long lead times if the local producer is able to produce according to accurate demand information. It should be noted that being local does not alone guarantee short lead times. (de Treville et al. 2014b)

7.4 Hybrid system cost model

In their research, Desai et al. (2012) divide and compare apparel production in two systems; the dominant system and the fast fashion hybrid system. The dominant system comprises of season-based production which is traditionally offshored to distant lower-cost countries. The fast fashion system contains continuously updated designs, short product cycles and therefore a reduced percentage of unsold items. This results in materials savings and less waste. Two important characteristics in the fast fashion system are: quick response (shorter production runs and distribution lead times aimed at better matching supply with demand) and enhanced design (highly fashionable products). The fast fashion system defined and analyzed in the research (Desai et al. 2012) most importantly involves domestic production in the U.S. for the U.S. market.

To determine which of the two fashion production systems is more attractive in terms of financial conditions, a model was developed in Desai et al. (2012) for examining operational profitability. The research includes a hypothetical cost-based analysis where costs are simply subtracted from revenues. The formation of costs and revenues is complex. (Desai et al. 2012) The model and formation of the figures will be introduced further in this chapter to introduce the factors affecting the profitability of the offshoring model and domestic hybrid system, which can be affiliated with production reshoring.

The basic process flow for the dominant system is as follows: fabric purchasing, apparel manufacturing in a distant low-cost country and finally ocean freight transportation to the U.S. The low-cost countries used as examples in the model are China, India, Pakistan and Cambodia. The basic process flow for the fast fashion system includes fabric purchasing from China and apparel manufacturing in the U.S. As the same fabric is used in both systems, fabric costs are equal. The marketplace for the finished products is assumed to be in the U.S. for both systems. (Desai et al. 2012) The two processes are displayed in Figure 11.

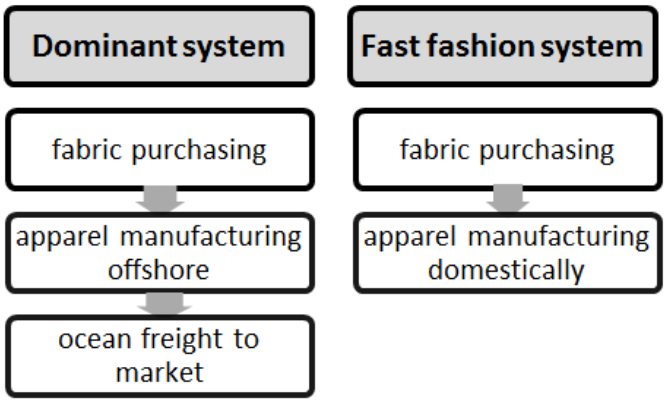

Figure 11. *The process flows for the two systems compared in the profit analysis.*

One of the key features of the fast fashion system is the ability to maintain a price premium by decreasing the amount of products sold at discount. In the hybrid cost model, a distinction is made regarding the components of both the revenues and costs obtained from items sold at a discount and those sold at the expected retail price. (Desai et al. 2012)

Three factors determine which of the apparel production systems is more attractive: price ratio, quantity ratio and average labor time per item. The price ratio is the ratio of the average selling price under the two systems. The quantity ratio includes the quantities sold at discount and at expected retail price. The average labor time is the total time that all line workers spend cutting, sewing, finishing and packing the product. The labor time varies by product type and line worker productivity, and for this reason, four different values are used for calculations to represent the variation. These four values are 20, 40, 60 and 80 minutes. The profit ratio indicates which of the systems is more attractive financially. A profit ratio >1 means the fast fashion system is more attractive, and a profit ratio <1 points to the dominant system. (Desai et al. 2012)

The fast fashion system requires more frequent deliveries, for example twice a week versus the industry standard of 6-8 weeks. However, there should not be a significant difference in transport costs as two trucks per weeks and 12 trucks every six weeks should cost approximately the same, as long as the trucks can be used at full capacity and the total amount of trucks is the same. (Desai et al. 2012)

Symbols used in the equations in the hybrid cost model are displayed in Table 10. The equations to determine gross operational profit are as follows:

$$\pi^F=(P^F \times Q^F + P_s^F \times Q_s^F) - C^F \times (Q^F + Q_s^F + Q_u^F) \quad (1)$$

$$\pi^D=(P^D \times Q^D + P_s^D \times Q_s^D) - C^D \times (Q^D + Q_s^D + Q_u^D) \quad (2)$$

Table 10. *Symbols, superscripts and subscripts used in equations 1 and 2.*

$\boldsymbol{\pi}$	gross operational profit	X^F	fast fashion system
P	unit price	X^D	dominant system
C	unit cost	X_s	sale price / quantity
Q	quantity	X_u	unsold products

Taking a ratio of the two operational profit values determines which one of the two systems is more attractive. Three key factors determining where the profitability ratio is >1 or <1 are calculated as follows. The price ratio is a ratio of the average selling prices; the difference comes from the fast fashion system as it is able to charge a higher markup price and decrease the amount of products sold at a discount price. The price ratio in equation 5 is calculated by forming a ratio of the average selling prices in the two systems, shown in equations 3 and 4. (Desai et al. 2012)

$$\bar{P}^F = \frac{P^F \times Q^F + P_S^F \times Q_S^F}{Q^F + Q_S^F} \quad (3)$$

$$\bar{P}^D = \frac{P^D \times Q^D + P_S^D \times Q_S^D}{Q^D + Q_S^D} \quad (4)$$

$$\text{Price ratio} = \frac{\bar{P}^F}{\bar{P}^D} \quad (5)$$

The quantity ratio takes into account the entire quantity sold as well as the quantity sold at discount prices.

$$\text{Quantity ratio} = \frac{Q^F + Q_S^F}{Q^D + Q_S^D} \quad (6)$$

The average labor time is displayed in four different values to represent the varying of the required labor time. The remaining components of the model are connected to the cost structure of the two systems. The main components in the cost structure are materials, labor and transportation. Also manufacturing overhead costs such as

electricity, rent and sales in addition to administrative staff and sales tariffs are important. (Desai et al. 2012)

The total costs per garment manufactured in each country are shown in Table 11. These costs are pre-inventory costs including all material costs associated with the garment, labor costs with efficiency adjustments, reject costs, manufacturing overhead costs, agent fees, shipping and insurance costs, tariffs and value-added tax. The transport costs include the land transport of the products from the factory to the port and the ocean transport from the Asian port to the port in the U.S. The transport costs from the U.S. port to the apparel factory and from the apparel factory to the distribution center are not included due to the lack of specific data. Inventory costs, distribution and retail costs, capital costs and corporate taxes are also not included in these full costs. The example product used by Desai et al. in the profitability examining model is a pair of standard men's trousers. Table 11 shows that the costs of manufacturing the example product in low-cost countries is about half of the costs of manufacturing in the U.S. The revenues and costs together determine which of the systems is more profitable.

Table 11. *The summary of full costs after duty in the USD currency. Calculated in the research by Desai et al (2012).*

	U.S.	**India**	**China**	**Pakistan**	**Bangladesh**	**Cambodia**
Full cost	15.716	7.991	7.602	6.092	6.522	6.750

The price P^F and quantity Q^F are varied so that both the price ratio and quantity ratio range from 1.0 to 1.3 under the four different labor times to form and compare the ratio determining which system is more profitable under which conditions. The results from the research by Desai et al. (2012) using the hybrid system cost model provide two key insights:

1. "A fast fashion system appears to be more profitable than the dominant system under circumstances that are not too extraordinary." Based on the analysis done in the research using example values for a pair of standard men's trousers from an existing case study, a fast fashion system could be more profitable with a labor time of 40 minutes if a quantity ratio of 1.13 is and price ratio of 1.07 is obtained. This indicates that the requirements for the fast fashion system to out rule the dominant system are not exceptionally challenging. (Desai et al. 2012)

2. "The profitability of the fast fashion system is highly dependent on the labor time requirements since that is the main driver in the cost differential." (Desai et al. 2012) More complex products require more labor time, but may also allow a higher price point. Reducing labor time with for example automation in parts of the production process could also increase the attractiveness of the fast fashion system and therefore domestic production.

8. SUSTAINABILITY

8.1 Definition

Sustainability refers to sustaining surrounding conditions so that there are resources left for the coming generations as well. Sustainability does not only refer to the environmental friendliness of different activities or materials, but consists of three pillars: environmental protection, economic development and social development. (Report of the United Nations Conference on Sustainable Development, 2012) Another description of sustainability is "possessing economic, environmental and social aspects of business". (Mani et al. 2015)

The European Commission defines sustainable development as "meeting the needs of present generations without jeopardizing the ability of future generations to meet their own needs". Sustainability should guide the choices consumers make every day, and also the political and economic decisions made. Sustainable development is a fundamental objective of the European Union. (Sustainable Development, 2015)

Stakeholders and social organizations are creating increasing pressure for companies to incorporate all the three dimensions of sustainability, especially the environmental and social affairs. (Freise & Seuring 2015; Mani et al. 2015) Companies are increasingly considered responsible for the actions related to sustainability, especially social and environmental practices; performed by their suppliers in addition to the company´s own actions. (Mani et al. 2015) Negative reports, loss of reputation and competitive advantage are possible outcomes when sustainability issues are not handled decently. It is important to create a positive image for stakeholders. The research by Freise & Seuringer (2015) shows, that though companies comply with legal regulations strictly, the regulations are not enough to satisfy stakeholders, as they imply even higher social and environmental standards. For many fashion companies, sustainability is a relatively new competitive priority; it can be a way to achieve differentiation from others companies. As the attention that sustainability is gaining increases, so does the demand for sustainable products. (Macchion et al. 2015)

Clothing production has many phases where sustainability needs to be taken into account. Some unsustainable characteristics in textile and clothing production are harmful chemicals, water and energy consumption, large waste generation, fuel consumption in transportation and non-biodegradable packing materials (Roy Choudhury 2014, p.1). Sustainability issues in the clothing industry also include: unacceptable working conditions; such as child labor, safety issues in factories, forced

labor and low minimum wages, but also environmental and ethic burdens in production. (Freise & Seuring 2015)

Some of the sustainability issues associated with offshoring include human rights issues, excessive pollution, counterfeit parts, legal issues, health scares and product recalls. (Moser & Montalbano 2015) Reshoring production to local manufacturing facilities enables better visibility, commonality and enforcement of sustainability laws. (Tate et al. 2014)

8.2 Social development

Mani et al. (2015) define social sustainability in the supply chain as "the product and process measures that determine the safety and welfare of the people in the chain." The company´s sustainability in terms of social development is determined by how these social issues such as safety, health, wages, labor rights, education and housing are managed.

Workplace safety is an important social development issue in the clothing sector (Karthik & Gopalakrishnan 2014, p.155). When production is localized through reshoring, it is easier to stop by and check on the conditions of factories, as opposed to when factories are located on the other side of the world. (Karthik & Gopalakrishnan 2014, p.180) Localized production enables operating in a more monitored supply chain and thus contributes to the better following of human rights. (Desai et al. 2012) Social sustainability activities in developed countries are enforced by law, which is not always the situation in developing countries. (Mani et al. 2015)

Another social development issue in the clothing industry is noise. This concerns factory workers, but also residents in the surrounding areas. (Karthik & Gopalakrishnan 2014, p.180) Reshoring does not have an effect on this issue, unless it involves the use of less noisy production processes.

8.3 Environmental protection

The textile and fashion industry is one of the largest causes of greenhouse gas emissions (Pal 2014, p.234). Environmental affairs especially can be used as a method for differentiation from competitors. (Freise & Seuring 2015) An LCA (Life Cycle Assessment) examines the overall impact of a product on the environment. Research by Roy Choudhury refers to an LCA performed in the Netherlands on a men´s shirt. In this assessment, it was found that the most environmental impact for this product is formed during the transportation phase, where non-renewable fuel is used. (Roy Choudhury 2014, p.30) These findings indicate that local production achieved by reshoring could improve the sustainability of clothing products. As transportation distances become shorter, also fuel consumption reduces.

Another phase with a high environmental impact in the clothing life cycle is during the consuming phase when the consumer washes the product. The more a piece of clothing needs washing, the more it consumes water and energy. This is something that clothing manufacturers could contribute to, by choosing materials that do not need frequent washing or high washing temperature to become clean. (Karthik & Gopalakrishnan 2014, p.158)

Clothing can be considered environmentally preferable if it among other things encourages the consumer to reduce personal consumption and buy fewer garments (Connell & Kozar 2014, p.50). From this point of view, apparel mass customization could increase the environmental friendliness of clothing, as consumers can customize their own made-to-order products. This could result in more pleasing clothing and fewer faulty purchases. As mass customization is associated with less finished product inventory, less over-stock is created. Over-stock causes a threat to sustainability because of the chemicals and toxins used and formed during the excess textile manufacturing process (Pal 2014, p.233). If the products in over-stock are not able to be sold at discount or recycled, they may also become additional waste. Even when local production is not in the form of made-to-order customized products, producing closer to the market and time of demand decreases the amount of excess inventories as the production amounts are less dependent on unreliable forecasts.

Local production offers potential to operate in a more monitored environment considering environmental issues as well. Water and air emission for example can be more regulated. Energy sources with lower emissions output can be favored in local production. Better resource productivity can also be achieved when producing in developed countries as more goods and services can be obtained from a lower input of resources. This happens through the conservation and re-use of resources. Resource efficiencies can even make up for cost differences in other parts of the supply chain. (Desai et al. 2012)

Transportation frequencies can be higher in local production (Desai et al. 2012), especially in the case of customized customer-specific products. Traditional apparel manufacturing can utilize once-a-season ship transport, but usually products do need truck transportation for the last parts of transportation in-land to distribution centers and retail outlets. As long as trucks are full enough to provide effective utilization of transport vehicles, it does not make a difference to use the same amount of trucks in different time periods.

In the traditional model for apparel production where products are manufactured at a distant, low-cost country, transportation times are long. If something goes wrong in production, an expensive rush transportation via air cargo with high emission of pollutants might be needed to balance the situation and prevent stock-outs. (Desai et al. 2012)

Environmental regulations concentrating on a single jurisdiction may favor offshoring to countries with laxer environmental regulations, but when measuring pollution across the whole supply chain, reshoring is favored. Carbon labeling for assessing carbon footprints is an example of this type of measurement; reshoring is favored because offshoring requires shipping across oceans and dirty coal is used for power generation. Offshoring leads to more overall pollution, so when considering the effects from the whole supply chain, reshoring is the environmentally more friendly option. (Gray et al. 2013)

8.4 Economic development

The economic dimension of sustainability takes into account the scenario where companies discount items and then lose profitability. (Pal 2014, p.233) This is often due to long lead times, as they create forecasting errors, which result in either lost sales or over-stock when clothing is bought based on forecasts. (Pal 2014, p.228) Reshoring can shorten lead times, and therefore decrease the amount of over-stock and lost sales and increase profitability.

The generation of waste contributes to sustainable economic development as well as environmental protection. When less waste is generated, more money is saved as well. Local production generates less waste because production can take place closer to demand, so the information on the amount of production needed is more accurate. (Desai et al. 2012)

Pollution and waste can be seen as an indication of some kind of business inefficiency; they show that resources have been used incompletely or ineffectively. Pollution and waste also generate additional costs because they need to be handled appropriately; for example hazardous materials, double handling of returned or recycled products, disposal and clean up. These activities add costs but very little value; these costs should be added to the direct cost of the product. (Cousins et al. 2008, p.203)

9. CONCLUSIONS

9.1 General conclusions

The manufacturing reshoring phenomenon is gaining increasing attention. The previous wave of offshoring is partly being balanced by a reverse movement. Companies have experienced difficulties while manufacturing in distant offshore locations. These problems include quality issues, uncertainty, long lead times, large inventories and hidden costs. The gap of cost competitiveness differences between former low-cost countries and developed countries has started to diminish with rising wage levels and transportation costs, decreasing productivity gains and fluctuating exchange rates.

The emphasis in product manufacturing and sourcing location evaluation has shifted from considering only purchase price, to taking into account the total costs associated with creating a product and delivering it to the end customer. Especially apparel companies have chased the cheapest labor costs and moved production in order to take advantage of the lowest wages. This has been a feasible enough strategy as long as cheap labor has been available. However, moving production to another facility creates switching costs. Also supplier relationships can be harmed.

A more stable strategy may be found in reshoring production to the immediate proximity of desired markets. A long lead time can create mismatch costs, when demand and supply are not balanced. These mismatch costs originating from over-stock or lost sales could be minimized with a shorter lead time, as the supply of products can better correspond to the actual demand. This would also result in less discounted products and therefore better profit margins.

Reshoring is especially fit for time-sensitive products, which have a short selling season. Fashion clothing is an example of this kind of products. The value of the product deteriorates if it is not sold during its selling season. Basic products, which have an extended selling season, will not benefit as much from the short lead time. They can also be manufactured in large quantities, unlike fashion products that require smaller production lots to achieve flexibility. However, quality is important for basic products as well. As quality is cited as the most important reason for reshoring, there is potential for reshoring in basic products as well. Quality is easier to monitor when production is local.

Reshoring does not necessarily mean that all production has to be reshored, but especially the production aimed for local markets can generate better profitability when reshored. The location of target markets is a key indicator for most of the benefits. Reshoring has been observed in both labor-intensive and capital-intensive industries. This indicates that the already decreasing labor cost gap can be balanced with other cost factors. China is reported as a common source of reshoring production, but this is expected as it has been one of the most important destinations for offshoring.

Productivity growth could be a way to increase the competitiveness of EU manufacturing. It could be achieved with technological improvements and higher quality manufacturing with less input of labor. Governments in many countries are encouraging the reshoring of production to create well-paying manufacturing jobs, which can stimulate the generation of other new jobs in the supply and service sectors.

Changes in demand patterns and consumer preferences are requiring increasingly shorter lead times and more personalized products. Virtual technologies in apparel manufacturing can speed up the time to market, and increase the possibilities for mass customization. When products are mass customized, they are only manufactured after an order is placed. This means producing single products at a time, which requires flexibility from both the product design process and the manufacturing process. Reshoring could enable increasing possibilities for shortening supply chains and lead times, which would enable a broader offering of mass customized products.

The lack of skilled workforce is one of the main concerns in reshoring production. In many countries the relocation of manufacturing jobs to offshore locations has created discontinuity in the availability of qualified manufacturing workers. This is an issue that could be addressed with collaboration between governments, educational establishments and manufacturing companies.

Customers may be willing to reward a reshoring company by purchasing their products, and some might be ready to pay more for domestically manufactured products. The gaining importance of sustainability to consumers could also favor reshoring, as it can address many of the sustainability issues in global supply chains. Surprisingly the sustainability aspect of reshoring is not widely discussed in academic literature, though the potential for sustainability gains through reshoring is evident.

This thesis has provided a comprehensive look into the possibilities of apparel reshoring, and combined the knowledge that is available so far. The research in this thesis indicates that there is potential for increasing profitability, quality and customer satisfaction in the reshoring of labor-intensive apparel production. However, each reshoring decision is an individual case, so thorough analysis should be performed concerning each case before making a reshoring decision.

9.2 Answers to research questions

Q1. Can companies generate more profit through reshoring clothing production and what is this based on?

Reshoring production offers possibilities for better profitability through both cost reduction and better profit margins. Lead time reduction can enable the minimizing of mismatch costs arising from over-stock or lost sales. Producing closer to demand can enable better responsiveness to actual demand and trends, which can result in maintaining a price premium and fewer items sold at discount prices. Some consumers are also willing to pay more for locally manufactured products. Less transport costs are associated with reshored production. When considering the total costs associated to a product instead of only purchase price, the relative profitability of manufacturing locations may change. Quality concerns can be costly for companies, and quality is sited as the most important reason for reshoring. It is easier to monitor production when it is local.

Q2. Does local production create more customer value in the clothing sector?

Customers can obtain more value from personalized products manufactured through mass customization methods without having to wait for weeks because of offshore production. Shortened lead times enable the production of more timely products. Customers may value the brand and reputation of a company which produces locally. Better quality products offer better value for customers.

Q3. How can virtualization develop the supply chain so that traditionally labor-intensive production is fit for effective reshoring?

Virtual technologies can shorten the time to market, increase efficiency and remove the need for some stages in the supply chain, such as physical product samples. Design changes can be made more efficiently and enable the mass customization of products. Building a direct channel from the manufacturer to the customer with the help of virtualization can enable a more flexible response to customer needs.

Q4. Are there restrictions that apply to reshoring clothing production successfully back to Europe?

Products that are not time-sensitive and can be produced in large production batches easily without quality concerns will probably not benefit from reshoring as much as time-sensitive products or products with quality issues. If the inventory does not lose its value during time, and the products are cheap to hold in inventory, low-cost country production might still be the best alternative for these products. There may also be products that require specialized manufacturing skills or equipment that is available at another location than Europe.

9.3 Validity and reliability

Validity in quantitative research means the extent to which a construct measures what it is supposed to measure. Credibility is treated as the qualitative equivalent to the validity of quantitative research. It is the assessment of the conclusions that have been drawn; are they logical, believable and justified by the data. (Hair et al. 2015, p.286)

As the researcher has interpreted the gathered data and made conclusions based on the findings, the assessment done by the researcher has had an effect on the credibility of the research. The credibility of this research is at an acceptable level, as the reference material gathered for reviewing is quite extensive. Both academic and non-academic material was utilized due to the restricted availability of purely academic literature. The non-academic data may have motivations of its own, so it slightly lowers the objectivity of the reference material. The research is able to provide appropriate answers to the attempted research questions.

The reliability describes the consistency and repeatability of the research (Greener 2008, p.37). The inconsistency of the meanings of the essential terms related to the research in reviewed literature may have had an effect on the reliability of the research. Though the researcher has made the conclusions as objectively as possible, the repeatability of the research when attempted by another researcher may not be at the highest possible level.

9.4 Future research

The generalization of the profitability of a reshoring decision is quite problematic, as location decisions have many different aspects and are case sensitive. Currently the empirical research on reshoring is based mostly on survey data and is focused on motivation and host countries. Based on an extensive database of product level data, a generalized framework for evaluating the suitability for reshoring of defined product types could be formed, considering both the current location and the reshoring location of the production. It is understandable, that this sort of data may be hard to gather, as it is not generally publicized.

As there already is a considerable amount of companies that have reshored production, one of the next targets for reshoring research could be following up on the companies that reshored. Researchers could interview companies on the successfulness of the reshoring decision, for example 5-10 years after the relocation of production. Also the actual cost performance indicators could be compared to the calculated evaluations that encouraged the reshoring decision.

REFERENCES

The Alliance Project, New Economy. Available (accessed 3.2.2015): http://neweconomymanchester.com/stories/1933-the_alliance_project.

AM4U_PAM Profitability Comparison, 2014. AM4U. Available (accessed 2.9.2015): https://www.youtube.com/watch?v=Tl1MH4kLCxY.

Annual turnover of textile and clothing manufacturing industry in the European Union, Statista. Available (accessed 30.9.2015): http://www.statista.com/statistics/417697/eu-european-union-textile-clothing-industry-segment-turnover/.

Asefeso, A. 2014. Reshoring: Manufacturing is Coming Home, AA Global Sourcing Ltd, 125 p.

Ashdown, S.P. 2014. Creation of ready-made cltohing: the development and future of sizing systems, in: Faust, M. & Carrier, S. (ed.), Designing Apparel for Consumers: The impact of Body Shape and Size, Woodhead Publishing, pp. 17-34.

Astarita, C. Italy is reshoring production back, ThisisItaly. Available (accessed 22.5.2015): http://www.thisisitaly-panorama.com/business-news/italy-is-reshoring-production-back/.

Average Wage of Employed Persons in Urban Units by Sector, National Bureau of Statistics of China. Available (accessed 23.9.2015): http://www.stats.gov.cn/tjsj/ndsj/2014/zk/html/Z0415E.htm.

Backing Britain: A manufacturing base for the future, 2014. EEF The manufacturers´ organisation, London.

Bailey, D. & De Propris, L. 2014. Reshoring: Opportunities and Limits For Manufacturing In The UK - The Case of The Auto Sector, Revue d'Économie Industrielle, (145), pp. 45-61.

Baldassarre, F. & Campo, R. 2014. Global sourcing and back-shoring: towards a possible shift of sourcing strategies? July 2014.

Banjo, S. 2013. Rampant Return Plague E-Retailers, Wall Street Journal. Available (accessed 26.6.2015): http://www.wsj.com/articles/SB10001424052702304773104579270260683155216.

Bhatia, A. & Asai, R. 2007. Mass Customization in Apparel & Footwear Industry - Today´s Strategy, Future´s Necessity, Wipro Technologies. Available: http://www.wipro.com/documents/resource-center/library/mass_customization.pdf.

Chang, W. 2012. The Economics of Offshoring.

Chen, L. & Hu, B. 2014. Offshoring versus Reshoring: A Tug-Of-War between Operational Flexibilities.

U.S. Textile Plants Return, With Floors Largely empty of People. 2013. The New York Times. Available: http://www.nytimes.com/2013/09/20/business/us-textile-factories-return.html?pagewanted=all&_r=0.

Coates, R. 2014. What Happens When You Decide to Leave China? Supply & Demand Chain Executive, December, pp. 8-11.

Coates, R. 2010. Quality Fade in China, Blue Silk Consulting.

Coates, R. 2015. Reshoring: Making All the Right Moves, Area Development Site and Facility Planning, Vol. 49(5), pp. 38-40.

Colovic, G. 2011. Analyze of the planning, layout and logistics in garment manufacturing, in: Colovic, G. (ed.), Management of Technology Systems in Garment Industry, Woodhead Publishing India, pp. 106-152.

The Conference Board Total Economoy Database: Summary Tables, 2015. The Conference Board, Available: https://www.conference-board.org/retrievefile.cfm?filename=The-Conference-Board-2015-Productivity-Brief-Summary-Tables-1999-2015.pdf&type=subsite.

Connell, K.Y.H. & Kozar, J.M. 2014. Environmentally Sustainable Clothing Consumption: Knowledge, Attitudes, and Behaviour, in: Muthu, S.S. (ed.), Roadmap to Sustainable Textiles and Clothing : Environmental and Social Aspects of Textiles and Clothing Supply Chain, Springer, Singapore, pp. 41-61.

Cousins, P., Lamming, R., Lawson, B. & Squire, B. 2008. Strategic supply management: principles, theories and practice, Prentice Hall, Harlow, 308 p.

Dachs, B. & Zanker, C. 2014. Backshoring of Production Activities in European Manfacturing, European Manufacturing Survey Bulletin Number 3.Available: http://www.isi.fraunhofer.de/isi-wAssets/docs/i/en/publikationen/EMS-Bulletin-3_en3.pdf.

da Silveira, G.J.C. 2014. An empirical analysis of manufacturing competitive factors and offshoring, International Journal of Production Economics, Vol. 150(0), pp. 163-173.

Deligio, T. 2014. The Truth About Reshoring, Plastics Technology, (March), pp. 26-29.

Desai, A., Nassar, N. & Chertow, M. 2012. American Seams: An Exploration of Hybrid Fast Fashion and Domestic Manufacturing Models in Relocalised Apparel Production, Journal of Corporate Citizenship, (45), pp. 53-78.

Eberle, H., Hermeling, H., Hornberger, M., Kilgus, R., Menzer, D. & Ring, W. 2009. Ammattina vaate, 6th ed., translator Luoto, P., revisor Boncamper, I., WSOYpro Oy, 304 p.

The Economic Case for Reshoring, The Manufacturer. Available (accessed 29.5.2015): http://www.themanufacturer.com/articles/the-economic-case-for-reshoring/.

Ellram, L., Tate, W. & Petersen, K. 2013. Offshoring and Reshoring: An Update on the Manufacutring Location Decision, Journal of Supply Chain Management, Vol. 49(2), pp. 14-22.

Eriksson, P. & Kovalainen, A. 2008. Qualitative Methods in Business Research, SAGE, 352 p.

Euratex Annual Report 2014, Euratex, Available: http://euratex.eu/fileadmin/user_upload/documents/Library/Annual_Report/new-euratex-annual-report-2014-LR.pdf.

Euro area unemployment rate at 11.1%, 2015. News Releases Eurostat. Available: http://ec.europa.eu/eurostat/documents/2995521/6862104/3-03062015-BP-EN.pdf/efc97561-fad1-4e10-b6c1-e1c80e2bb582.

Europe 2014: Back in the game, 2014. EY European attractiveness survey, Ernst & Young. Available: http://www.ey.com/Publication/vwLUAssets/EY-2014-european-attractiveness-survey/$FILE/EY-2014-european-attractiveness-survey.pdf.

European Competitiveness Report 2014: Helping Firms Grow, 2014. European Union.

European Economic Forecast Winter 2015, 2015. European Economy European Commission. Available: http://ec.europa.eu/economy_finance/publications/european_economy/2015/pdf/ee1_en.pdf.

Fan, J. (2004). Subjective assessment of clothing appearance, in: Fan, J., Yu, W. & Hunter, L. (ed.), Clothing Appearance and Fit: Science and Technology, Woodhead Publishing, Elsevier, pp. 15-30.

Ford, M. 2014. Reshoring Made Simple, Surface Mount Technology Maqazine. Available: http://www.magazines007.com/pdf/SMT-Aug2014.pdf.

Fratocchi, L., Barbieri, P., Di Mauro, C., Nassimbeni, G. & Vignoli, M. 2013. Manufacturing Back-reshoring - An Exploratory Approach for Hypoetheses Development.

Fratocchi, L., Di Mauro, C., Barbieri, P., Nassimbeni, G. & Zanoni, A. 2014. When manufacturing moves back: Concepts and questions, Journal of Purchasing and Supply Management, Vol. 20(1), pp. 54-59.

Freise, M. & Seuring, S. 2015. Social and environmental risk management in supply chains: a survey in the clothing industry, Logistics Research, Vol. 8(1).

Frydrych, I., Dziworska, G. & Cieślińska, A. 2000. Mechanical fabric properties influencing the drape and handle, Int Jnl of Clothing Sci & Tech, Vol. 12(3), pp. 171-183.

Giannoulis, K. Reshoring initiative by the French government, New Europe. Available (accessed 17.2.2015): http://www.neurope.eu/article/reshoring-initiative-french-government/.

Gibson, M. 2014. Bringing Manufacturing Back: Is the tide of offshoring beginning to turn towards reshoring? Civitas: Insitute for the Study of Civil Society. Available: http://www.civitas.org.uk/pdf/BringingManufacturingBack.

Goldman, D. 2014. Made in the USA? Kurt Salmon Review. Available: http://www.kurtsalmon.com/uploads/Kurt%20Salmon%20Review%2003%20VFSP%20140815.pdf.

Grappi, S., Romani, S. & Bagozzi, R.P. 2015. Consumer stakeholder responses to reshoring strategies, Journal of the Academy of Marketing Science.

Gray, J.V., Skowronski, K., Esenduran, G. & Johnny Rungtusanatham, M. 2013. The Reshoring Phenomenon: What Supply Chain Academics Ought to know and Should Do, Journal of Supply Chain Management, Vol. 49(2), pp. 27-33.

Greener, S. 2008. Business Research Methods, Ventus Publishing ApS, 110 p.

Gribbin, E.A. 2014. Body shape and its influence on apparel size and consumer choices, in: Faust, M. & Carrier, S. (ed.), Designing Apparel for Consumers: The Impact of Body Shape and Size, Woodhead Publishing, pp. 3-16.

Grier, B. 2013. Time for a New Apparel Profit Revolution, Apparel Magazine. Available: http://www.sresearch.com/am4u/wp-content/uploads/2014/07/ApparelMag_Time-for-a-New-Apparel-Profit-Revolution_2013.pdf.

Gültepe, U. & Güdükbay, U. 2014. Real-time virtual fitting with body measurement and motion smoothing, Computers & Graphics, Vol. 43pp. 31-43.

Gylling, M., Heikkilä, J., Jussila, K. & Saarinen, M. 2015. Making decisions on offshore outsourcing and backshoring: A case study in the bicycle industry, International Journal of Production Economics, Vol. 162pp. 92-100.

Hair, J.J., Wolfinbarger Celsi, M., Money, A.H., Samouel, P. & Page, M.J. 2015. Essentials of Business Research Methods, 2nd ed., Routledge, 576 p.

Hammami, R. & Frein, Y. 2013. An optimisation model for the design of global multi-echelon supply chains under lead time constraints, International Journal of Production Research, Vol. 51(9), pp. 2760-2775.

Harrison, A. & Hoek, R.v. 2008. Logistics management and strategy : competing through the supply chain, 3rd ed. ed., Prentice Hall Financial Times, Harlow, xxiv, 316p.

Helper, S. New tool shows manufacutring in America carries huge potential saving; a reshoring success "toy story", U.S. Department of Commerce. Available (accessed

12.5.2015): http://www.esa.doc.gov/under-secretary-blog/new-tool-shows-manufacturing-america-carries-huge-potential-savings-reshoring.

Holte, M. 2013. The Virtual Dressing Room: A Perspective on Recent Developments, in: Shumaker, R. (ed.), Virtual, Augmented and Mixed Reality. Systems and Applications, Springer Berlin Heidelberg, pp. 241-250.

Horn, P., Schiele, H. & Werner, W. 2013. The "ugly twins": Failed low-wage-country sourcing projects and their expensive replacements, Journal of Purchasing and Supply Management, Vol. 19(1), pp. 27-38.

How Global Manufacturing Cost Competitiveness Has Shifted over the Past Decade, 2014. BCG Perspectives The Boston Consulting Group. Available: https://www.bcgperspectives.com/content/articles/lean_manufacturing_globalization_how_global_manufacturing_cost_competitiveness_has_shifted_over_past_decade/.

Hunter, L. & Fan, J. 2004. Fabric properties related to clothing appearance and fit, in: Fan, J., Yu, W. & Hunter, L. (ed.), Clothing Appearance and Fit: Science and Technology, Woodhead Publishing, Elsevier, pp. 89-113.

Hutzel, T. & Lippert, D. 2014. Bringing Jobs Back to the USA: Rebuilding America´s Manufacturing through Reshoring, CRC Press, 245 p.

Jacobs, F.R., Berry, W.L., Whybark, D.C. & Vollmann, T.E. 2011. Manufacturing Planning and Control for Supply Chain Management, 6th ed., McGraw-Hill, New York, NY, USA, 470 p.

Jones, R. 2006. The Apparel Industry, 2nd ed., Blackwell Publishing Ltd, 304 p.

Karthik, T. & Gopalakrishnan, D. 2014. Enrivonmental Analysis of Textile Value Chain: An Overview, in: Muthu, S.S. (ed.), Roadmap to Sustainable Textiles and Clothing : Environmental and Social Aspects of Textiles and Clothing Supply Chain, Springer, Singapore, pp. 153-188.

Kazmer, D.O. 2014. Manufacturing outsourcing, onshoring, and global equilibrium, Business horizons, Vol. 57(4), pp. 463-472.

Kinkel, S. 2012. Trends in production relocation and backshoring activities: Changing patterns in the course of the global economic crisis, International Journal of Operations & Production Management, Vol. 32(6), pp. 696-720.

Kinkel, S. & Maloca, S. 2009. Drivers and antecedents of manufacturing offshoring and backshoring—A German perspective, Journal of Purchasing and Supply Management, Vol. 15(3), pp. 154-165.

Knowler, G. 2015. China's rising costs sending European manufacturers home, Journal of Commerce .

Kunz, G. & Garner, M. 2007. Going global: The Textile and Apparel Industry, Fairchild Publications, New York, 401 p.

Labour costs in the EU, 2015. News Releases Eurostat. Available: http://ec.europa.eu/eurostat/documents/2995521/6761066/3-30032015-AP-EN.pdf/7462a05e-7118-480e-a3f5-34e690c11545.

Lahidji, B. & Tucker, W. 2014. The Case for Re-shoring Manufacturing Jobs, XXVI Convegno annuale di Sinergie, Manifattura: quale futuro? 13-14 November 2014, pp. 457-464.

Li, H., Li, L., Wu, B. & Xiong, Y. 2012. The End of Cheap Chinese Labor, Journal of Economic Perspectives, Vol. 26(4), pp. 57-74.

Luebker, M. 2014. Minimum wages in the global garment industry, International Labour Organization. Available: http://www.ilo.org/wcmsp5/groups/public/---asia/---ro-bangkok/documents/publication/wcms_317002.pdf.

The Lure of Cheap Chinese Manufacturing Is Fading For European Companies. 2014. Reuters.

Macchion, L., Moretto, A., Caniato, F., Caridi, M., Danese, P. & Vinelli, A. 2015. Production and supply network strategies within the fashion industry, International Journal of Production Economics, Vol. 163pp. 173-188.

Mani, V., Agrawal, R. & Sharma, V. 201). Supply Chain Social Sustainability: A Comparative Case Analysis in Indian Manufacturing Industries, Procedia - Social and Behavioral Sciences, Vol. 189pp. 234-251.

Manufacturing Technology Behind ViMA's PAM, ViMA Alliance. Available (accessed 3.9.2015): http://www.vimalliance.org/PAM.

Markowitz, E. Made in USA (Again): Why Manufacturing Is Coming Home, Inc.com. Available (accessed 17.4.2015): http://www.inc.com/eric-markowitz/the-long-journey-home-why-manufacturing-is-returning-to-the-usa.html.

Martínez-Mora, C. & Merino, F. 2014. Offshoring in the Spanish footwear industry: A return journey? Journal of Purchasing and Supply Management, Vol. 20(4), pp. 225-237.

Mean real monthly earnings of employees, annual growth, International Labour Organization. Available (accessed 23.9.2015): http://www.ilo.org/ilostat/faces/help_home/data_by_subject/subject-details/indicator-details-by-subject;jsessionid=GF8X9QDMrkS3pjVQLU3ZT5S8IrkJpoPlwGNcYQNCMm3GQ99YGRBL!639101744?indicator=EAR_MREE_NOC_GR&subject=EAR&_afrLoop=1871330698878580&datasetCode=GWR&collectionCode=GWR&_adf.ctrl-state=12zlya7wy4_626#%40%3Findicator%3DEAR_MREE_NOC_GR%26subject%3DEAR%26_afrLoop%3D1871330698878580%26datasetCode%3DGWR%26collectionCode%3DGWR%26_adf.ctrl-state%3Diih6zqouc_4.

Melendez, S. For Clothing Designers, Virtual Models Are Faster Than Flesh, Fast Company. Available (accessed 17.9.2015): http://www.fastcolabs.com/3022487/for-clothing-designers-virtual-models-make-all-the-difference.

Meng, Y., Wang, C.C.L. & Jin, X. 2012. Flexible shape control for automatic resizing of apparel products, Computer-Aided Design, Vol. 44(1), pp. 68-76.

Moser, H. & Kelley, M. 2015. Reshoring and Total Cost of Ownership, Supply & Demand Chain Executive. Available (accessed 10.4.2015): http://www.sdcexec.com/article/12049748/positive-trends-at-home-bring-manufacturing-jobs-back-from-overseas-as-rush-to-offshore-slows.

Moser, H. & Montalbano, S. 2015. The Common Sense of Reshoring, Industrial Maintenance & Plant Operation.

Mustonen, M., Mattila, H., Huhma, A., Kääriäinen, P. & Palmu, J. 2013. Virtuaalisuuden hyödyntäminen vaatteiden tuotesuunnittelussa, Finatex ry. Available: http://www.stjm.fi/media/projektit/raportti_virta2013.pdf.

Needham, C. 2014. Reshoring of EU manufacturing, 140791REV1, European Parliamentary Research Services. Available: http://www.europarl.europa.eu/EPRS/140791REV1-Reshoring-of-EU-manufacturing-FINAL.pdf.

Olaru, S., Spânachi, E., Filipescu, E. & Salistean, A. 2014. Virtual Fitting – Innovative Technology for Customize Clothing Design, Procedia Engineering, Vol. 69pp. 555-564.

OpLab | Cost Differential Frontier, Université de Lausanne. Available (accessed 21.7.2015): http://cdf-oplab.unil.ch/.

Pal, R. 2014. Sustainable Business Development Through Designing Approaches for Fashion Value Chains, in: Muthu, S.S. (ed.), Roadmap to Sustainable Textiles and Clothing : Environmental and Social Aspects of Textiles and Clothing Supply Chain, Springer, Singapore, pp. 227-261.

Pasquarelli, A. 2014. Apparel Manufacturing picks up in the U.S. Crain's New York Business. Available (accessed 17.2.2015): http://www.crainsnewyork.com/article/20141215/RETAIL_APPAREL/141219903/apparel-manufacturing-picks-up-in-the-u-s.

Polvinen, E. How PAM and Mini-Factories can help us Avoid the US Apparel Industry's Perfect Storm, Virtual Fashion Technology. Available (accessed 26.2.2015): https://fashiontech.wordpress.com/2012/08/15/how-pam-and-mini-factories-can-help-us-avoid-the-us-apparel-industrys-perfect-storm/.

Production goes to the customer, 2014. Industrial Journal. Available: http://www.industry.siemens.com/topics/global/en/magazines/industry-journal/Documents/industryjournal-2014-2.pdf.

Production´s coming home: what companies need to know about reshoring 2014. KPMG Consumer Currents, (16), pp. 16-19. Available: http://www.kpmg.com/global/en/issuesandinsights/articlespublications/consumercurrents/pages/productions-coming-home.aspx.

Reform EU to help reshore jobs - CBI European survey, CBI (Confederation of British Industry). Available (accessed 17.2.2015): http://www.cbi.org.uk/media-centre/press-releases/2014/03/reform-eu-to-help-reshore-jobs-cbi-european-survey/.

Repatriation of UK textiles manufacture, 2015. The Greater Manchester Combined Authority. Available: http://neweconomymanchester.com/downloads/3234-J2747-Alliance-Project-Report-LB-Low-FINAL-pdf.

Report of the United Nations Conference on Sustainable Development, 2012. A/CONF.216/16, United Nations. Available: http://www.un.org/ga/search/view_doc.asp?symbol=A/CONF.216/16&Lang=E.

Reshore UK, United Kingdom Government. Available (accessed 2.3.2015): https://www.gov.uk/reshore-uk.

Reshoring Initiative Library: Advanced Search, Reshoring Initiative. Available (accessed 2.3.2015): http://www.reshorenow.org/library-search/.

Reshoring Initiative: What is reshoring?, Reshoring Initiative. Available (accessed 2.3.2015): http://www.reshorenow.org/what-is-reshoring/.

Rice, J. & Stefanelli, F. 2014. Reshoring: New Day, False Dawn or Something Else? Industry week.

Rosenau, J. & Wilson, D. 2006. Apparel Merchandising: The Line Starts Here, 2nd ed., Fairchild Publications, Inc., 481 p.

Roy Choudhury, A.K. 2014. Environmental Impacts of the Textile industry and Its Assessment Through Life Cycle Assessment, in: Muthu, S.S. (ed.), Roadmap to Sustainable Textiles and Clothing : Environmental and Social Aspects of Textiles and Clothing Supply Chain, Springer, Singapore, pp. 1-39.

Ruppert-Stroescu, M., LeHew, M., Hiller Connell, K. & Armstrong, C. 2015. Creativity and Sustainable Fashion Apparel Consumption: The Fashion Detox, Clothing and Textiles Research Journal, pp. 1-16.

Sarder, M.D. & Nakka, R. 2014. Transforming Business Strategies of Manufacturing Industries through Reshoring, IIE Annual Conference.Proceedings, pp. 3803-3812.

Simchi-Levi, D., Kaminsky, P. & Simchi-Levi, E. 2008. Designing and Managing the Supply Chain: Concepts, Strategies and Case Studies, 3rd ed., McGraw-Hill/Irwin, New York, NY, USA, 456 p.

Sürie, C. & Wagner, M. 2008. Supply Chain Analysis, in: Stadtler, H. & Kilger, C. (ed.), Supply Chain Management and Advanced Planning: Concepts, Models, Software, and Case Studies, 4th ed., Springer Berlin Heidelberg, pp. 37-61.

Sustainable Development, European Commission. Available (accessed 30.7.2015): http://ec.europa.eu/environment/eussd/.

Tate, W.L. 2014. Offshoring and reshoring: U.S. insights and research challenges, Journal of Purchasing and Supply Management, Vol. 20(1), pp. 66-68.

Tate, W.L., Ellram, L.M., Schoenherr, T. & Petersen, K.J. 2014. Global competitive conditions driving the manufacturing location decision, Business horizons, Vol. 57(3), pp. 381-390.

Thomasson, E. 2013. Online retailers go high-tech to size up shoppers and cut returns, Reuters. Available (accessed 26.6.2015): http://www.reuters.com/article/2013/10/02/net-us-retail-online-returns-idUSBRE98Q0GS20131002.

Transit Time, Distance calculator & Port to port distances, SeaRates.com. Available (accessed 22.7.2015): https://www.searates.com/reference/portdistance/?B=22149&E=21349&.

de Treville, S. The financial case for local manufacturing, Outsource Magazine, 2014. Available (accessed 11.5.2015): http://outsourcemag.com/the-financial-case-for-local-manufacturing/.

de Treville, S. The real value of producing close to demand: CDF calculator presentation, Laboratory in the Operations Department at HEC Lausanne. Available (accessed 20.5.2015): http://wp.unil.ch/hecimpact/operations-management/the-real-value-of-producing-close-to-demand-cdf-tool-presentation/.

de Treville, S., Schürhoff, N., Trigeorgis, L. & Avanzi, B. 2014a. Optimal Sourcing and Lead-Time Reduction under Evolutionary Demand Risk, Production and Operations Management, Vol. 23(12), pp. 2103-2117.

de Treville, S., Bicer, I., Chavez-Demoulin, V., Hagspiel, V., Schürhoff, N., Tasserit, C. & Wager, S. 2014b. Valuing lead time, Journal of Operations Management, Vol. 32(6), pp. 337-346.

Tyler, D. (ed.). 2008. Carr and Latham's Technology of Clothing Manufacture. 4th ed. Wiley-Blackwell. 344 p.

Van den Bossche, P., Gupta, P., Gutierrez, H. & Gupta, A. Solving the Reshoring Dilemma, Supply Chain Management Review, (January/February 2014). Available: http://www.atkearney.fi/documents/10192/4059261/Solving+the+Reshoring+Dilemma.pdf/29edad5b-8327-46e4-bc67-edabfcc64af6.

van Weele, A.J. 2005. Purchasing & Supply Chain Management: Analysis, Strategy, Planning and Practice, 4th ed., Thomson Learning, 351 p.

Wang, J. Op-Ed: Reshoring Garment Manufacturing is Viable and Scalable, Business of Fashion. Available (accessed 21.5.2015): http://www.businessoffashion.com/articles/opinion/op-ed-reshoring-garment-manufacturing-viable-scalable.

Wang, J. 2011. Rising labor cost and the comparative advantage of Chinese textile industry analysis, in: Wang, R. & Liu, H. (ed.), Advances in Textile Engineering, Trans Tech Publications Ltd, pp. 694-698.

White, A. 2014. Economics not 'Madein Britain' brand brings textiles home, The Telegraph. Available (accessed 17.2.2015): http://www.telegraph.co.uk/finance/festival-of-business/10785895/Economics-not-Made-in-Britain-brand-brings-textiles-home.html.

Wren, A. 2013. Made in the U.S.A. and Making Money, Inc., Vol. 35(5), pp. 100-101.

WTO | International Trade and Market Access Data, World Trade Organization. Available (accessed 23.9.2015): https://www.wto.org/english/res_e/statis_e/statis_bis_e.htm?solution=WTO&path=/Dashboards/MAPS&file=Map.wcdf&bookmarkState={%22impl%22:%22client%22,%22params%22:{%22langParam%22:%22en%22}}.

Wulfhorst, B., Gries, T. & Veit, D. 2006. Textile Technology, Hanser Publishers.

XE Currency Charts (EUR/CNY), XE.com. Available (accessed 25.9.2015): http://www.xe.com/currencycharts/?from=EUR&to=CNY&view=10Y.

XE Currency Charts (USD/CNY), XE.com. Available (accessed 25.9.2015): http://www.xe.com/currencycharts/?from=USD&to=CNY&view=10Y.

Yu, C. 2014. China Made-up Textile Articles Manufacturing, Taiwan Institute of Economic Research, 1-5 p.

Yu, W. 2004. Subjective assessment of clothing fit, in: Fan, J., Yu, W. & Hunter, L. (ed.), Clothing Appearance and Fit: Science and Technology, Woodhead Publishing, Elsevier, pp. 31-42.

Yu, W. 2004. Objective evaluation of clothing fit, in: Fan, J., Yu, W. & Hunter, L. (ed.), Clothing Appearance and Fit: Science and Technology, Woodhead Publishing, Elsevier, pp. 72-88.

2014 A.T. Kearney Reshoring Index: Down 20 Basis Points Year-over-Year From 2013, A.T. Kearney. Available (accessed 10.4.2015): https://www.atkearney.com/operations/ideas-insights/manufacturing-reshoring/news-release/-/asset_publisher/TNQKR39KhaTV/content/2014-a-t-kearney-reshoring-index-down-20-basis-points-year-over-year-from-2013-uncovers-what-manufacturers-are-actually-doing/10192?_101_INSTANCE_TNQKR39KhaTV_redirect=%2Foperations%2Fideas-insights%2Fmanufacturing-reshoring

APPENDIX 1: LIST OF RESHORING REASONS IN LITERATURE

Reason	N	Cited in (reference)
quality	11	(Dachs & Zanker 2014; Fratocchi et al. 2014; Fratocchi et al. 2013; Gylling et al. 2015; Kinkel 2012; Kinkel & Maloca 2009; Knowler 2015; Lahidji & Tucker 2014; Martínez-Mora & Merino 2014; Sarder & Nakka 2014; Tate et al. 2014)
flexibility & responsiveness	9	(Dachs & Zanker 2014; Desai et al. 2012; Fratocchi et al. 2014; Gylling et al. 2015; Kinkel 2012; Kinkel & Maloca 2009; Tate et al. 2014; Tate 2014; Sarder & Nakka 2014)
manufacturing cost advantage changes	7	(Fratocchi et al. 2013; Gray et al. 2013; Gylling et al. 2015; Lahidji & Tucker 2014; Martínez-Mora & Merino 2014; Tate et al. 2014; Tate 2014)
labor costs	6	(Bailey & De Propris 2014; Fratocchi et al. 2014; Gray et al. 2013; Kinkel 2012; Knowler 2015; Sarder & Nakka 2014)
transportation & logistics costs	6	(Bailey & De Propris 2014; Dachs & Zanker 2014; Fratocchi et al. 2014; Fratocchi et al. 2013; Knowler 2015; Martínez-Mora & Merino 2014)
control, coordination & monitoring	4	(Kinkel 2012; Kinkel & Maloca 2009; Knowler 2015; Martínez-Mora & Merino 2014)
exchange rates	3	(Bailey & De Propris 2014; Fratocchi et al. 2013; Gray et al. 2013)
lack of qualified personnel	3	(Fratocchi et al. 2013; Kinkel & Maloca 2009; Tate et al. 2014)
proximity to consumers	3	(Gylling et al. 2015; Sarder & Nakka 2014; Tate et al. 2014)
time (transportation & lead time)	3	(Knowler 2015; Martínez-Mora & Merino 2014; Sarder & Nakka 2014)
economic crisis	2	(Martínez-Mora & Merino 2014; Tate 2014)
changes in distribution patterns	2	(Knowler 2015; Martínez-Mora & Merino 2014)
sustainability	2	(Desai et al. 2012; Tate 2014)