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A TIME EFFICIENT SUPPLY CHAIN MODEL FOR AN APPAREL COMPANY

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Abstract

In most market places today competition has become stronger, not only between single companies but between networks of linked partners, known as supply chains. Consumer demands are changing more often and companies have to react quickly when new trends and consumer requirements appear, thus the competition becomes more time-sensitive. This is especially true in the apparel fashion industry because time is a crucial factor and can make the difference between the success or failure of a company in this business. This dissertation deals with the development of a supply chain model for a fashion apparel retailer with focus on short lead-times through the entire supply chain. The basis for this model constitutes on the one hand various theoretical models and time concepts from the literature and on the other hand a case from the successful fashion retailer Zara. Furthermore, the authors of this dissertation conducted interviews with several store managers before and after they created the model. In the last section an analysis of the interviews conducted after the creation of the model is presented and evaluated. The newly created model should give an international fashion apparel retailer ideas to improve parts or even the whole supply chain of it.

Keywords: supply chain model, fashion industry, time efficiency, apparel retailer

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List of Abbreviations

AS	Automated Storage
CAD	Computer-Aided Design
EAN	European Article Numbering
ECR	Efficient Consumer Response
EDI	Electronic Data Interchange
e.g.	exempli gratia
EPOS	Electronic Point of Sale
etc.	et cetera
et al.	et alia
FMS	Flexible Manufacturing Systems
IT	Information Technology
JIT	Just-In-Time
POS	Point-of-Sale
QR	Quick Response
RCP	Relative Cost Position
RS	Retrieval System
SCM	Supply Chain Management
TBM	Time Based Management
TCT	Total Cycle Time
UPC	Universal Product Code
VMI	Vendor-Managed Inventory

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1. Introduction

In this chapter the background is described. It also gives information about research problems and the research objective. In addition, definitions and limitations for this dissertation and finally the outline are presented.

1.1 Background

While brainstorming about a dissertation topic, the authors tried to focus on a topic that was interesting and important. The topic of fashion and an efficient supply chain came to mind. After narrowing down ideas, the final research topic, a time efficient supply chain model for an apparel company was determined.

This was chosen for a number of reasons. Firstly, apparel companies have become international in scope. This has necessitated that they implement new and computerized methods of supply chain management (SCM). Secondly, the apparel industry, perhaps more than any other, must be able to react quickly to seasonal changes to their goods. Finally, competition in the apparel industry has meant that only those that can respond fast and accurate to new consumer requirements will survive and succeed.

A quick and efficient supply chain is always a goal for most companies and the author's purpose was to create a model that could be used for an apparel company.

1.2 Research Problem

The basic problem in every organization is that “the time it takes to procure, make and deliver the finished product to a customer is longer than the time the customer is prepared to wait for it” (Christopher 1998, 167). This is known as lead-time gap. The gap can be reduced by shortening the logistics lead-time. Especially in the apparel industry a lot of new trends come up every year. To resist the competition and to be successful, a company in this business has to

react fast to the constantly changing market demands. Thus, a quick and good working supply chain is necessary.

1.3 Research Questions

The dissertation is based on following research questions:

- Which measures could be taken by an international fashion apparel retailer to shorten the lead-time and consequently the lead-time gap?
- Which measures could be taken by an international fashion apparel retailer to enable it to respond more quickly to changes in the market?

1.4 Research Objective

The main objective of this dissertation is to develop a model, which helps an international apparel company to compress the lead-time of its supply chain and to react more quickly to changed consumer requirements.

The model can be a useful tool for an apparel company, which is in the process of attempting to implement an efficient supply chain management and thereby improving time to market. The model can be applied as a whole or in parts as deemed necessary.

1.5 Definitions

Below are defined several necessary terms used throughout this dissertation.

- *Apparel*: clothing, especially outer garments; the term clothing and apparel are used in this dissertation as synonyms.
- *Supply chain*: a series of linked stages in a network that provides goods or services; the layers of processes involved in the manufacture of goods or provision of services.
- *Lead-time*:
 - From the consumer's perspective: the elapsed time from order to delivery.

- From a supplier's point of view: the time it takes to convert an order into cash and, indeed, the total cycle that working capital is committed from when material are first procured through to when the customer's payment is received (Christopher 1998, 157).
- *Time efficient*: means in this dissertation the shortening of lead times within the supply chain on the one hand. Additionally, it refers also to a short respond time to the market.
- *Echelon*: means in this dissertation the single level in the supply chain e.g. manufacturing, warehouse, distributor. The term *tier* means the same and is used as synonym.
- *International apparel retailer*: A firm that arranges the design and production of clothing that it then retails in own stores, which are located in at least two countries.

Further definitions of special concepts are given later on in the section where these concepts are explained.

1.6 Limitations

The authors made following limitations:

- Due to the short amount of time given to write this dissertation the authors were only able to do a limited amount of field research.
- Resources were another limitation because the budget was limited.
- The response rate was rather limited so the findings are a starting point for further research.
- Neither mathematical data from other sources were included nor any formulas were developed in this report.
- The model created in this dissertation is only valid for international fashion apparel retailers.
- The marketing, sales and human resource aspect is not considered.
- The models and concepts presented in the third chapter are only described to the extent they can be useful for this dissertation, even

though the person(s) who developed the models originally intended to explain or describe other phenomena.

- The authors concentrate only on the reduction of time within the apparel supply chain. Costs or other aspects are not considered. However, when the authors came up with some propositions, the cost aspects are also considered because it is more realistic.

1.7 Outline

The second chapter of this dissertation presents the choice of methodology in detail, e.g. the research philosophy.

In the third section theoretical supply chain models and time concepts are described. These theories constitute valuable components for the supply chain model created by the authors. Some “time” concepts and practices e.g. which have the utility to improve processes and thus shorten lead-times. Finally, the various transport modes are presented.

The next part contains the choice of relevant elements of the various models and concepts.

In the fifth chapter the authors attempt to create a time efficient supply chain model for an international fashion apparel retailer.

The sixth section describes the empirical method. Various choices of research are presented in this chapter.

In the seventh chapter, the qualitative interviews with the respondents from Blend, Esprit, Hennes & Mauritz and MQ are analysed and presented.

In the seventh chapter, the interviews are analyzed.

The last chapter summarizes the dissertation. The applicability of the model is discussed and it is slightly modified. Finally, some conclusions are made.

2. Method

This chapter presents the methodology, the research philosophy, scientific approach and the choice of theory the authors used in the dissertation. In addition, it describes partly the research process (continuation in 6th chapter).

2.1 Choice of Methodology

The research problem was first developed in August of 2004. Then the purpose and objectives of the dissertation were made clear. After clarifying the main goals, the gathering of secondary and primary research was conducted. Once the secondary and primary research was completed, the analyzing of the data was done. Finally, conclusions and recommendations were made possible after analyzing, interpreting and compiling the data.

The purpose of this dissertation is the development of a time efficient supply chain model for an international retailer in the apparel industry. To create the model, the authors looked at basic supply chain theories. An example of this is Porter's value chain. In addition the authors reviewed and considered specific clothing supply chains and time specific models. The purpose was to find out how the structure of a supply chain, and in particular of a clothing supply chain, appears. The clothing supply chain model contains time problems, which is another emphasis in this dissertation. Various time concepts were considered, which can be crucial in a supply chain. Case studies of successful clothing companies were read to see how a good working supply chain looks.

Parallel to the literature review, the authors made some field studies by conducting several semi-structured interviews with the respondents from companies in the U.S., Hong Kong and Sweden (see list of interviewees). These interviews provided insights in the fashion industry, which helped to emphasise on the most important issues when building up the time efficient supply chain. The theories, case studies and interviews were the basis to develop the supply chain model. Not every theory is completely suitable to build a time efficient supply chain model so the authors chose various

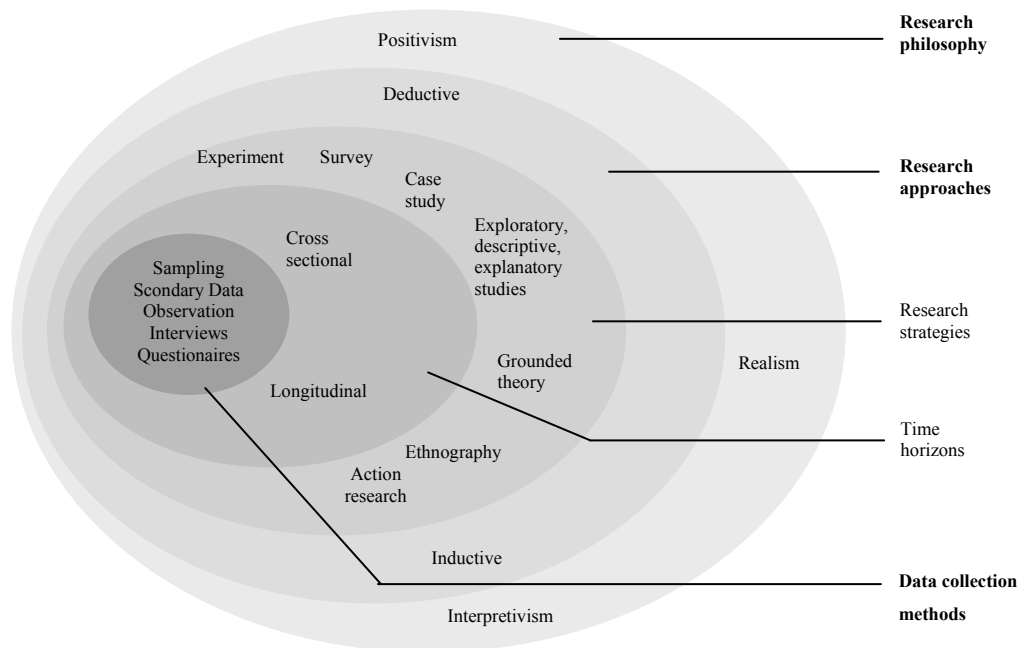
parts from the models reviewed. After reviewing the literature, a time efficient clothing supply chain model and some propositions were created.

After the final model was created, interviews were conducted again with the respondents from Blend, Esprit, Hennes & Mauritz and MQ in order to justify the propositions and to see if it is applicable in practice or not.

Figure 2.1 is the research process “onion” for the choice of data collecting methods. This “onion” contains five layers, which start from the outer layer and move to the inner layer. In this chapter the research philosophy, scientific approach and also the choice of theory (data collection methods) is presented.

The next section tells more about the authors’ choice of the before mentioned “onion layers” and works as a kind of guide throughout the second chapter.

Figure 2.1: The research process “onion”



(Saunders *et al.* 2003, 83, modified)

2.2 Research Philosophy

According to the research process “onion” the first layer, research philosophy, has to be peeled away. There are three dominating views about the research process in the literature, namely positivism, interpretivism and realism (Saunders *et al.* 2003). Research philosophy in this work is based on the principles of positivism. To develop knowledge about the topic the authors analysed in an objective way and interpreted data in a value-free manner (Saunders *et al.* 2003, 83).

The business and management situation is complex and unique. It has its own characteristics and variables. The authors share the same value with the interpretivist that humans are active and make choices intentionally. In addition, the aim of developing knowledge about the topic in an objective way and interpreted data in a value-free manner (Saunders *et al.* 2003, 83).

Therefore, the chosen research philosophy for this dissertation reflects both the principle of positivism and interpretivism.

2.3 Scientific Approach

Another decision was the research approach, which can be *deductive* or *inductive* (see figure 2.1). According to Saunders *et al.* (2003), there is also a mix between inductive and deductive approach. The research process started with already existing theories and models. Later on the authors came up with some propositions. Thus a mainly deductive approach was used with inductive elements.

As mentioned in Saunders *et al.* (2003), using multi-methods enable triangulation to take place. The deductive approach was chosen by the authors as a main way to research due to the fact that a substantial amount of literature already exists on the supply chain issue.

The authors also adopted some elements of the inductive approach. Firstly, the authors conducted several interviews, which are usually regarded as a technique for an inductive approach at the beginning stage. This was done in order to get some basic but practical information about the industry and the companies.

Besides, the author's work is also coincidence with the inductive approach by studying a small sample of subjects with qualitative data to establish different views of phenomena (Easterby-Smith *et al.*, 2002).

2.4 Choice of Theory

The inside layer of the research process "onion" gives an overview of the data collection methods. This section describes the process of secondary data research in the dissertation.

The *Kristianstad University Library* was the primary resource for collecting information on the topic. The authors' were able to borrow books from the library, which helped a great deal in the research. The Internet was also a research tool that the authors took advantage of; by using it they were able to search for articles and journals that were relevant to the study. The Internet sources were only from well-established and accredited sources. The authors made sure that they chose reliable, accurate and up to date data.

The literature about supply chains and in particular about supply chain management is very broad. Various new theoretical concepts, tools or methods are developed concerning the whole supply chain or only elements of it for example, processes, actors or relationships. To reduce the amount of literature, the authors first looked for general supply chain models. The value chain from Michael Porter was particularly interesting and provided a useful model for this dissertation. In addition, the authors focused on specialized literature concerning supply chains in the fashion and clothing industry. Two important models that contain the time problem created by Stalk and Hout, and Jay Forrester were adopted in this dissertation.

Most of the literature was linked to the topic *agile supply chain*. Three authors attracted the author's attention, who are Martin Christopher, Denis Towill and Remko I. Van Hoek. They wrote several articles about this topic. One article written by M.L. Fisher was published in 1997 and called "What is the right supply chain for your product?" This article was also helpful to understand why agile supply chains make sense in the fashion apparel industry.

The next step in the literature research was the focus on the time factor and its reduction within the supply chain. Thus, the authors read a lot about the topics *quick response* and *time compression*. These concepts were also mentioned with agile supply chains and fashion apparel industry. Other approaches like *vendor-managed inventory* and the *just-in-time (JIT)* strategy were also studied. In addition, the authors read case studies. This helped to give them real world examples and understand the industry. Literature was a huge part of developing the final model.

2.5 Summary

This chapter has presented an overview of a part of the research process procedure of the dissertation linked to the research process “onion”. It has provided information of the choice of research philosophy, research approach and choice of theory. The authors will refer to the “onion” again in 6th Chapter, which discusses the empirical method known as the research strategy, time horizon and secondary data collection methods for this dissertation.

3. Theory

This chapter presents the theories on which the model is based. These are *Porter's Value Chain*, Jay Forrester's *Classic Supply Chain*, Stalk and Hout's model of the *Basic Clothing Supply Chain* and finally the *Integrated Agile Supply Chain Model* by Christopher and Towill. At the end of the first section of this chapter, the supply chain of the fashion retailer Zara is presented. In the second part of this chapter, some other useful basic concepts related to the factor "time" are explained. Finally the authors consider the various transport modes because the choice of these can also influence the lead-time.

3.1 Supply Chain Theories and Models

3.1.1 Michael Porter's Value Chain

Michael Porter's value chain was developed as a company tool for identifying ways to create more customer value. The value chain framework helps to analyze specific activities that firms use. Figure 3.1 presents Porter's model. Porter's concept of the value chain breaks down an organization into discrete "activities", functions, or processes that are the basic building blocks of corporate competitive advantage. Porter's value chain consists of nine value-creating activities, which include five primary activities and four supporting activities.

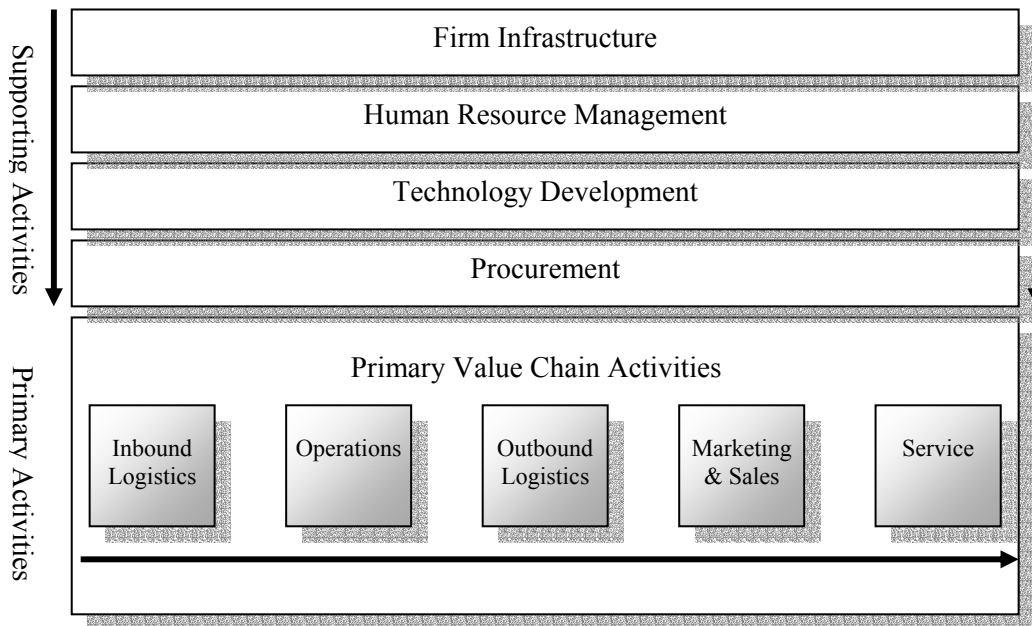
The primary activities are:

1. **Inbound Logistics** – managing the supply of raw materials or goods into the business
2. **Operations** – the process of converting the inputs into finished goods or products
3. **Outbound Logistics** – managing the process of shipping out final products, such as, order fulfillment and warehousing
4. **Marketing and Sales** – the process by which a business is able to provides goods or services that customers will be willing to purchase.

5. **Service** – the process that allows the business to maintain value:

- Procurement
- Technology development
- Human resource management
- Firm infrastructure development and maintenance

Figure 3.1: Porter's Value Chain



(Porter 1998, 46, modified).

The procurement activity includes the purchasing of raw materials and other inputs needed to create valuable activities. The technology development activity is comprised of research and development, process automation and any other relevant technology development. The human resource management activity involves all activities connected with recruiting, development and compensation of employees. Lastly, the firm infrastructure activity includes activities such as finance and quality management.

Porter goes on to say that labelling activities in service industries can sometimes cause uncertainty because they can often be closely tied together. Linkages within the organization's value chain relate the value activities. Porter states, "Linkages are relationships between the way one value activity is performed and the cost or performance of another" (Porter 1998, 48). Porter refers to these linkages as "vertical linkages"; he goes on to say that these

linkages are similar to the linkages within the value chain. These vertical linkages are often overlooked. The competitive advantage can often control linkages among activities same as it does from the individual activities. The two ways linkages can lead to competitive advantage are by optimization and coordination. It is important that a firm optimizes linkages reflecting their strategy so that they can achieve competitive advantage.

It is additionally important that a firm coordinates activities because this can lead to cost reduction. Porter lists some value activities that arise from general causes. The ones Porter uses are as follows:

1. The same function can be performed in different ways.
2. The cost or performance of direct activities is improved by greater efforts in indirect activities.
3. Activities performed inside a firm reduce the need to demonstrate, explain, or service a product in the field.
4. Quality assurance functions can be performed in different ways.

Porter says that the above causes are generic and only provide a starting point. Porter also states, that “linkages exist not only within a firm’s value chain but between a firm’s chain and the value chains of suppliers and channels.” (Porter 1998, 50). The linkages between a supplier’s value chain and a firm’s value chain can provide opportunities for the firm to improve its competitive advantage.

All of the activities in the value chain contribute to an organization’s *relative cost position* (RCP) and create a sound basis for the organization’s differentiation and competitive advantage. The supporting activities listed above are handled mostly in specialized departments and occasionally in other departments. A firm’s success according to Porter depends on how well each department performs its work and how well inter-departmental activities are handled. It is quite easy for a department to become so focused on its own functions that it loses sight of the overall organization’s goals. It is important that the departments focus on the interests of both the customers and company.

In order to create buyer value a firm must endorse value to its customers by performing activities better than its competitors. In order to do this it is important for a company to perform their activities in a different way than their competition. By studying various companies in the apparel industry the authors will discover which activities make a company stand apart from others.

The authors chose this model because it contains fundamental activities of companies within their value chain. In the analysis chapter the authors will pick the parts that can be useful for the creation of their apparel supply chain model.

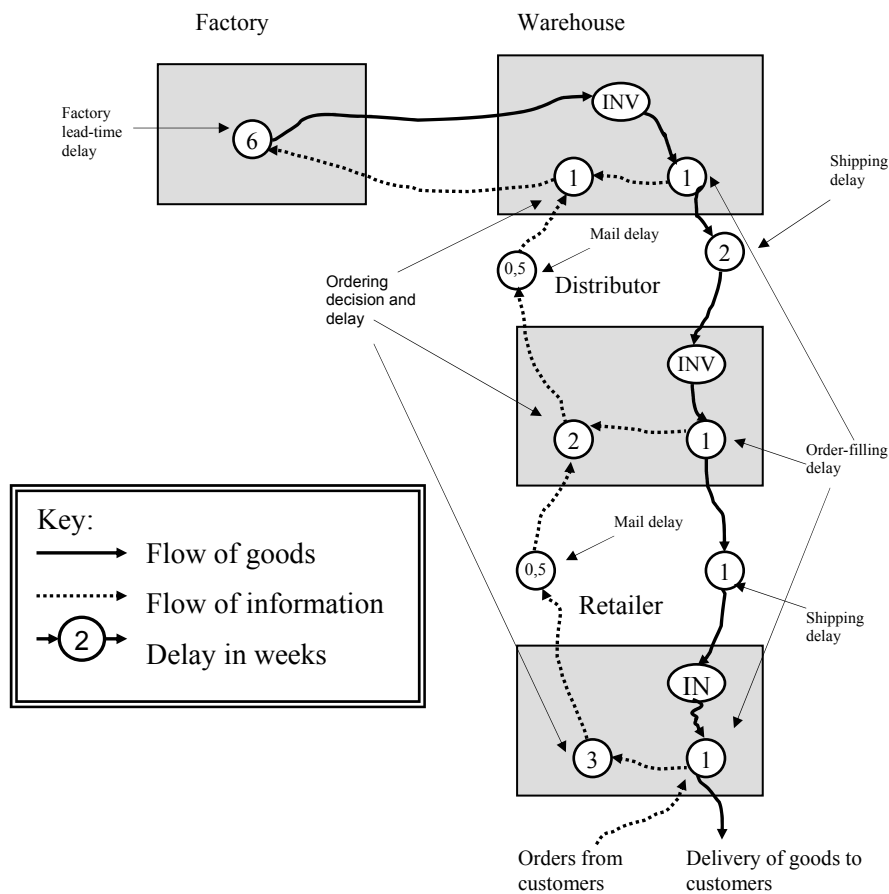
3.1.2 Forrester's Supply Chain Model

Another model that is considered in this dissertation is the supply chain model by Jay Wright Forrester (1961), which includes the time factor or the time problem respectively. This model is shown in figure 3.2 on the next page and refers to the organizational structure of a hard goods industry. Denis Towill, who used this model as a basis in one of his papers stated that “a fundamental problem with supply chains is demand amplification, as initially diagnosed over 30 years ago by Forrester but it is only recently that the full extent of the problem has been recognized” (Towill 1996, 16).

The model shows a simple supply chain with only four echelons. The order flow goes upstream from the marketplace via retailers, distributor and warehouse to the factory. The material flow in the form of products starts from the factory and goes then downstream via warehouse, distributor and retailers to the marketplace. Changes in the marketplace will lead generally to delays in association with every upstream and downstream flow activity (Towill 1996).

The complete cycle takes 19 weeks, from the point when the information e.g. in form of orders comes from the marketplace through the various echelons to the factory and back to the point when the good is delivered to the customer. Which activity exactly consumes how much time is also shown in the model e.g. shipping delay between warehouse and distributor amounts to two weeks.

Figure 3.2: The classic supply chain model by Jay Forrester



(Forrester 1961, 22+139, modified)

Most of the echelons of the supply chain like the retailers, the distributor and the warehouse hold inventory. This means that normally the customer does not see these 19 weeks that are needed from ordering a product to the delivery. The fact is that the complete cycle of business amounts to 19 weeks, which must be regarded in planning. The expectation in this example is that the system is stable as long as the demand is stable, or sales forecasts are perfectly accurate 19 weeks into the future. The following example shows what happens when unexpected demand occurs, because the system has to respond to this. For instance, the sales rise to 10 percent. To prevent delivery delays and acting on new forecasts, the factory responds by increasing the production for example to 40 percent. Then the management notices too late that the increase of production to 40 percent was too much, thus the production is reduced to 30 percent, which is too late again. This continues over a year till the system has reached stabilization at the new demand level.

The system is distorted by time, namely the delay between the event that causes the change of demand and the time when the factory finally responds to this information. The factory receives information that is out-of-date, because the information is bundled and passed on to each echelon. The longer the delay, the larger is the distortion of the view of changes in the marketplace. Those distortions cause disruptions, waste and inefficiency in the supply chain (Stalk & Hout 1990).

Even though this model shows the organizational structure in a hard goods industry, the authors of this dissertation are of the opinion that it is (or elements of it are) transferable to an apparel supply chain model. The authors chose this model because it illustrates the basic structure of the supply chain and makes the time delay in weeks exemplary visual. In addition, it presents values that were set by Forrester for his classic supply chain simulation studies.

This model might be useful for this dissertation because it presents in a simple way in which steps and through which activities in the supply chain time is consumed. It illustrates very clearly which processes need plenty of time. When attempting to create a model in the fifth chapter, this can help the authors to focus on the important steps within the supply chain, where it is necessary to reduce time. Which parts or elements of this model are useful as to be chosen for the development of the time efficient supply chain model, will be discussed in the next chapter.

3.1.3 The Nature of Fashion Markets and Basic Clothing Supply Chain

3.1.3.1 Characteristics of Fashion Markets

First of all, it is necessary to present the nature of fashion markets because it affects the design of a supply chain in the apparel industry. The term fashion is very broad and embraces any product or market when there is an element or style, which is short-lived.

Fashion markets have following characteristics that challenge supply chains for companies acting in markets like these:

- Short life cycles: the product is short-lived and the sales period is brief and seasonal (only some months or weeks).
- High volatility: the demand is rarely stable or linear and might be influenced by factors like weather or idols (e.g. footballers, pop stars).
- Low predictability: because of high volatility the demand is very hard to predict.
- High impulse purchasing: the consumer makes a buying decision when he or she is confronted with the product at the point of purchase (Christopher *et al.* 2004).

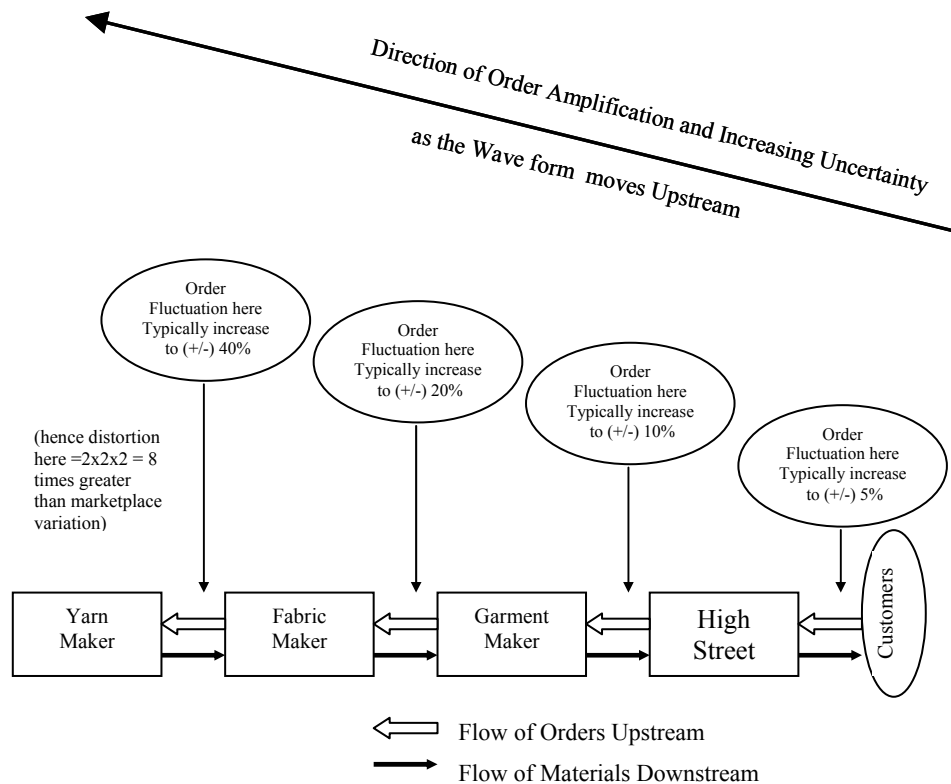
In the clothing industry, time becomes an important key factor. Product ranges in the apparel fashion industry need to be “refreshed” very often, because of the various seasons a company in this business is confronted with (Christopher *et al.* 2004).

3.1.3.2 The Basic Supply Chain in the Clothing Industry

Figure 3.3 below illustrates a clothing supply chain model showing the problem of timeliness of information. It is originally created by Stalk and Hout (1990), but in this dissertation the authors adopted a (graphically) alternative version of this model. They chose the modified one by Mason-Jones and Towill (1999), because it shows the time problem on the several echelons of the clothing supply chain visually.

On the top level is a retailer, the second is a clothing maker, the third level is a fabric maker and the fourth is a yarn maker. Each tier in this supply chain sends and receives information. The retailer places an order for example for jeans to a jeans maker. This one places orders to a denim fabric maker ordering from a yarn maker with shipments in the reverse order. These activities go on and are driven by the demand in the market, the inventory levels (at each of the four tiers in the chain), and also the rules, which govern production lot sizes.

Figure 3.3: Basic structure of traditional clothing supply chain



(Mason-Jones & Towill 1999, 66)

Stalk and Hout assume that the consumer demand varies at the marketplace from month to month and the changes may be up or down by 10 - 15%. In the supply chain, the changes in order are getting larger and larger. The reason is that every upstream supplier fights “to catch up from the last ripple of the demand curve” (Stalk & Hout 1990, 237). It might happen that weeks or months pass by till the upstream supplier e.g. in the fourth level hears about the retail demand in form of an order that is set up, for example 30 – 35% over last order (Stalk & Hout, 1990). This goes on and on and is also presented by figure 3.3. According to Stalk and Hout (1990, 237) this is called “amplification of order changes and is a continuing source of late orders, excessive inventories, and high overheads in industry”.

Following example makes the time problem clear within this simple supply chain. The retailer has not provided any information to his supply chain about the rise of sales for e.g. almost three months and places a large order. The jeans maker, who is informed about increased sales for jeans, is ignorant about

this retailer's jeans sales rise for three months. With the arrival of the order, the jeans maker does not know which amount of the order volume consists of a sales increase and which is one-time inventory replenishment. Thus, the information for this garment maker is late and hard to interpret. But the jeans maker waits one month to place an order to the denim maker because he had to liquidate inventory. It takes the fabric maker one month for the reverse of his expectations. Then he amplifies the order for covering the month of unexpected inventory depletion. The denim maker is further away from the jeans market and is the worst prepared one for sudden large orders. To cope with this, the fabric maker can only postpone some of its customers' shipments. The result is the drop of the customer service levels across the product range (Stalk & Hout 1990, 237/238). To avoid this, a fluent and transparent exchange of information among the players within a supply chain is necessary.

This model is useful for the authors because it includes the fundamental echelons for a clothing supply chain. Thus, the structure of the model is interesting. Similar to the Jay Forrester model it describes the time problem. The example shows the value of timely information. The information, in this model the order, is given too late to the next step (upstream) of the supply chain. The demand amplification is increased at every step of the supply chain. This leads to a distortion at the first step downstream (the yarn maker) eight times greater than the marketplace variation. This can cause late orders. It follows that late orders lead to late deliveries and thus cause longer lead-times.

3.1.4 Agile Supply Chains

According to Christopher (2000), agility is a business-wide ability, which encompasses organizational structures, information systems, logistics processes and mindsets. Flexibility is one of the main characteristics of an agile organization. The origin of agility as an organizational orientation lies in flexible manufacturing systems (FMS). Formerly, it was thought that flexible manufacturing could be achieved by automation to enable quick-change, e.g. reduced set-up times, and therefore a better responsiveness to changes in product mix or volume. The idea of manufacturing flexibility was spread out

into the wider business context and the business concept of agility was developed. According to Christopher (2000, 38) agility might be defined “as the ability of an organization to respond rapidly to changes and demand, both in terms of volume and variety”.

Fisher (1997) developed a supply chain matrix that makes clear which supply chain fits to which type of product. This matrix is presented in figure 3.4 below. He distinguishes between functional and innovative products. The demand for functional products is predictable, while innovative products are marked by unpredictable demand. The product life cycle for latter mentioned products is rather short and the product variety high. According to Fisher, innovative products require a market-responsive process. The focus here is on speed and flexibility.

Figure 3.4: Matching supply chains with products

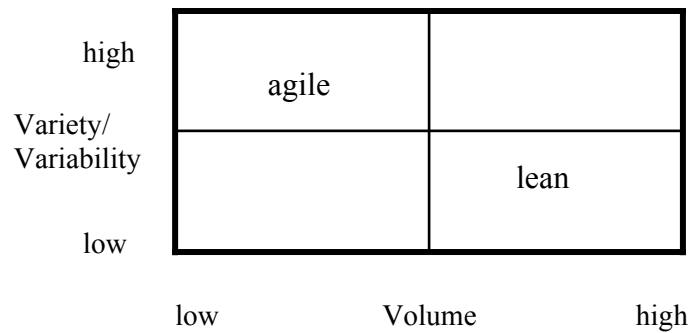
	Functional Products	Innovative Products
Efficient Supply Chain	match	mismatch
Responsive Supply Chain	mismatch	match

(Fisher 1997, 139)

Functional products, however, have following characteristics: long product life cycles, low variety requirement of a physically efficient process. These supply chain processes emphasize more on costs (Fisher 1997). According to van Hoek *et al.* (2001), efficient processes have been defined as lean terms of productivity and quality. It follows that agile supply chains are equivalent to market-responsive processes.

In this context, Christopher’s (2000) matrix shown in figure 3.5 makes clear when an agile and when a lean supply chain (strategy) is needed. Three critical dimensions, namely variety, variability (or predictability) and volume are critical for the determination of the lean or agile approach.

Figure 3.5: Lean or agile



„Agility“ is needed in less predictable environments where demand is volatile and the requirement for variety is high.

„Lean“ works at best in high volume, low variety and predictable environments.

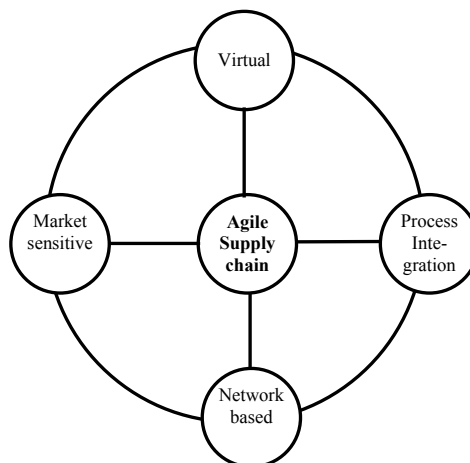
(Christopher 2000, 39)

Referring to Fisher (1997) and Christopher (2000) and with regard to the nature of fashion markets it follows that agile supply chains are meaningful for a company in the fashion clothing business. Christopher and Towill (2001) find that the combination of capabilities of the network of linked companies, namely the supply chain, leads to competitive advantage. Because of volatile and less predictable markets, agile response becomes necessary. It follows that a company might be successful in these markets by creating an agile supply chain.

3.1.4.1 Characteristics of the Agile Supply Chain

According to Christopher (2000) a supply chain is truly agile when it has four distinguishing marks. These are presented in figure 3.6 below.

Figure 3.6: The agile supply chain



(Christopher 2000, 40)

The first characteristic, *market sensitive*, means that the supply chain is able to read and respond to real demand. A lot of enterprises are forecast-driven (rather than demand-driven), which means that they make forecasts based on past sales or shipments and determine in that way their inventory. Because of efficient consumer response (ECR) and information technology, which have developed in the past 10 years, organizations are capable to get data on demand direct from the point-of-sale (POS). These enable a company to be demand-driven, so that it can control the inventory by hearing the voice of the market and thus responding directly to it. The use of information technology to exchange data between buyers and suppliers is to create a *virtual* supply chain, which is information-based (instead of inventory-based). The visibility of demand makes conventional logistics systems through the exchange of information unnecessary. Partners in a supply chain are enabled to act upon the same data by electronic data interchange (EDI) and the Internet. The share of information between supply chain partners can only be used as an advantage through *process integration*. This form of cooperation encompasses collaborative working between buyers and suppliers, joint product development, common systems and shared information. Process integration becomes more common because companies focus on core competencies and outsource the other activities. A greater dependence on suppliers or alliance partners becomes unavoidable. There are no boundaries in a company like this and trust plays an important role.

The fourth characteristic, which makes a supply chain agile, is the *network* in which the partners are linked together. Individual businesses do not compete against each other; it is a competition of supply chains. According to Christopher (2000), we are now entering the era of “network competition”. The winners here will be organizations, which are able to structure, coordinate and manage better the relationships with their partners in the network. These organizations are committed to better, closer, and more agile relationships with their final customers. Christopher (2000, 39) argues, “In today’s challenging global markets, the route to sustainable advantage lies in being able to leverage the respective strengths and competencies of network partners to achieve greater responsiveness to market needs”.

3.1.4.2 Integrative Model for Enabling the Supply Chain

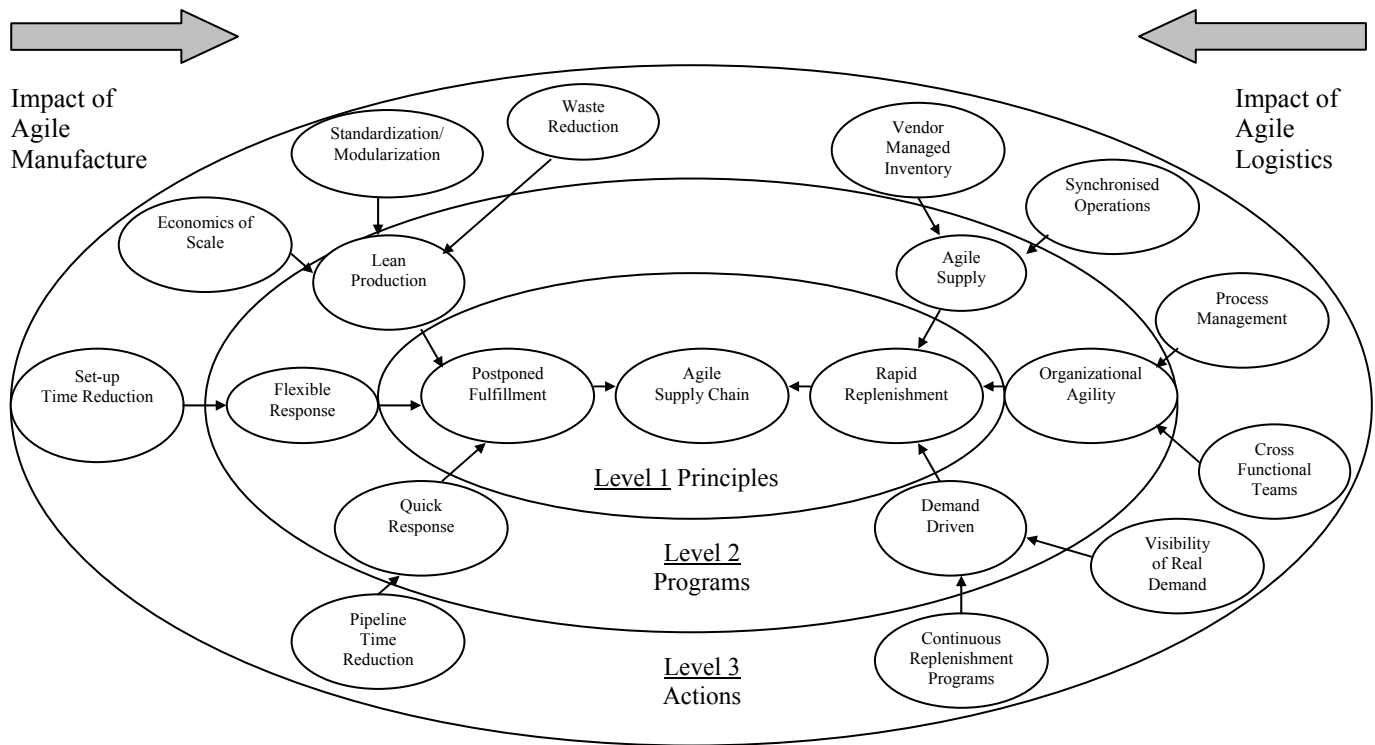
Christopher and Towill (2001) analyzed in their article both the agile and the lean approach and tried to combine them for greater effect. The focus in their paper lies on the creation of hybrid strategies to develop cost-effective supply chains. They suggest an integrated manufacture/logistics model to enable the essential infrastructure. In this model there are included various components, which can be used for the purpose of this work, the development of the time efficient supply chain model.

This model is shown in figure 3.7 below. It presents a three-level framework, which contains all elements of an agile supply chain. The first level identifies the two key principles that support the agile supply chain, namely rapid replenishment and postponed fulfilment. The second level specifies the individual programmes, which must be implemented to achieve the principles in level one. These programmes are e.g. flexible response, organizational agility or agile supply. The third level represents individual actions to support the programmes in level two like e.g. time compression, information enrichment and waste elimination.

Of course, not all elements that figure 3.7 embraces are necessary in every specific market or manufacturing context but an agile supply chain will probably contain many of these characteristics.

The authors chose this model because it comprises various interesting concepts, which are needed to reduce lead-times in the supply chain or improve processes with regard to the time factor. Some of these components may be picked when the authors try to develop the time efficient supply chain model. Some of the approaches, which are included in this model, will be presented in more detail in the next section of chapter three.

Figure 3.7: An integrated model for enabling the agile supply chain



(Christopher & Towill 2001, 243)

3.1.5 Zara's Supply Chain

Zara is a Spanish fashion retailer for men's, women's and children's wear with 693 stores in 50 countries. In 2003 Zara could deliver apparels to its stores in only 15 days after they were designed. Zara is one of the eight divisions of Inditex. These are Pull and Bear, Massimo Dutti, Bershka, Stradivarius, Oysho, Zara Home and Kiddy's Class. Altogether they count 2,155 Inditex stores worldwide. In 1975 the first Zara store was opened in La Coruña, there where the headquarters is located today. Based on the information they found about Zara's supply chain, the authors make visual the structure of Zara's supply chain in figure 3.8.

1) Design

Zara designs all products. The headquarters of Zara has a commercial team that consists of designers, market specialists and buyers. The designers for men's, women's and children's wear are sitting in different halls in a building attached to the Inditex headquarters.

2) Order Administration

There are a number of market specialists and each one is responsible for dealing with a number of certain Zara stores. These market specialists are in regular contact, in particular via phone, with the store managers of “their” shops. They discuss sales, orders, new lines etc.

Furthermore, the store managers are equipped with special devices to make quick and accurate exchange of market data possible (Ferdows *et al.* 2003). The salespersons in the Zara stores are equipped with wireless handsets to communicate the inventory levels to the store manager at the closing time in the evening. The store managers use internet-connected phone lines to pass the numbers on to the design/order and distribution departments (Heller, R. 2001). Zara stores hold very low levels of inventory. Because of this, it happens very often that the shelves are empty at the end of the day. So, the stores are dependent on regular replenishment with the newest designed products.

Designers, market specialists and buyers make final decisions about the products. After the decision is made, the buyers are responsible for the order fulfilment process, which includes monitored warehouse inventories, allocated production to different factories and third party suppliers and kept track of shortages and oversupplies. It follows that the headquarters, where all the data from the stores flow together starts the production, when the when consumer requirements are identified (through the support of the stores).

3) Production

40 % of the fabrics are supplied by Inditex part owned mills. The rest of the fabrics is produced by 260 other suppliers. To minimize the dependency on single suppliers and support maximum responsiveness from them, the amount on Zara’s total production of each supplier accounts not more than 4 %. More than half of the fabrics are purchased undyed to make faster response to mid-season color changes possible.

Figure 3.8: Zara's supply chain

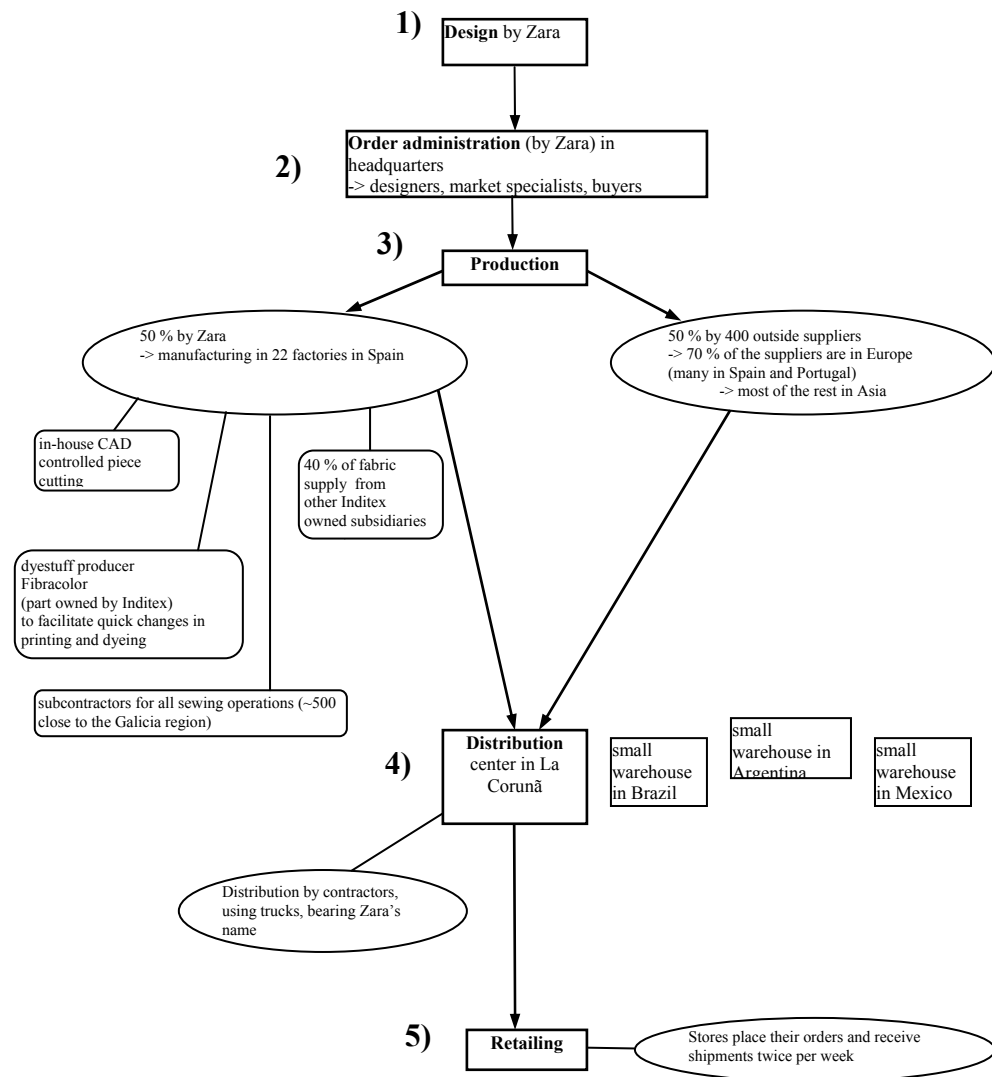


Figure 3.8 illustrates that 50 % of Zara's merchandise is produced by its own 22 factories. 18 of these are located next to La Coruña. The other 50 % of the manufacturing is outsourced to 400 suppliers. 70 % of them are located in Europe, most of them in Spain and Portugal. The rest is mostly in Asia. Because of the cost and quality advantage, Zara procures the basic products in Asia. The piece cutting is controlled through computer-aided design (CAD) in-house.

For all sewing operations, Zara has subsuppliers (around 500) under contract (Ferdows *et al.* 2003). These are workshops that are not owned by Inditex and employ informal economy workers (mothers, grandmothers, teenage girls). They are located in Spain and Portugal and strictly monitored by Zara. The

company has established a long relationship to these workshops. These suppliers receive precut pieces with easy-to-follow instructions (Heller, R. 2001). The sewn items are brought back by the subcontractors to the same factory. There each piece is inspected during ironing (Ferdows *et al.* 2003).

4) Distribution

The major distribution center of Zara is located in La Corunã, where all products pass through. The distribution center is equipped with the most sophisticated and up-to-date automated systems. For every store, the orders are packed in separated boxes and racks and are ready to ship within 8 hours after the order arrived. The apparel is then transported directly to Zara's stores in Europe by contractors, which use trucks bearing Zara's name. For deliveries over sea, the trucks drive to airports, which are close to La Corunã (mostly Santiago di Compostela) (Heller, R. 2001). The orders arrive in the stores in Europe normally within 24 hours, in the USA within 48 hours and Japan within 48 to 72 hours (Ferdows *et al.* 2003).

5) Retailing

A Zara store normally places the orders and receives its shipments twice per week. The stores have to place orders at determined times. Stores in Spain and Southern Europe have to place the orders on Wednesdays before 3 p.m. and on Saturdays before 6 p.m. By keeping the production volumes low when the season starts and reacting fast to orders and new trends during the season, Zara tries to minimize the risk of oversupply (Ferdows *et al.* 2003).

3.2 Time Reduction Approaches and Practices

The authors considered also some approaches and practices, which are used successfully by a lot of companies. Even though the authors called the headline "time reduction" they present also practices that make rapid response possible. These approaches and practices facilitate the question how processes or activities within the supply chain can be speeded up. Thus the lead-time of the entire supply chain can be shortened and a rapid response to the market is possible. When creating the model, the authors may build in some of these "time approaches and practices" in their model.

3.2.1 Time Compression

The Total Cycle Time (TCT) is defined as “the elapsed time between customer enquiry and customer need being met is shown to be a fundamental driver in achieving enhanced business performance” (cited by Mason-Jones & Towill 1999, 63). Especially in the agile supply chain, time compression has become an important key enabler. The approach of time compression has become so powerful that it is now known as a paradigm. Another term for the TCT compression paradigm is also Time Based Management (TBM) (Mason-Jones & Towill 1999). The increase of productivity, improvement of quality, reduction of cycle times and the speeding of innovative products to market have been the primary objectives of time compression (Hui 2004). The Time Compression Paradigm works at all levels from total supply chains down through business processes to individual work processes. In table 3.1 there are shown the four basic ways to achieve cycle time compression.

Table 3.1: Basic tactics for engineering time compression

Tactics adopted	Engineering procedure
Elimination	Remove a process
Compression	Remove time within a process
Integration	Re-engineering interfaces between successive processes
Concurrency	Operate processes in parallel

(Towill 1996, 24)

Stalk and Hout (1990) state that supply chain leaders, who work with the objective time compression will adopt following tactics:

- Working to provide each company in the chain with better and timelier information about orders, new products and special needs.
- Helping members of the chain, including themselves, to shorten work cycles by removing the obstacles to compression that one company often unwittingly imposes on another.

- Synchronizing lead times and capacities among the levels or among tiers of the supply chain so that more work can flow in a co-ordinated fashion up and down the chain (Stalk & Hout 1990, 234/235).

Time compression can be achieved by special technologies, which can be divided in following categories: industrial engineering, production engineering, information technology, and operations engineering (Towill 1996). Table 3.2 presents the practical ways to achieve time compression.

Table 3.2: Practical ways to achieve time compression in supply chain echelons

Strategy	Technique	Example
Industrial engineering improvements	Set-up time reduction	Single minute exchange of dies
	Handling methods	Container design and conveyor use
	Product design	Design for manufacture
Production engineering improvements	Integration of processes	Combine two processes into one
	Sequencing of processes	Resequencing to postpone variety
Information technology improvements	Quicker and more accurate data capture	Barcoding on order paperwork and/or materials packaging
	Electronic data interchange	Orders, funds transfer or engineering designs transferred instantly
Operations engineering improvements	Kanban	Production controlled via actual orders
	Just-in-time (JIT) supplies	Greater frequency and smaller quantities
	Shared call off information	Improved service levels through lower forecast errors

(cited by Towill 1996, 25)

The authors think that this time compression concept is useful for the creation of the model. It may help the authors to show ways to shorten (or here: compress) time. Some of the tactics and strategies will be integrated in the clothing supply chain model.

3.2.2 Quick Response (QR) and Flexible Manufacturing

Quick response is defined as follows: “A state of responsiveness and flexibility in which an organisation seeks to provide a highly diverse range of products and services to a customer in the exact quantity, variety and quality, and at the right time, place and price as dictated by real-time customer/consumer demand” (cited by Christopher *et al.* 2004, 372). As cited by Christopher *et al.* (2004, 372), “QR provides the ability to make demand-information driven decisions at the last possible moment in time ensuring that

diversity of offering is maximized and lead-times, expenditure, cost and inventory minimized. *QR* places an emphasis upon flexibility and product velocity in order to meet the changing requirements of a highly competitive, volatile and dynamic marketplace”.

The emphasis of the quick response approach is on faster communication between partners to enable them to respond better and faster to rapid changes in the retail marketplace (Schary *et al.* 2001). *QR* is the umbrella term for both information systems and the *JIT* logistics systems (Christopher 1998). *QR* has its origins in the textile and clothing industry, which purposed to increase the industry response to change in product demand and also to reduce total costs of the pipeline (Schary *et al.* 2001).

The primary objective of *QR* is the reduction of all time spans that happen in the period between design of the apparel and the time when it is sold to the final customer. In the clothing industry, *QR* seems to be a critical factor in the process to improve competitiveness. Through making the whole supply chain dependent on the expectations of the market, *QR* ensures a better provision of service, reduction of stocks and elimination of clearance sales caused by forecasting errors (Vinelli & Forza 2000).

The development of information technology (IT) and especially electronic data interchange (EDI), bar coding (Universal Product Code (UPC) and European Article Numbering (EAN)), the use of electronic point of sale (EPOS) systems and laser scanners has made *QR* practicable. Through the UPC and EAN systems automated data is collection possible. Retail products in the USA are labeled by the UPC system. In Europe, these products are labeled by the EAN system. These two bar code systems provide useful information for the entire supply chain. POS data generated by EAN or UPC can e.g. be used to set forecasts or serve as a substitute for replenishment ordering (Schary *et al.* 2001). These are necessary elements to make quick response possible.

When all partners, like primary and secondary producers, manufacturers and retailers throughout the supply chain adopt the *QR* concept it can be

advantageous for all of these. Referring to fashion garments, the retail sales should be linked with the apparel manufacturers and these should be linked to the suppliers of fibres (Christopher 1998).

There will be a high pressure on the manufacturing to meet the various customer needs when *QR* is required by all parties in the supply chain and this is why flexibility is crucial. Total flexibility could be achieved when manufacturing and logistics lead times are reduced to zero. Obviously, it is not possible to achieve zero lead times, thus the emphasis is on *flexible manufacturing systems (FMS)*, which contribute to progress in this direction (Christopher 1998). Lawson *et al.* (1999, 23) argue that “flexible manufacturing describes the idea of combining general purpose capital equipment and skilled, adaptable workers to produce a wide and changing range of semi-customized goods – matching the variety of goods produced to match variety of demand. Flexible manufacturing reverses the principles of mass production. Its many components include: customization of products, creation of additional product features, rapid development times, short throughput times and frequent development delivery of small batches”. The time to change from one variant to another, which is called “set-up time”, constitutes the main barrier to flexibility. Flexible response to customer demands is not a problem when set-up times can be reduced as close as possible to zero (Christopher 1998).

QR has a number of strategic effects for the company:

- The alignment of organisational activity to demand - all activities within a company should match to the demand of the customers and their behaviour.
- Linkages between demand and supply – connected to the importance of the alignment activity, a strategic understanding of the drivers of demand and its synchronised connection with supply is essential for *QR*.
- Demand relationships - *QR* notices that both customers/consumers and products are dynamic and place unique demands on the organisation. Identical products will have unique product

flows, which depend on customer/consumer buying behaviour and QR necessities.

- Resource configuration - Strategy and strategic thinking in the QR are at a network level, comprising various external interconnections.
- Time – Time is essential to QR operation. As with demand, time-based competition demands careful estimation as to where best it can serve customers/consumers. Fast and correct adjustment to market change is maybe the most important component of the QR strategy.
- Primacy of information - Data and information is the base of QR. Accurately timed and correct flows will make quick and accurate responses possible.
- Partnerships and alliances – The performance depends increasingly on a series of alliances and relationships with other companies. This is an effective way to accomplish consistent changing market conditions (Christopher *et al.* 2004).

The authors believe that both of these practices are useful for the model and will possibly be components for their supply chain model. This is confirmed by the literature, where the quick response approach is mentioned very often in context with agile supply chains (e.g. in Christopher *et al.* 2004).

3.2.3 Just-In-Time (JIT) Philosophy

The purpose of the *JIT* management philosophy is to eliminate sources of manufacturing waste by producing the right part in the right place at the right time. Moving and sorting is an example of manufacturing waste, which adds cost without adding value. The principle of *JIT* is to improve profits and return on investment by reducing inventory levels adding benefits such as improving product quality and reducing other costs. The *JIT* practice works best for manufacturing processes using the same components and products over and over again (van Weele 1997).

JIT logistics will be successful when the following conditions are fulfill:

- A disciplined approach to plan and schedule of inbound requirements.
- A degree of communication and planning linkage between supply chain partners.
- More often not the use of “third parties” or logistics partners to manage the inbound consolidation and sequencing of deliveries.
- The design of vehicles and physical facilities to make small shipment quantities easy to load and unload rapidly.
- The value and variety of the materials required tend to be higher than average (Christopher 1998, 191/192).

The authors recognize that the *JIT* principle may fit better for industrial products, e.g. cars. In the clothing industry, there is no “assembly” of goods in the sense e.g. a car is produced. Nevertheless, there may be processes in the clothing supply chain where just-in-time approach can be adopted. The authors will discuss this principle in the fourth chapter again.

3.2.4 Vendor-Managed Inventory (VMI)

“*Vendor-Managed Inventory* is an efficient replenishment practice designed to enable the supplier to respond directly to actual demand without the distortion and delay of decisions in the customer’s purchasing organization” (Schary *et al* 2001, 205). In *VMI*, the supplier has the responsibility for the replenishment of the customer’s inventory. There are advantages and disadvantages from both the manufacturers’ and distributors’ point of view.

The benefits are the offered logistic control over shipment and inventory and the elimination of fluctuations stemming from retail buying practices. Disadvantages are difficulties in unstable order patterns and also needed preparation of shipments for individual retail stores. Furthermore, some retailers are unwilling to share POS data and are not using POS data by themselves (Schary *et al.* 2001, 338).

Advantages for the customer are that on the one hand inventory levels can be reduced and the risk of stock-outs is diminished. On the other hand, the

customer does not have to pay very often for the inventory till after it has been sold or used (cash flow benefit) (Christopher 1998, 195). Major retailers complain about that *VMI* has not been integrated into the own processes of the retailers and that there is no visibility into the supplier's system to identify problem areas (Schary *et al.* 2001, 338).

Even though there are disadvantages for both customers (e.g. retail shops) and the manufacturers, *VMI* is a concept that might be useful for the development of the model. When this concept is implemented in the right way it can shorten the replenishment time and thus the lead-time to the retailer.

3.2.5 Transportation

Transportation is one of the most important links of the supply chain model. It has become the key factor in time value and one of the most important determinants of competitive success; it determines how often and how quickly a product moves from one point to another (known as *time-in transit*). As Lambert and Stock state, "logistics involves the movement of products (raw materials, parts, supplies, and finished goods) from point-of-origin to point-of-consumption." (Lambert & Stock 1992, 162). The role of transportation in the supply chain has helped allow great production improvements, particularly in respect to "just-in-time manufacturing".

The five most common transportation modes are *motor*, *rail*, *air*, *water* and *pipeline*. The latter transport mode will not be described further because it is not suitable for the transport of apparels.

Motor transportation mode is the successful and most widely used mode of transportation. This is because of its flexibility and versatility. Motor carriers are able to transport products of varying weights and sizes over most distances. The motor carriage is preferred to many customers because it is faster than railroads and it provides customers with reliable services.

The *rail* transportation mode is another widely used mode of transportation. The railroad service is available in most large urban centers and small cities as

well. Unfortunately, the rail mode does not have the elasticity and adaptability that the motor carriers have, because it lacks set track facilities and services. On the positive side, the rail transport costs less than the motor carriage or air transportation. The trains do travel on a set timetable schedule but their departure times happen to be less frequent than the motor carriers. Another disadvantage of the rail transport is that “railroads lines use each other’s cars, and at times this equipment may not be located where it is needed most.” (Lambert & Stock 1992, 170).

Many shippers chose to use *air* transport (also known as airfreight) as a regular service, but because of the very high cost of service they chose only to use the service in emergency situations. The huge advantage that air transport offers is that it can get goods delivered far distances in a short amount of time. Air transport is the fastest mode of transportation.

Water transportation can be classified into four different categories, which are inland waterway (rivers and canals), lakes, coastal and intercostals oceans and international deep sea. Most of the goods carried by water are very large and are bulk packages. Due to the geographical location, different countries rely on waterways more than others. An advantage to water carriage is that it is an inexpensive way of shipping goods. Water carriers have many limitations so it is unlikely that water transportation will grow in the future, the one expectation is marine shipping.

After carefully examining the different modes of transportation available, the authors came to the conclusion that *air* and *motor* transportation would be the fastest transport modes. Although *airfreight* is very expensive the model is concerned with time efficiency and not cost reduction (refer to limitations section). *Motor* is also a fast mean to transport goods (over shorter distances e.g within a country) because it is very flexible. The authors suggest for their model the fastest modes of transportation, which is considered again when the model is created.

4. Relevant Elements

In this section the single models are analyzed and the authors choose and discuss, which part(s) of the models may be useful components for the clothing supply chain model. Additionally, the Zara case is reviewed and finally an overall view of the components for the time efficient supply chain model is presented.

4.1 Relevant Elements of Porter's Value Chain

In order to create a time efficient supply chain the authors believe that the following activities from Michael Porter's value chain should be included.

Inbound Logistics is one of Michael Porter's primary activities and the authors of this dissertation agree that it should be included in the supply chain model because it deals with activities such as, warehousing, vehicle scheduling, material handling and more activities. These activities can cut down the time and help in making materials move smoothly.

Operations are another of Michael Porter's primary activities and the authors believe it is an import part to be used in the model. Operations include the process of changing inputs into the final product. These activities could comprise, packaging, assembling machinery and maintenance.

Outbound Logistics, developed by Michael Porter is included in the supply chain model. In order for there to be a complete chain someone needs to be responsible for physically distributing the product to the buyer.

Technology Development is a support activity from Michael Porter's value chain and should be included in the supply chain model because it includes a broad range of activities. The authors decided to mention it in their model, but will not go into detail.

Procurement is the function of purchasing inputs used in the firm's value chain (not the purchased inputs themselves). Some examples of purchased inputs are, supplies, machinery, raw materials, and office equipment. Procurement is a very important part of the supply chain because purchased inputs are present in every activity.

The following activities of Michael's Porter's value chain the authors decided not to include in their model. The primary activities: marketing/sales and service and the supporting activities: human resource management and firm infrastructure. The authors find that infrastructure belongs to the internal organizational structure of a firm. This is not further considered even though the authors know that every firm has to carry out these activities. The focus in this dissertation is on the supply chain structure and not on the infrastructure of the firm.

4.2 Relevant Elements of Jay Forrester's Model

Jay Forrester's model can be useful for the development of the clothing supply chain model in two perspectives. Firstly, the authors might include some of the echelons, which will form the fundamental structure of the supply chain model. Secondly, it helps the authors to identify which entities and activities of the supply chain consume most of the time (even though this is only an example). Thus it is easier to find out the factors responsible for time delay.

The authors will include the factory in their model, because it produces the clothing. They will call it in their model not factory but "apparel manufacturing". This function may be carried out by an apparel retailer itself or by a supplier. This will be determined in the fifth chapter when the model is created. The authors have to criticize that this model, even though they know that it is very simple, does not include the suppliers of the factory. Which suppliers are included in this model will be discussed later on.

Another important echelon in the supply chain is the warehouse (of the garment maker), where all the products of the garment maker are stored.

It may also receive the products, which are not manufactured by the garment maker, but are outsourced to suppliers.

The third echelon in Forrester’s model constitutes the distributor that has also an important function. There is no information in this model if this is an external or an internal distributor. The supply chain model will comprise an internal distributor, but the authors have not decided yet if they should include an external distributor. One echelon less in the supply chain may reduce also the total lead-time in the supply chain. This will be discussed in the section where the model is created.

Because the objective of the dissertation is to create a model for an international fashion retailer, it is obvious that the retailer, as last downstream echelon in the supply chain will be included in the model.

The time problem that this model contains is useful for the authors to recognize which steps in a supply chain are most time consuming. This is more obvious after the authors analyzed the time-consuming activities by adding up the delays. The authors summarized these delays in table 4.1.

Table 4.1: Added up time delays

Kind of delay	Total amount in weeks
order decision and delay	6
order filling delay	3
shipping delay	3
mail delay	1
factory lead-time	6

The authors take the view that it is also possible to summarize these delays in lead-times of the various echelons, which they present in table 4.2 below.

Table 4.2: Total lead-times of the supply chain entities

Lead-times of the entities	Elements of the lead-time	Total amount in weeks
factory lead-time	production	6
warehouse lead-time	ordering decision and delay, ordering filling delay, shipment delay	4
distributor lead-time	ordering decision and delay, ordering filling delay, shipment delay, mail delay	4.5
retailer lead-time	ordering decision and delay, mail delay	4.5

The Forrester model gives the authors the valuable indication that holding inventory at every tier of the supply chain is important to shorten the lead-time and to enable a quick response to the market.

The authors conclude that the factors leading to time delay are the different activities of the partners in the supply chain. This causes a long total lead-time for the delivery of the product to the retailer. The authors assume that better and faster information exchange between the supply chain partners may shorten the time delays and thus has a positive effect on the lead-time.

4.3 Relevant Elements of Stalk and Hout's Model

The model by Stalk and Hout (1990) shows the demand amplification caused by late information exchange between the entities within a clothing supply chain. Similar to Jay Forrester's model, it is also simple and comprises four basic, inventory holding clothing supply chain echelons.

Stalk and Hout's model is crucial for the authors because it explains which factor are responsible for the demand amplification. The factor is slow and bad information (exchange) between parties in the supply chain.

This model as well as the model by Jay Forrester gave the authors the valuable background knowledge about the importance of information exchange between the partners in a supply chain. Thus, the authors will focus on information exchange between the echelons in the supply chain when creating the model.

The Stalk and Hout model is useful because it comprises some more tiers upstream (compared to Forrester's model), namely the yarn maker and the fabric maker. On the other hand this model totally ignores downstream echelons like warehouse or distributor. The authors decided to include in their model the fabric maker, which they call "fabric production" in their model. They think it is crucial to include because it constitutes the basis for the clothing production. The authors will not consider in their model the suppliers or other upstream partners of this tier. In addition, as already mentioned in the

section where Jay Forrester's model is discussed, the essential part of the supply chain will be the garment maker (here: "apparel manufacturing"). It will constitute only the production of the apparels. Obviously, there are various functions and steps necessary to manufacture an article of clothing, e.g. cutting, sewing. This will also be discussed later on. The retailer is included also in the model (see page 45).

4.4 Relevant Elements of the Integrated Supply Chain Model

As described in chapter three, for a clothing supply chain fits best an agile supply chain, because the fashion market is volatile and difficult to predict. The authors will base their supply chain model on the agile approach. This is best compatible with the objectives of this dissertation.

The integrated model for enabling an agile supply chain includes all elements of an agile supply chain. The authors decided to choose only a few of these components, which are in their opinion important elements for their model.

The right side of the model embraces components that have impact on the agile manufacture. As stated in the third chapter, the QR practice fits best for agile supply chains. Thus the authors believe that this program is useful for their model. In Christopher and Towill's model the pipeline time reduction, as an action (in level three) is linked to the quick response practice. So, the authors will take this in consideration also. A further program they plan to adopt in their model is the flexible response program. Furthermore, the authors want to include from the left side of the model (comprises components with impact on agile logistics) the *VMI* strategy, which was presented in the third chapter as well. The authors also think that in particular for the fashion supply chain a *demand-driven* approach makes sense, which is normal in an agile supply chain.

These are the components the authors will adopt when they attempt to create the time efficient clothing supply chain model for the fashion industry.

4.5 Relevant Elements of Time Reduction Concepts & Practices and Transport Modes

The first approach introduced in the third chapter was the *time compression* and the tactics for engineering time compression. Later on it will be decided if include some of them are included when the model is developed. Concerning special technologies to achieve time compression the authors will focus on information technology and operations engineering to compress cycle time. They also believe that the three tactics suggested by Stalk and Hout (see page 35) are important to integrate in the model.

In section 3.2.2 the authors presented the *quick response and flexible manufacturing* practice. As already explained, the authors believe that both are useful and thus will be adopted in their model.

The next practice introduced in the second section of the third chapter was the *JIT* practice. The authors know that this is not necessarily best for a clothing supply chain model because it is better applicable to goods that have to be assembled. But because it is practice to save time, the authors find it important to take the *JIT* practice in consideration.

In addition, the *VMI* was introduced and the authors decided to include this practice in their model. The third chapter also presented several *transport modes*, which are important because through the choice of fast transport means, the lead-time can be shortened. The authors came to the conclusion that *air* and *motor* transportation would be the fastest transport modes. Although *airfreight* is very expensive the model is concerned with time efficiency and not cost reduction. *Motor* is also a fast mean to transport goods because it is very flexible. The authors suggest for their model the fastest modes of transportation, which is considered again when the model is created.

4.6 Review of Zara's Supply Chain

Because Zara is a successful fashion retailer and has one of the best working supply chains in its segment, the authors will adopt some elements of Zara's supply chain. First of all the authors consider the structure of the supply chain.

The design department of Zara is located next to the headquarters in La Coruña, which allows fluent information exchange because of the proximity between these entities.

The order administration is carried out together by designers, buyers and market specialists in the headquarters of Zara. The decision making by a team with members from different departments is a good solution and supports the internal information exchange among the departments.

Zara factories located in Spain manufacture half of the production and the other half is outsourced. The outsourced part of production is mainly located within Europe (thus the transport ways to the main distribution center are short). Zara outsourced the sewing operations, which is a labor-intensive part of the apparel manufacturing. These are carried out by small workshops in Spain and Portugal and employ only a few grey workers. It is assumed that the wages paid these workers are low. Thus, it is not necessary to produce in a low cost country. Zara found a cheap solution within its home country and a neighboring country. The advantages are the lower costs and the short transport ways because of the geographical proximity.

The central distribution center (warehouse) from where the merchandise is distributed all over the world is located in La Coruña. This makes sense at the sight of the fact that all Zara factories are in Spain and most of the outsourced production is in Europe.

Finally, the information exchange between retail managers and the responsible persons in the headquarters is consistent and frequent.

Based on Zara's supply chain, the authors include in their model also the design, which is a basic function of the apparel supply chain. The authors like from Zara's supply chain that the main warehouse is located in the same country where most of the goods are produced. Furthermore they think to suggest a similar outsourcing strategy for their model. A crucial fact making Zara successful is the steady and frequent flow of information between the retail stores and the responsible persons in the headquarters that are not only buyers, but also market specialists and designers.

4.7 Summary of Relevant Elements for the Model

In this section the basic elements that the authors chose for their model are presented. Some small details that the authors recognize are important to include during they develop the model are discussed at this point.

The authors include from *Porter's value chain* model the primary activities *inbound logistics, outbound logistics and operations*. From the supporting activities the authors chose *technology development and procurement*.

Forrester's model is important for the basic levels in the supply chain model. The authors decided to include from this the tiers factory (in this dissertation: apparel manufacturing), warehouse, (eventually) distributor and retailer. The model gave the authors also the useful information that lead-times might be shorter when inventory is holding on each tier of the supply chain. This is adopted for the supply chain model, too.

The authors adopt from the *Stalk and Hout model* some fundamental tiers for the model. These are the fabric maker (fabric production), the garment maker (apparel manufacturing) and the retailer.

The authors learned both by the *Forrester model* and by the *Stalk and Hout model* the importance of timely information exchange between the entities in the supply chain. Thus the authors put focus on information exchange when creating the model.

From the *integrated model for enabling an agile supply chain* the authors decided to adopt the following components from this model, *quick (and flexible) response, VMI, and demand-driven*. The authors wanted to create a model that has the four basic characteristics of the agile supply chain.

Through *Zara's supply chain* the authors got to know how a good working and fast supply chain in “reality” looks like. Because of this, they include the following parts of *Zara's supply chain* in the same way or in a similar way: location and outsourcing of production activities. The authors like at *Zara's supply chain* that all goods produced in various countries are transported to a main distribution center (the warehouse). From this central point the distribution takes place all over the world. The authors may also suggest in their model also good technical equipment in the stores that makes fast and actual information exchange between the stores and the headquarters possible.

The authors decided to include from the presented time concepts and practices all of them: *time compression, QR and flexible manufacturing, JIT and VMI*.

In addition, an overall view of the *transport modes* was given. The authors focus, when developing their model on the transport modes air and motor, because through these are probably the shortest transport lead-times available.

5. Development of a Time Efficient Apparel Supply Chain Model

In this chapter the authors attempt to build a time efficient supply chain model for international fashion apparel retailers. First, the basic structure and the outsourced parts of this model are described. Explanations follow about the location of the entities, the equipment, the concepts and strategies that are included in the model. Finally, some propositions are presented, which the authors set up from their supply chain model.

5.1 Development of the Model

The time efficient model that will be created in this section is based on the relevant elements presented in the 4th chapter. It can be useful for international fashion apparel companies that want to improve their supply chain in order to shorten the lead-time through its entire supply chain. It will be a qualitative model giving the apparel companies ideas to shorten process cycle times and to enable them to respond quicker to changing consumer requirements. The single apparel company can adopt the whole supply chain model or only some parts of it that seem to be relevant. The model is valid for the newest and trendiest fashion products of an international apparel retail company. When the authors use the term “apparel company” in this text, they mean the international fashion apparel retailer for which the model is created.

5.1.1 Basic Echelons in the Supply Chain Model

It was decided by the authors to include the basic echelons design, fabric production, apparel manufacturing, warehouse, maybe an external distributor and as last entity downstream the retailer. They authors assume for their supply chain model that the fashion apparel are designed by the apparel company itself.

5.1.1.1 Fabric Production and Apparel Manufacturing Process

The authors recommend that the *fabric production* should be outsourced to competent suppliers. The authors believe that it saves time when this step of the supply chain is outsourced.

The *apparel manufacturing* consists of a number of steps. In this dissertation only four of these are considered: cutting, dyeing, sewing and ironing. The authors realized that it is important to pack up the apparel products after the last production step at the same place where the items are ironed. This is shown by figure 5.1. It is suggested that the apparel company should manufacture the clothing in its own factories and outsource only some activities. The fabric items should be treated in following order: cutting, dyeing, sewing, ironing and finally packaging. It makes sense to cut the items first and then dye it, because the company is more flexible if there come up new color preferences of the consumers during the season. The authors think that in this way quick response is possible.

Figure 5.1: Apparel manufacturing process



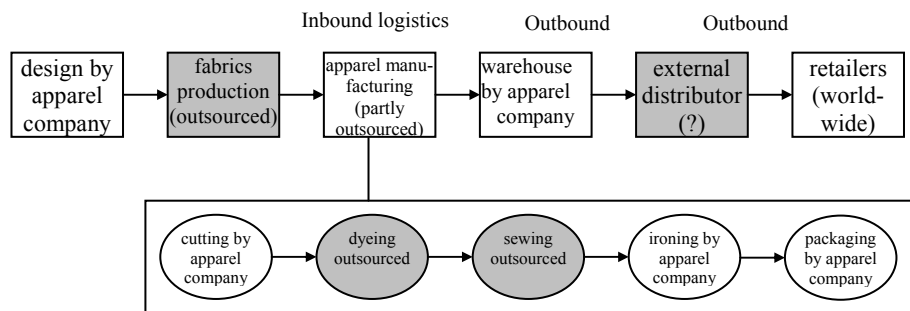
5.1.1.2 Warehouse Function and Distribution

The entire *warehouse function* should also be carried out by the apparel company itself.

The authors first thought about the inclusion of an echelon, an *external distributor*, which should constitute an outsourced service provider and be responsible for further distribution of the merchandize. But on the other hand this would be one step more in the supply chain and it might cause time delays and so longer lead-times. Thus it is decided that an external distributor should be eliminated (if there is one) or not included from the beginning in the supply chain. The merchandize should be transported directly to the warehouse, which constitutes the distribution center, and from there to the retail stores worldwide.

The model also encompasses some of Porter's primary activities, which are *inbound* and *outbound logistics*. Figure 5.2 illustrates all these components (**note**: the shadowed elements are the outsourced activities; the box presents the different manufacturing steps).

Figure 5.2: Basic supply chain structure (without headquarters)



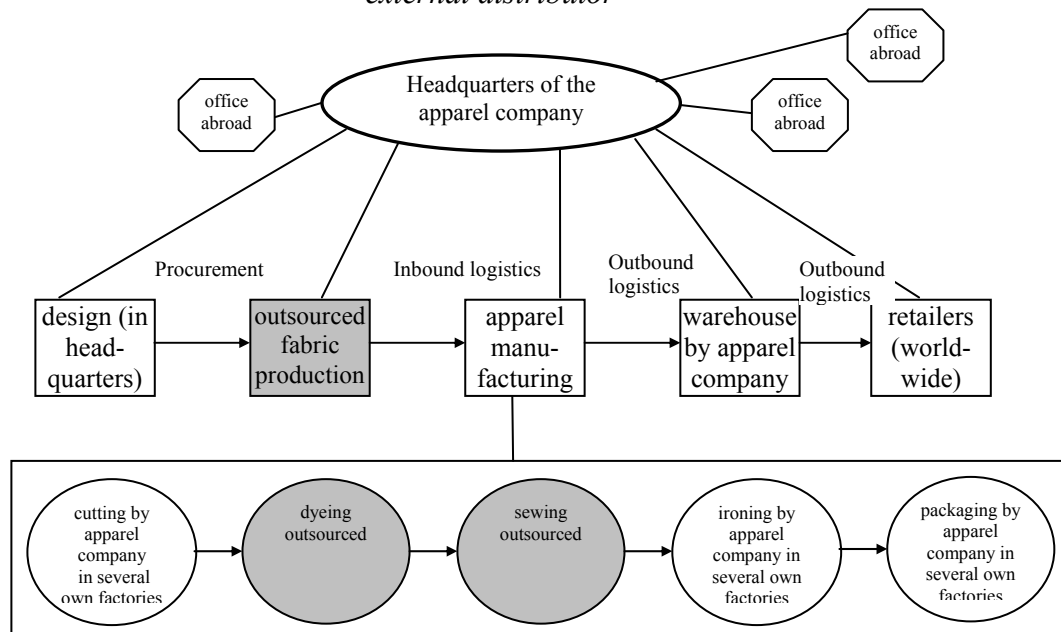
5.1.1.3 Basic Structure of the Time Efficient Supply Chain Model

Figure 5.3 below presents the basic entities the authors suggest for their time efficient supply chain model. One supporting activity of *Porter's Value Chain* constitutes the procurement function, which is also included in the model. In addition, the model as a whole shows the *operations* (the process of converting the inputs into finished goods or products).

The headquarters should coordinate all operations. Furthermore, there should be offices located abroad for the support of retail stores and collection of market data.

The headquarters that is inspired by the designers, who create the newest and trendiest fashion products should initiate the production of the apparel. They should get the relevant information about consumer requirements from the retailers. The production starts after the designers placed orders to the fabric production. The supply chain starts on the left side with the design of the clothing and goes through each echelon to the retailer.

Figure 5.3: Basic supply chain structure (headquarters included) without the external distributor



Note: The lines show that there are linkages between the entities. The box presents the apparel manufacturing in detail. The arrows inform about the order the apparel items pass the supply chain echelons. The shadowed elements are the outsourced parts in the supply chain (this will be presented in the same way throughout this chapter).

5.1.2 Outsourced Parts of the Supply Chain

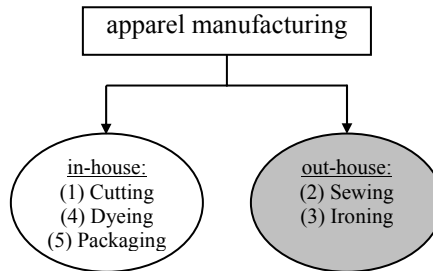
From the apparel manufacturing steps, the cutting and ironing and finally the packaging should be conducted by the company itself. The authors suggest to outsource the dyeing function to several specialized and reliable suppliers.

The authors also find that it makes sense, similar to the fashion retailer *Zara*, to outsource the sewing operation to various small factories, because it is extremely labor and time intensive. It is also recommended that the apparel company has a number of suppliers for dyeing and sewing under contract.

Various suppliers should be obligated by the apparel company and these should carry out same functions. Thus, flexibility is guaranteed and dependency from single suppliers is minimized. If one of the suppliers breaks down, is overworked or has no production capacity left, there are still other

suppliers with the same capabilities to fulfill the order. This should ensure flexibility if new market demands come up and avoid delivery breakdowns or late deliveries. Figure 5.4 below presents the outsourced manufacturing parts.

Figure 5.4: Outsourced parts of the apparel manufacturing



In addition, the logistics between all entities, both inbound and outbound logistics should be carried out by the apparel company itself. This encompasses also the transport. Thus, the company has to possess its own transport means.

5.1.3 Geographical Location of Supply Chain Entities and Transport

5.1.3.1 Geographical Location

The authors suggest to carry out all previously mentioned operations in the same country or in a neighboring country, where the headquarters of the apparel company is located. Thus, the distances between all involved partners are short and thus transport lead-times are shorter. In the authors' opinion, another positive effect of this is that there are fewer cultural and linguistic barriers. This facilitates the communication between the partners of the chain and ensures a faster handling of processes.

The authors believe that it is most time saving to centralize the warehousing function. Thus there should be a central warehouse to which all goods are delivered and distributed with good traffic infrastructure (broad extended and intact road system). The warehouse should constitute the main distribution center located next to an airport to facilitate fast distribution worldwide. Furthermore, the factories of the apparel company should be as close as possible to the warehouse. The authors recommend that the fabric producing suppliers should be next to the factories of the apparel company or at least in

neighboring countries to keep the distance between these entities short. All other supplying entities, which are involved in the production of apparel goods for instance dyeing factories, should be located next to the factories of the apparel company and next to the suppliers for the following production step, for instance to the sewing workshops. In that way, short transport ways and thus short transport times are ensured. It is proposed that the headquarters of the apparel company is in the same area as the apparel manufacturing.

Finally, the authors assume that it shortens transport lead-times when the headquarters of the apparel company is also located close to the factories, suppliers and the warehouse.

5.3.1.2 Transport

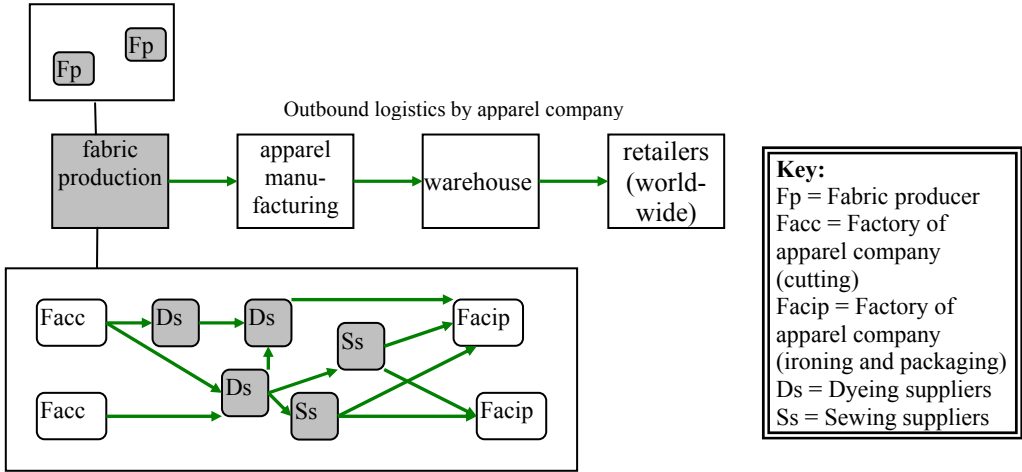
As stated in the previously, the authors find that transportation by *motor* and *air* are the fastest and most flexible transport modes. Trucks for example can either run on fixed timetables or can be used when there is special transport need. The same is suggested for transport by airplanes.

Depending on geographical circumstances or on the distance between the warehouse and the manufacturing entities and suppliers, the goods should be transported either by truck (short distances) or by airplane (far distances, difficult areas or bad road infrastructure). Important is that also the supply chain entities are reachable by truck or that an airport is close to them.

Transport should be organized so that less time is wasted. First, the fabrics should be brought by the apparel company's own transport means to the clothing manufacturing entities. After cutting by the apparel company, it should be transported by the apparel company's own trucks (or by airplane) to the suppliers, which are responsible for the dyeing. Then the items should be delivered by vehicles belonging to the apparel company to the sewing factories or workshops. After this production step, the items are delivered back to the factories of the apparel company for ironing and packaging. After the complete finish, the apparel should be transported to the warehouse.

Figure 5.5 illustrates the transport between the entities. The green arrows present the transport that should be carried out by the apparel company by motor or airplane depending on the distance or other circumstances (as aforementioned). The numbers of suppliers are just chosen to make the model more visual and clarify the way the various entities are involved. The suppliers are presented in detail in boxes, which are linked through lines to the supply chain tier they belong to. Outsourced parts are the boxes with grey filling.

Figure 5.5: Transport between the supply chain entities



5.1.4 Strategies and Practices

5.1.4.1 JIT, QR and flexible Manufacturing in the Apparel Supply Chain

The supply chain model should be based on quick response that encompasses the information systems and *JIT* systems (see third chapter). The authors suggest the apparel company should use the *QR* strategy to provide the retailers the right products in the right quantity in the shortest lead-time as possible. The warehouse is responsible to distribute the clothing merchandize to the retailers, continuing with the *QR* strategy. A condition for this is the communication between the supply chain partners, especially between retailers (or the warehouse) and the apparel manufacturing. Thus, it is suggested that systems should be integrated to achieve faster and more facilitated communication. Further recommendations about information and communication systems follow in the next section of this chapter.

FMS should be integrated in the apparel manufacturing part of the supply chain to enable flexible and *QR* to changing consumer requirements.

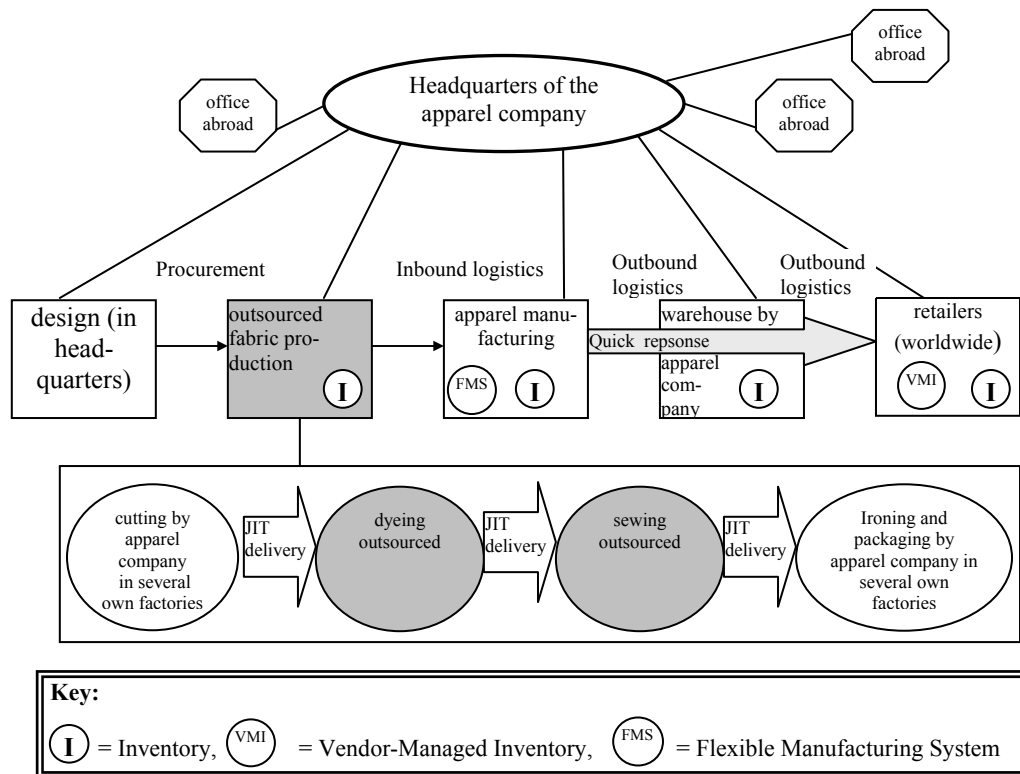
The authors expect that through frequent orders and frequent deliveries, namely the *JIT* practice, the production lead-time can be shortened. After cutting, the pieces should be transported immediately to the dyeing factories in small numbers. Then the items should be distributed as soon as possible, also in small numbers to the sewing factories where the next treatments follow. The clothing should then be transported back to the factories of the apparel company where every article of clothings is ironed, quality checked and packed. From there the merchandize should be brought to the warehouse.

5.1.4.2 VMI in the Apparel Supply Chain

It is suggested that the retailers should also hold small levels of each article of clothing in a storeroom. The replenishment both of the shelves in the store and the inventory in the storeroom should be handled by the *VMI* practice. As previously explained, the supplier (here the warehouse) is responsible for replenishing the shelves of the retailers. The authors assume that by using *VMI* time is saved, because there are no time delays caused through inattentive retailers, mailing or other information delays. To ensure a reliable *VMI* the authors propose that the retailers share the POS data. Furthermore, the authors require the integration of *VMI* in the retailer's processes. Every single retailer has to make visible its systems of data and good administration for the supplier (the warehouse of the apparel company). Every retailer should have the same internal data and administration system.

The authors suggest that low levels of inventory should be held at each tier of the supply chain if an unexpected demand comes up. This also shortens the lead-time to the final consumer. Figure 5.6 summarizes the discussed strategies and concepts that should be included in the supply chain model.

Figure 5.6: Strategies and practices in the supply chain



5.1.5 Technical Equipment of the Supply Chain Members

The authors propose that all partners and all departments in the headquarters are equipped with the best and fastest technologies for the fields they are acting in. This should ensure faster processes in administration, production and warehousing and also quick and more accurate exchange of information between the entities. The authors think that equipping the partners with the newest technology can shorten the lead-time of the supply chain and this makes quick response to changing market demands possible. As shown in *Porter's Value Chain*, the company should use the results of (the latest) technology developments to ensure faster processes in the supply chain. As mentioned in the 3rd chapter, time compression is possible through *IT*. It is an efficient mean to capture data more quickly and more accurately. As also required by Shen *et al.* (2004, 2), the authors propose a stable and secure electronic linkage between the company and its suppliers and partners. Furthermore, they demand a high-bandwidth *IT*: Each partner in the supply chain should both be provided the newest *IT* e.g. EDI systems, bar coding systems, scanners and so on.

5.1.5.1 Computers and Technical Equipment for Designers

The designers should get the newest computer soft- and hardware and other necessary means to design trendy fashion apparel. The authors suggest that the stylistic creation and elaboration phase is supported by CAD systems, which make it possible to drastically reduce the apparel design time. Apparel can be generated with the pattern design system quickly and with precision and thus considerably reducing the clothing design cycle. In addition, the authors suggest that all information related to the creation of clothing should be united in one central electronic data bank that constitutes an integrated information system. This makes it possible to document the data about each apparel item from the design phase to the production phase. It presents the ability to achieve multimedial telecommunication, leading to a timely coordination of units, which are geographically distant. The presence of a central data bank eliminates the need for repetitive insertion of identical information coming from different divisions of the same company.

5.1.5.2 Computers and Technical Equipment for Suppliers and Manufacturing Entities

To ensure fluent and timely communication and information, the external suppliers and apparel company's manufacturing entities should be equipped with modern computer soft- and hardware. The fabric suppliers should use the fastest technology for the fabric production. The quicker the fabrics can be produced, the quicker they can be delivered to the next production step, where they can be processed in the following manufacturing step. The apparel factories should be equipped with the latest production technologies and machinery to enable a fast manufacturing of the apparel. The suppliers should use automatic systems that enable shorter cycle times through the whole production process. The headquarters should support smaller factories by providing them assets and technologies for production. All partners that are directly involved in the manufacturing process should have access to the central electronic data bank that was mentioned in the previous section.

5.1.5.3 Computers and Technical Equipment for Warehouse and Retailers

The authors suggest that the warehouse should also have the newest automated warehouse systems, which enable a quick handling of all processes within the warehouse. This comprises storage and order-picking equipment, equipment for transporting and sorting and automated storage and retrieval systems (AS/RS) (Lambert & Stock 1992). This should enable the warehouse to distribute the right apparel in the right quantity to the right retail stores worldwide and thus continue with the *QR* strategy.

Finally, it is particularly important that the retail stores are equipped with *IT*, because they communicate market data to other members in the supply chain. The retailers are the first in the chain that get market and POS data because the sale of the apparel happens there. The stores are an essential entity in the supply chain. POS data should be captured by bar coding systems and scanners and passed through EDI systems directly to the headquarters and the main tiers of the supply chain (warehouse, apparel company's factories and fabric production factories). When the article is sold and captured by scanner through the bar coding system information about the kind of article, color, size and quantity of it should be sent automatically to the headquarters. The authors propose that the apparel company collects all POS data (quantity, size, color etc.) of the sold articles of clothing in a central electronic data bank. This central data bank should also contain data about the consumer markets in the various countries the apparel company is acting in.

The authors propose a sophisticated information computer system, which should be developed especially for the data exchange between the apparel manufacture and the retailers. All available product data, market data and further information should come in to the factories immediately. When the manufacturing entities receive data and information, they find out when a new order might come up and what this order might contain. When suppliers get important market information in time, they can make arrangements and thus they are prepared for a potential order and can begin with the production immediately when the order arrives. The suppliers can react and deliver quickly. In that way, the authors think that the lead-times can be kept short.

5.1.5.4 Information Exchange and Communication

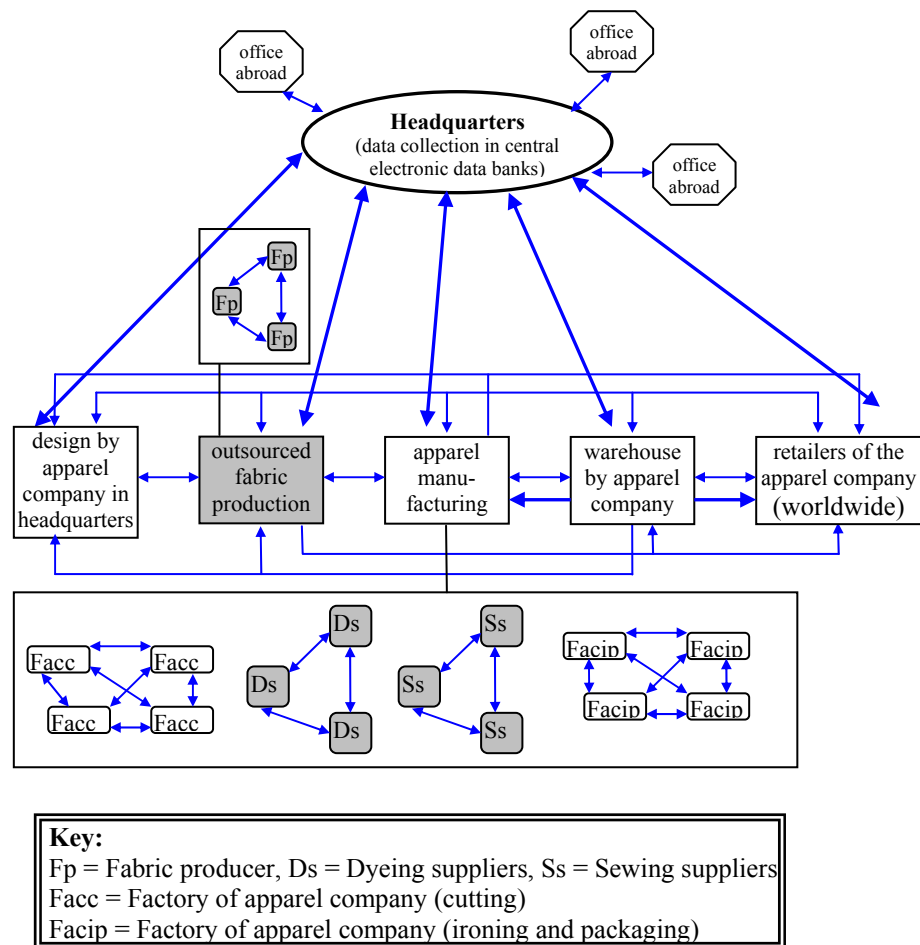
As previously mentioned, Stalk and Hout (1990) stated that time compression can also be achieved through providing each company in the chain timely information not only about orders but also about products, special needs and market data. As learned from Forrester's and Stalk and Hout's model, the authors focus also on information exchange. In this supply chain, the information and the quick, accurate, frequent and correct exchange of it should have priority. The authors think that information exchange and information share among all up and downstream partners and also the headquarters in the supply chain is the main factor to ensure short lead-times and quick response. All supply chain members have to be willing to share information. Data and information from all supply chain partners should flow together in the headquarters, where the decision-making departments of the apparel company are located. The basis for enabling information exchange is the equipment of the partners with the necessary *IT* and communication systems.

Figure 5.7 presents the information exchange between the entities, which the authors make visual with the arrows.

As mentioned previously, there should exist offices in the countries where the apparel company has large marketshares. The offices should conduct market research to find out country specific consumer requirements and sent all data and information to the headquarters. In that way, the apparel company can adapt to various fashion tastes in different countries.

The authors suggest introducing a computer network through which all partners are linked together. This should be used to send data between the entities. For instance, each partner should send in regular intervals e-mails to the other partners within the supply chain. Furthermore, as previously suggested, the partners could have access to the central data banks.

Figure 5.7: Information exchange between supply chain entities

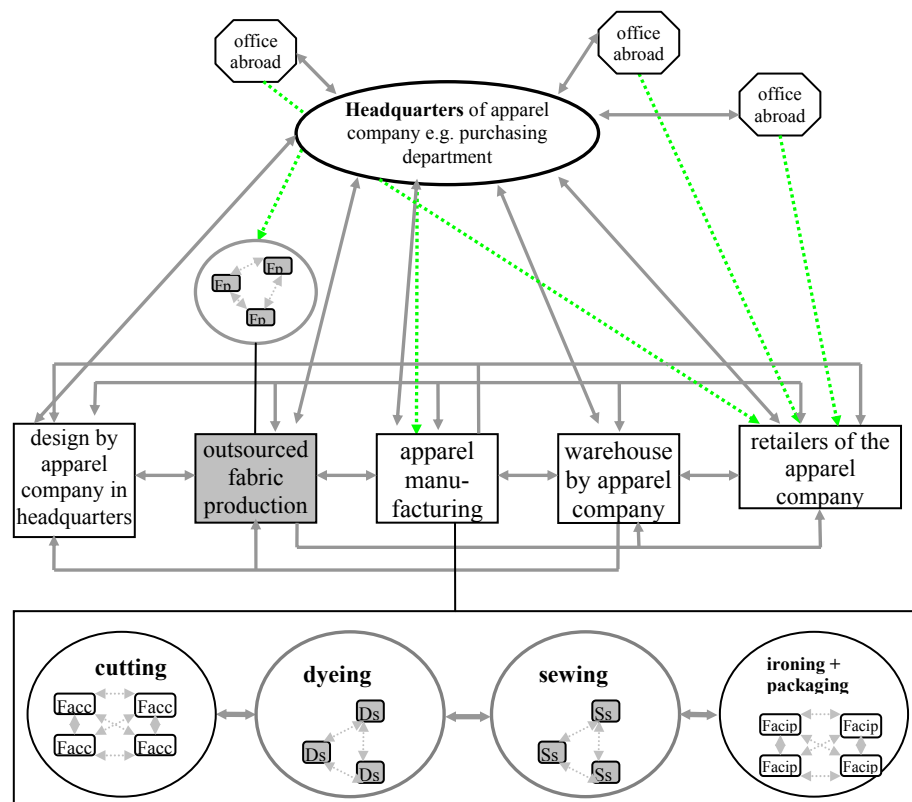


5.1.6 Relationships and Cooperation between Supply Chain Partners

A condition of fluent and accurate information exchange between the supply chain members is relationships between all of them. The authors think that this also leads to quick response and shortens the lead-time. They believe that close and efficient relationships facilitate the communication and information exchange between the entities. Thus, they suggest that one department in the headquarters of the apparel company should be responsible for the supporting and advising external suppliers and retail stores and building up close relationships with them. The offices of the apparel company abroad should have a supporting function for the retailers. Employees of these should visit the retail stores regularly and help if there occur problems. The support and care of the retailers in countries, where the market share of the apparel company is not large, should be coordinated from the headquarters. The authors also propose an extensive care of all external suppliers. The support of the external suppliers should be coordinated from the headquarters. A special

department in the company, for example the purchasing department should be responsible for them. The support should include for instance information and advice about faster and more efficient production and processing methods and technologies. The authors think that the whole supply chain can benefit with regard to time reduction when the suppliers work together. It is suggested that equivalent external suppliers (for example dyeing supplier with the other dyeing suppliers) collaborate, e.g. that they give orders to other suppliers when these are working to capacity. The authors suggest that further cooperation between external up and downstream suppliers between dyeing factory and sewing workshop should be managed and coordinated by the headquarters.

Figure 5.8: Collaboration, cooperation and supporting activities among supply chain partners



Key:	
Fp = Fabric producer	↔ = cooperation
Facc = Factory of apparel company (cutting)	⋯ = collaboration
Faci = Factory of apparel company (ironing)	↔ (green dotted) = supporting relationship
Ds = Dyeing suppliers	
Ss = Sewing suppliers	

The entities belonging to the apparel company (headquarters, apparel factories, warehouse, retailers and transport entities) should also cooperate to speed up processes and so shorten the lead-time. Figure 5.8 makes the relationships between the partners visual. In this figure, the outsourced parts in the supply chain have a grey margin. The lines point at the boxes, where the cooperation among the suppliers is presented.

5.1.7 Final Time Efficient Supply Chain Model

All the elements the authors considered in the previous sections of this chapter are based on the theories, which were presented in the third chapter.

The authors determine for their supply chain that it should be demand-driven instead of forecast-driven and information-based (see 5.1.5.4) instead of inventory-based. This means that the production of apparel is started when there is a market demand or, more precisely, when the apparel company notices a demand. The authors recommend an agile strategy for the supply chain. They think that their model fulfills the four necessary requirements (characteristics) to make a supply chain agile. Due to the information exchange and partnerships and also because it should be demand-driven, the supply chain is *market sensitive*. Through the technology and computer equipment and the use of IT, it is information-based and thus *virtual*. The partners in the supply chain should share information among each other, build up relationships and cooperate/collaborate. That is why it is *integrated* in *processes*. Finally, the partners in the author's supply chain are linked together in a network, which has to resist the competition. Figure 5.9 on the following page presents the final model the authors came up with.

This model presents the basic ideas, which were discussed in the previous sections of this chapter but some parts (like information exchange or partnerships) are not as detailed illustrated as in the sections where these were explained (see previous sections). The development of a time efficient model was the main objective of this dissertation. In the next section of this chapter the authors will set up some propositions from this model.

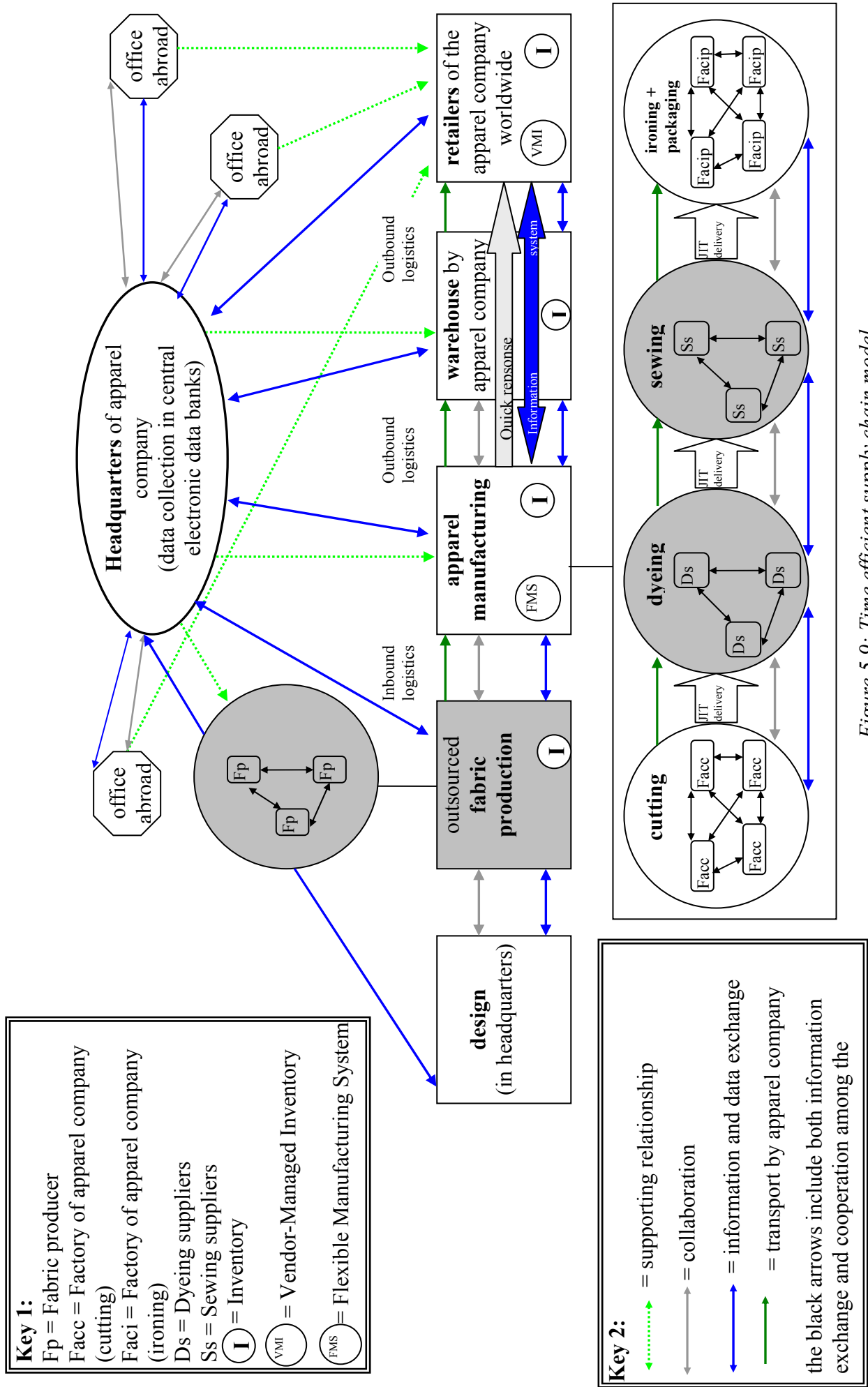


Figure 5.9: Time efficient supply chain model

5.2 Propositions

The authors set up seven propositions from the time efficient model they created in the previous section of this chapter. The authors chose the word “propositions” because it fits better than “hypotheses”. The reason is that there should be evaluation of some key suggestions the authors did in the model. Thus “testing of hypotheses” would be the wrong expression for that what the authors are doing actually.

Proposition 1 (technology):

A sophisticated information system for sales data and information between the point-of-sale (retail shops) and the main manufacturers/suppliers should be introduced. With this kind of system, manufacturers/suppliers could get immediate feedback from the point-of-sale and make necessary adjustments right away. Thus the response time to changing market demands can be shortened considerably.

Proposition 2a (transportation):

The transportation of all merchandize from the factory to the warehouse and from the warehouse to the retail stores over long distances by air reduces the transportation time and the lead-time significantly.

Proposition 2b (transportation):

The delivery of the newest and trendiest merchandise by airfreight shortens the transportation time and thus the lead-time to the market.

Proposition 3 (transportation):

The delivery of merchandize from the warehouse to the retailers should be carried out by the apparel company’s own trucks instead of outsourcing this function to logistics providers. Through handling the transportation in this way, the possible time delay could be minimized and greater flexibility could be ensured.

Proposition 4 (geographical location):

Instead of locating the manufacturing entities in the Far East, they should be located in European low cost countries (e.g. Poland) next to the main retail market. Thus, if the apparel company is also located in Europe it can deliver the merchandize faster and it can also respond quicker and more flexible to changing market conditions.

Proposition 5 (strategy and practice):

The elimination of the external distributors (agents) shortens the total lead-time of the supply chain. The reason is that because when there is one less entity the total lead-time will shorten.

Proposition 6 (relationships):

The headquarters of the apparel company should ensure that close relation (ships) is developed between itself and its (in-house) supply chain partners. Furthermore, it should take care to develop good collaboration between its own entities and external suppliers and also among the suppliers themselves (cooperation). These close relationships could facilitate and speed up the data and information exchange and this leads to shorten the total supply chain lead-time.

6. Empirical Method

This chapter presents the research strategy, time horizon and the data collection method especially for secondary data (continues with the research process “onion” from chapter two). In addition, the selection of the sample, operationalization, data analysis, reliability and validity are presented.

6.1 Research Strategy

The principle research strategy of this dissertation is a case study. The strategy adopted by this dissertation is to conduct research, which involves an empirical investigation of a particular contemporary phenomenon within its real life context using multiple sources of evidence (Robson 2002, 178).

As the supply chain of fashion industry is a very broad scope of study, conducting a case study research allows the authors to gain a rich understanding of the fashion industry. It provides an opportunity for an intensive analysis of many specific details habitually overlooked by other methods. Furthermore, with the information gathered from the case study, the authors were able to systematically analyze the time element in the supply chain of the fashion industry thus providing a source of new propositions that enable improved supply chain efficiency.

6.1.1 Type of Study

This dissertation employs three types of study: descriptive, exploratory, and explanatory studies.

A descriptive study is applied for the literature reviews and case studies in order to depict a clear picture of the related theories about supply chains and the current situation in the fashion industry.

An explanatory study is used to clarify the various components in the supply chain of the fashion industry and their impacts/relationships to the lead-time (i.e. from manufacturing to the hands of end-customers).

An exploratory study is used to find out what is happening in the supply chain of the fashion industry and to seek new insights regarding the issue of the quick response strategy in the fashion industry. Thus, it aims to help the companies to react more quickly than before and reap the potential benefits.

The authors also followed the principle way of conducting exploratory research by searching literature and then talking to experts in the fashion industry.

One of the advantages of an exploratory study is that it is flexible and easily changeable. The research focus should be initially broad and become progressively narrower as the research process (Adams & Schvaneveldt, 1991). The authors decided to focus on the time element in the supply chain after a field study (interviews) with the companies.

6.2 Time Horizon

This dissertation is based on a cross-sectional study (“snap-shot approach”). It means that it is a study of a particular phenomenon at a particular time (Saunders *et al.* 2003, 96). Although semi-structured interviews were conducted over a short period of time, the authors were not going to examine the supply chain of the fashion industry over a lengthy period of time. The authors looked at the supply chains of the current situation and tried to propose a model that might be useful in contemporary fashion industry.

6.3 Data Collection Method

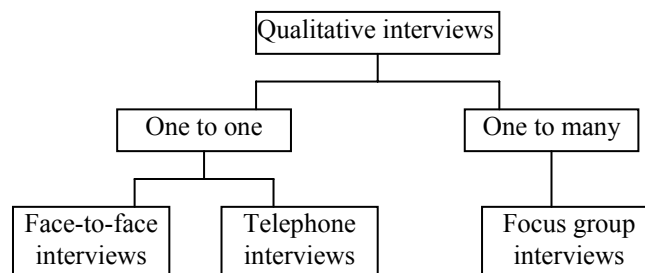
The collection of suitable, reliable and valid data lays the foundation of a meaningful research. It is important to identify the nature of data required to answer the author’s research questions. In this work, both primary and secondary data (see second chapter) were adopted.

Primary data are first hand data directly collected to be used in a specific project by the research. The main advantage of this data source is its validity; reliability and dependability to tackle the research question as this data are collected for the research purpose only.

Personal interviews are taken as primary data that are suitable for this dissertation due to the fact that they are relatively easy to be conducted within the time frame. The advantages of using interviews as primary data are:

- The information gathered is highly relevant to the topic because the interview is designed directly on the case study topic.
- The data collected are more insightful as they provides perceived causal inferences (Yin 1994, 80).

Figure 6.1: Forms of qualitative interview



(Saunders *et al.* 2003, 247, modified)

Someone may argue that the data collected from interviews may not be accurate due to poor recall, however, with the help of recordable MP3 player, the authors were able to record the interviews so as to minimize inaccuracies.

Nevertheless, the authors cannot say that there is no disadvantage in using interviews as a primary data collection methodology. Response bias is a common problem, perhaps because the interviewees have different levels of knowledge and experience. In addition, the interviewee may tend to give/say what the interviewer wants to hear.

Secondary data are what have already been collected (see chapter two) for some other purpose and contain both raw and published data summaries. This type of data are relatively easily accessible, inexpensive and quickly obtained. Documentations are the main source of secondary data in this dissertation. The authors focussed on books, articles from the Internet and established journals. Documentations are used to give the readers and the authors a theoretical background about the supply chain and the relevant elements of the fashion industry. It covers a relatively long span of time, many events and many settings. It contains exact names, references and details of the event. Documentation, usually, is not created as a result of the case and it can be reviewed repeatedly.

Like interviews, documentations also have disadvantages. Reporting bias may be the result of the authors' bias. Furthermore, as it is up to the authors which literature to select, biased selection may follow.

It should be mentioned that there are many other means of data collection method, which are not used in this paper, for example archival records, direct/indirect observations, participant observations, and physical artifacts. They are not selected in this dissertation for various reasons. Some of those methods are time consuming, for instance direct and participant observation. Some of those methods are not suitable for this paper due to technical constraints; such as, physical artifacts because the cultural feature is out of the scope of this dissertation.

6.4 Sample Selection

The authors's finance, time, and personal-relation limitations make it impossible to study the entire fashion industry. Moreover, the authors believe that in order to spot to the most important issue (the time element in the supply chain), it is more appropriate to undertake an in-depth study that focuses on a small number of cases.

Blend, Esprit, Hennes & Mauritz, MQ and Zara are chosen for investigate in the topic due to a number of reasons:

- All of the five companies belong to a manufacturing brand, which means the manufacturers themselves own the brand names, and they sell the final product to end-customers by their own retail-chain stores.
- All of the five companies have a similar retail market segment. Their main target customers are a younger generation.
- All of the five companies produce some (all) of their products overseas, in Far East Asia.

The similarities of the three companies' background make them suitable for an analysis in this dissertation.

Additionally, some more companies were selected to provide further information. These are the Topform Ltd. and Genexy Ltd. which are Hong Kong based manufacturers and Jantzen, which is an American based swim suits producer, have also been selected to provide further information.

Topform, Genexy and Jantzen are chosen primarily because of the authors' contact with the people working in the related industry. Although these three companies seem to have a very different background from the already mentioned five fashion retailers, they are in fact in different positions in the supply chain and therefore they were interviewed through e-mail and telephone. The authors believe that it will not only enrich the content of this research but also help to understand the supply chain. The authors also believe that with the experiences from the three different regions (the U.S., China, and Europe), the quality of the dissertation could be positively improved and this matches with the main objective of the author's course – International Business.

Finally, the ability of the authors to communicate with the native language of Topform, Genexy and Jantzen is another intention for the authors to include their experience in this work.

6.5 Operationalization

In order to operationalize the concept, the authors decided to conduct interviews in order to gather valid and reliable data. The authors believe that in-depth interviews can be very helpful to explore what is happening in the industry.

During the stage of field study, the authors adopted a rather unstructured and non-standardized way to conduct the interviews. The authors prepared a list of themes and questions but the order of questions were varied depending on the flow of the conversation. It should be noticed that all the respondents had answered the same set of questions set by the authors.

In the stage of evaluating the propositions, the authors also conducted semi-structured interviews with the respondent from the above-mentioned companies. Once again, the authors prepared a list of themes and questions but the order of questions was strictly followed in this time. As mentioned above, a MP3 player recorded the process of the interviews, in order to minimize inaccuracies.

6.6 Data Analysis

As a field study and as an evaluation, the authors conducted qualitative interviews with the already mentioned companies. Qualitative data are associated with such concepts and are characterized by their richness and fullness based on the opportunity to explore a subject in as real a manner as is possible (Robson, 2002).

The authors adopted the following main strategies to analyze the collected data:

- Discovering regularities
- Comprehending the meaning of text or action
- Reflection

The propositions were categorized into five main areas, which are technology, transportation, geographical location, strategy & practice and finally, relationships. The purpose of generating these categories is to facilitate easy grouping and comparing of the collected data.

6.7 Reliability

The authors tried to write in a way that minimizes the threats to the reliability to the paper. A standardized questionnaire about the ways to improve the response time of the supply chain was prepared in order to avoid the threat of observer bias.

When conducting the semi-structured interviews with the respondent from the above-mentioned fashion retailers and considering the complexity of the propositions, the authors decided to explain them and to make sure each of the respondents understood what was meant by the propositions. The authors explained the propositions based on their understanding from the contemporary literature and their own experience. However, the authors cannot guarantee that all respondents understand the propositions in the same way.

Furthermore, it should be assumed that the respondents have different levels of professional/industrial knowledge. Last but not the least, the respondents may have different levels of ability to understand English. The authors believe that this is also a crucial factor for understanding the propositions in the same way as the authors.

6.8 Validity

Validity is concerned with whether the findings are really about what they appear to be about (Saunders *et al.* 2003, 101). As previously stated, the time, financial and personal relation limitation and the numbers of companies used as a sample are very limited which may affect the validity of the work. However, the authors used a wide-range of research for the secondary data and

the authors believe that the most relevant and valuable theory and data have been included in this dissertation.

Although the authors cannot state with assurance that all the points in the theory are included, the authors believe that with the help of the interviews with the persons who work in the industry, state-of-the-art techniques adopted in the fashion industry are a considered and a rather comprehensive analysis has been made with the help of both practical and theoretical knowledge.

7. Analysis of the Interviews

In this part, the authors try to evaluate the proposition by conducting in-depth interviews with four apparel companies, which are Blend, Esprit, Hennes & Mauritz (H&M) and MQ. The primary purpose for the interviews was to verify if the propositions are applicable in practice. After that, the results of the interviews are presented.

7.1 Analysis of the Evaluation of Propositions

The authors are aware that the ideal situation would be to interview responsible persons from the headquarters. These persons would have an overall view about the complete supply chain in their company. The retailers are not able to evaluate the model in the same way, as the personnel from headquarters would be because they constitute the last echelon in the supply chain. Unfortunately, the authors were only able to interview store managers of local retail stores. This is because the authors had some trouble scheduling meetings with personnel from the headquarters of the stores. Time and money (as previously mentioned) was another problem.

7.1.1 Proposition 1 (Technology)

A sophisticated information system for sales data and information between the POS (retail shops) and the main manufacturers/suppliers should be introduced. With this kind of system, manufacturers/suppliers could get immediate feedback from the point-of-sale and make necessary adjustments right away. Thus the response time to changing market demands can be shortened.

Table 7.1: An overview of respondents' attitudes towards proposition 1

	Strongly Agree	Agree	Neutral	Disagree
Blend		✓		
Esprit	✓			
Hennes & Mauritz	✓			
MQ	✓			

The authors found that the responses from the four interviewees to the introduction of the information system were in fact very positive. As of now, the mechanisms used by the companies to collect the information from point of sales are quite different.

Hennes & Mauritz tags each product with a five-digit barcode and this barcode system helps the POS to record everyday sales. In addition, there is an information system installed between each retail shop and the head office in Stockholm, Sweden. The information in the database is accessible by all retail shops, the warehouse in Eskilstuna, Sweden and the head office in Stockholm. That means the manufacturers can only receive feedback from the head office of Hennes & Mauritz but not from the market. The respondent from Hennes & Mauritz reflected that if the information system had built further down to the suppliers, the problem of mismatch of supply and demand would probably be reduced. “Because the suppliers will be able to know more about what the market really need and they are able to prepare”, the respondent explained. When the manufacturers are able to identify the sales pattern, they will be able to re-arrange their production resources to fit the possible order from the apparel company. By that way, the compression of response time to the changing market conditions can be ensured.

In Esprit, the store manager needs to produce a sales data fact sheet every week and send it to the Scandinavian head office in Denmark. Esprit does not offer any cash-desk system or merchandise-systems. Although they are developing an EDI Interface between the retail stores and the head office. Through the EDI-Interface, the retail shops can send sales and inventory report to the head office and receive product master data, order response and dispatch advice from the head office. Similarly, the manufacturers can only receive feedback from the head office of Esprit passively but not from the market.

The respondent of Esprit agreed that the proposed information system could reduce the response time and as a result shorten the lead-time of the whole supply chain. She said that if the manufacturer were able to access to the sales and inventory information, they might be able predict the trend of sales. The

respondent pointed out that the speed of replenishment of stock could be improved.

It is true that if the manufacturers know the inventory level of the retail stores, they can replenish the stock for the stores provided that the company adopts a Vendor-Managed Inventory system (see page 40).

MQ and Blend, do not have any information systems built between the head office and the POS. The respondents informed the authors that they produced a sales data fact sheets regularly and sent it back to the head office through e-mail.

The respondent from Blend expressed concern that the exposure of confidential sales data might result in a destructive effect to the company. Although this issue is out of the scope of this dissertation, the authors concur with the respondent's concerns. The respondent and the authors have the same opinion that a comprehensive set of procedures for the selection of main suppliers to gain the right to access to the data could ensure the safety of the company

Based on the information gathered, the authors believe that this proposition is supported by all of the four interviewed apparel companies.

7.1.2 Propositions 2a and 2b

7.1.2.1 Proposition 2a (Transportation)

The transportation of all merchandise from the factory to the warehouse and from the warehouse to the retail stores over long distances by air reduces the transportation time and the lead-time significantly.

There are two issues inside:

1. Delivery from the factories to the warehouse, and
2. Delivery from the warehouse to the distributors

*Table 7.2: Respondents' views on proposition 2a
 -- delivery from the factories to the warehouse by air*

	Strongly Agree	Agree	Neutral	Disagree
Blend				✓
Esprit				✓
Hennes & Mauritz				✓
MQ				✓

Concerning the delivery of the factories to the warehouse, all of the four companies agree that it is impossible to deliver all the products by plane. The companies' main concern is about the extra transportation cost for delivering the merchandize by air comparing to the traditional means by ship. The companies share the same idea that transporting the products by air is much faster than by ship, it is not cost effective.

As mentioned by the respondent from Blend, "We will make an order for winter during the summer, so they will have plenty of time to ship the products".

The authors discovered that in practice, delivering all the products by air is not necessary in the fashion industry. The total lead-time from the factories to the warehouses would be shorter if the companies delivered the merchandise by air. The more the costs of transportation the higher are the unit costs of the product and thus the price will rise. Referring to the discussions above, the authors believe that this proposition is not practicable.

*Table 7.3: Respondents' views on proposition 2a
 - delivery from the warehouse to the retail stores by air*

	Strongly Agree	Agree	Neutral	Disagree
Blend				✓
Esprit				✓
Hennes & Mauritz				✓
MQ				✓

Concerning the delivery from the warehouse to the distributors, the opinions gathered from the four respondents were quite similar. The respondents said that there was no immediate need to deliver the merchandize from the warehouse to the distributors by air. They stated that they felt quite satisfied with the existing transport mode by train and trucks.

In addition, they all emphasized that the cost of transportation would be enormous because of the frequent delivery and high cost of taking the plane.

Table 7.4: An index of warehouse locations and frequencies of delivery

<u>Name of the companies</u>	<u>Location of warehouse</u>	<u>Frequency of delivery</u>
Hennes & Mauritz	Eskilstuna, Sweden	Everyday
Esprit	Germany	2 times a week
MQ	Borås, Sweden	3 times a week
Blend	Denmark	Once a week

However, the respondent from Esprit said that they did want the warehouse to deliver the goods by air occasionally. Esprit has 12 clothing lines a year and the retail shops make an order every month. Four months are required from the date of ordering till the date of delivery to the shops. Whenever the retail shops need, they can go on the Esprit B2B e-shop to replenish their stock (from Germany) and it will take five working days or more for them to receive the goods. “Faster is always better! It’s true that the customers do not even want to wait for one more day!” the respondent from Esprit said.

Referring to table 7.4, the distance between the warehouse location of H&M, MQ and Blend with the retail shops is relatively short comparing with that of Esprit.

The authors conclude that the proposition of delivering all the merchandize by air from the warehouse to the retail shops is not suitable in practice. Nevertheless, after this evaluation the authors think that the location of warehouse affects the answer of the respondent. One should not neglect the relationship between the location of the warehouse and the mode of

transportation (proposition 4 will discuss the issue related to geographic location).

7.1.2.2 Proposition 2b (Transportation)

The delivery of the newest and trendiest merchandize by airfreight shortens the transportation time and thus the lead-time to the market.

Table 7.5: Respondents' views on proposition 2b

	Strongly Agree	Agree	Neutral	Disagree
Blend				✓
Esprit		✓		
Hennes & Mauritz	✓			
MQ	✓			

The three respondents from Hennes & Mauritz, Esprit, and MQ, said that it would be possible to deliver the newest fashion products by air in order to shorten the transportation time. Only the respondent from Blend said that it was not acceptable to pay the extra cost for the air flight in return for the limited profit. She explained that the company's main selling items were jeans and the style of jeans would not change at an un-expectable speed. She also pointed out that it took quite a long time for the customer to accept a pair of newly designed jeans, even for the young generation. Therefore, she claimed that this proposition was not acceptable.

The respondents from Hennes & Mauritz and MQ jointly indicated that they had requested the suppliers to delivery the products by air in the past.

For MQ, the respondent said it was common for the customers to made comments on their clothes. Based on these comments, plus when MQ saw the quick growing trend, they will consider sending the merchandize by air. The respondent said that the primary drive for MQ to act in this way was to reap the potential quick profit and competed with other retailers. As the respondent said, "A rush is a rush!"

The respondent from Hennes & Mauritz stated that the company wanted to provide the trendiest items to the customers. He provided an example; a Poncho that is a very popular item in the autumn and winter 2004 would be a loss to the company if the supply did not match with the demand.

Although both of the respondents from Hennes & Mauritz and MQ disclosed that the companies did not transport the merchandize by air very often in the past, they mentioned that their companies would probably increase the frequency of adopting it.

The authors believe that the suggestion of delivering the newest and trendiest merchandise from the factories to the warehouse by air will be increasing adopted by the fashion company. It is because there is increasing demand uncertainty in the fashion industry. The interviews had an implication that only the company who can response to the customers and satisfy their needs will be survive. Therefore, the authors believe that this proposition is applicable in practice.

7.1.3 Proposition 3 (Transportation)

The delivery of merchandize from the warehouse to the retailers should be carried out by the apparel company's own trucks instead of outsourcing this function to logistics providers. Through handling the transportation in this way, the possible time delay could be minimized and also greater flexibility and shorter waiting time could be ensured.

Table 7.6: Respondents' views on proposition 3

	Strongly Agree	Agree	Neutral	Disagree
Blend				✓
Esprit				✓
Hennes & Mauritz				✓
MQ				✓

The warehouse of Blend is located in Denmark, which is not very far away from Kristianstad, Sweden. The respondent from Blend said that the company

had been employing UPS as a partner to transport the merchandize from the warehouse to the retail chains. The respondent believes that this relationship is reliable and is sustainable because there has not been any mistakes made by UPS regarding to the delivery.

The warehouse of Esprit is in Germany and the company delivers the products by a few logistics companies, namely UPS, DHL and Swedish Post Office as well. Large batches of products, such as clothes are delivered by the Swedish Post Office while small but important products are delivered by the UPS or DHL. The respondent mentioned that it was not necessary for Esprit to develop its own trucks team because it would increase the cost of transportation. She also pointed out that transportation was not the strength of Esprit so that Esprit should outsource the transportation function to other professional companies. Furthermore, she said the company felt satisfied with the logistics companies because they were reliable and relatively fast.

The respondent from Hennes & Mauritz mentioned that the company received the products from the central warehouse everyday. The main logistics company Hennes & Mauritz employed were DHL and Green Cargo under which sub-tier contractors did exist.

Both respondents from Hennes & Mauritz and Blend mentioned that it would not be as flexible as they are now if they possess their own trucks. It is because the companies would only start delivery until the trucks are fully loaded in order to save various cost of transportation, for instance, the cost of fuel. As a result, the flexibility would be reduced and cause longer lead-time.

The respondent from MQ reflected the similar opinions as the other three companies. MQ have a contract with two logistics companies namely ASG and Danzas. The respondent said that the company was happy with the logistics companies and MQ regarded the two logistics companies as part of the supply chain. As the respondent said, "They need us and we need them!"

The authors discovered that the proposition of delivering the merchandize by in-house trucks is not applicable in practice. The authors believe that the apparel companies have two main concerns:

- The cost of running the in-house trucks
- The flexibility of running the in-house trucks

It can be concluded that it seems not worthwhile for the apparel company to take the risk of changing the existing method of delivery and bear the potential cost that might result.

7.1.4 Proposition 4 (Geographical Location)

Instead of locating the manufacturing entities in Far East countries, they should be located in European low cost countries (e.g. Poland) next to the main retail market. Thus, if the apparel company is also located in Europe it can deliver the merchandize faster and it can also respond quicker and more flexible to changing market conditions.

Table 7.7: Respondents' views on proposition 4

	Strongly Agree	Agree	Neutral	Disagree
Blend			✓	
Esprit		✓		
Hennes & Mauritz	✓			
MQ			✓	

Regarding to this proposition, the response gathered from the four companies are quite diverse but tend to support the proposition.

As informed by the respondent from Hennes & Mauritz, the company has 21 production offices around the world, of which ten are located in Asia, another 10 are located in Europe and one is located in Africa. The company does not have its own production facilities; rather it has over 900 suppliers from different regions around the world. The respondent said, "It is absolutely true that the factory located nearby response faster! Look at Zara!"

As mentioned above, Zara manufactures approximately 50% of its products in its own network of 22 Spanish factories. The other half of its products are procured from 400 outside suppliers, 70% of which are in Europe, and most of the rest are in Asia. Many of the European suppliers are based in Spain and Portugal.

The respondent from Hennes & Mauritz mentioned that it was not uncommon that a fashionable product comes up suddenly, for example men's scarves were very popular last year, which he did not expect. He said geographical proximity could ensure quick response to the company's orders.

The respondent from Esprit agreed that locating the manufacturing factories in the European countries that are close to the main retail market region might reduce the response time to the market. In addition, the respondent mentioned that the ability of replenishment would also improve as the distance between the factories and retail stores decreased.

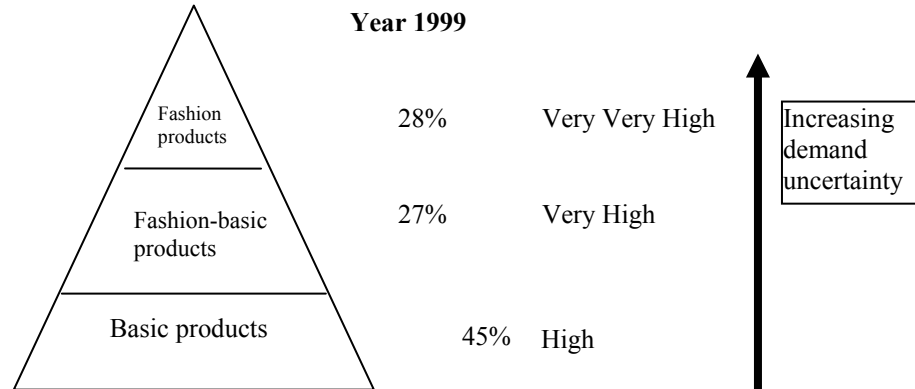
The respondent from MQ had quite a different idea with than the respondent from H&M. The respondent agreed that geographical closeness might ensure quick response, however he thought that the cost of production in Far East countries was still much cheaper comparatively. The higher production cost will return higher retail price, which the customer is going to bear the cost. Furthermore, the respondent drew the authors' attention to the fact that all the World Trade Organization Members have committed themselves to remove the quotas by the first of January 2005. The authors understand that the removing of the quota system implies that there will be pressure to lower the cost of production in far-east countries due to competition.

The respondent from Blend had no opinion on this proposition.

After interviewing the four companies, the authors have the same opinion as the respondents that geographical proximity will highly probable to reduce the response time thus total lead-time. Referring to figure 7.1 (next page), it is true that the demand uncertainty is increasing because the preferences of customers

change rapidly, so the proportion of “fashion products” will becoming more and more important.

Figure 7.1: Fashion triangle describing the demand uncertainty



(Hammond, 1999)

Although the cost factor is out of scope of this dissertation, the authors think that it could be possible for the apparel companies to procure the basic products in Far East countries to capture the cost advantage. On the other hand, the apparel companies could produce the fashion products and part of the fashion-basic products within the same country or neighbor countries in order to benefit from quick response to the market.

7.1.5 Proposition 5 (Strategy and Practice)

The elimination of the external distributors (agents) shortens the total lead-time of the supply chain. The reason is that since there would be one less entity it shorten the total lead-time.

Table 7.8: Respondents' views on proposition 5

	Strongly Agree	Agree	Neutral	Disagree
Blend			✓	
Esprit	✓			
Hennes & Mauritz	✓			
MQ			✓	

The respondents from Hennes & Mauritz and Esprit support this proposition. But the respondent from MQ had specific concerns regarding this issue. The respondent from Blend has no opinion about this proposition.

The respondent from Esprit said that the company had started their operation in Hong Kong as early as the 1970's. She revealed that the company had done business with this kind of distributors (agents) in the past for the purpose of sourcing production facilities in Hong Kong. From the website of Esprit, the authors found that Michael Ying, who was the sourcing agent, became the co-owner of Esprit Holdings Ltd in the middle of 1970's. This means the company has already brought the function of in-house. The respondent mentioned that as the company does not need to spend so much time sourcing these agents in Far East countries, the total lead-time is definitely shorten.

As mentioned above, Hennes & Mauritz has 21 production offices. The responsibilities of them are to source textiles and garments in different regions. Some of these production offices deal with the external agents and some of them deal directly with the manufacturers. The respondent from Hennes & Mauritz agreed that one intermediary less would shorten the total lead-time.

The respondent from MQ, however, said that without the help of these external distributors (agents), the company had to have someone to perform the responsibility of these agents. "What they have to do now is just placing an order to the agent who is going to follow up all the production and sometimes shipment of it", the respondent described. However, without the help of the agency it would take longer time for the company to explore the reliable suppliers. The respondent further pointed out that the company might not possess the required information about the manufacturers and the suppliers. Thus it would be easier for the company to fall into the potential business trap. Nevertheless, it should be noticed that the respondent agreed that the total lead-time would be shorten if the company had sufficient supplier information.

The authors and the interviewees think that if the company was able to find out the suitable suppliers, the elimination of the external distributor (agent) would reduce the total lead-time. Although it is out of the scope of this dissertation, the authors discovered that the concern of the apparel companies would be the ability of the company to find reliable manufacturers/suppliers. The authors believe that in today's technology era, the difficulties for the company to source the suitable suppliers should be gradually reduced. In the light of above, the authors conclude that this proposition is supported by the interviewees.

7.1.6 Proposition 6 (Relationships)

The headquarters of the apparel company maintain close relationships with its supply chain partners. These close relationships could facilitate and speed up the data and information exchange and this leads to shorten the total supply chain lead-time.

Table 7.9: Respondents' views on proposition 6

	Strongly Agree	Agree	Neutral	Disagree
Blend	✓			
Esprit	✓			
Hennes & Mauritz	✓			
MQ	✓			

All of the four respondents reacted positively to this proposition. They all agreed that closer relationships with supply chain members would shorten the lead-time.

The respondent from Hennes & Mauritz mentioned that the company did a lot to support its suppliers. For instance, the company discovered that the problem of working overtime was quite serious in its factories in China and Cambodia. Therefore, they set up a course of actions to investigate the problem. The company gave guidelines to the factories in how to improve the working environment, increase productivity and reduce quality problems. The purpose of these guidelines is to reduce the days off sick and to lower staff turnover. Higher productivity and shorter lead-time could be resulted. In the long term it

will enable the company to motivate the suppliers to reduce the amount of overtime worked but without reducing the factory's profitability or employees' incomes.

The respondent from MQ informed the authors that the company occasionally had a meeting with the representative from the logistics companies (ASG, Danzas). He said that MQ would give feedback to the logistics companies and would specific any changed requirements to the companies.

The respondents from Esprit and Blend also mentioned that they had meeting with the representative from the logistics companies when necessary.

As all of the four interviewees support this proposition, the authors conclude that the closer relationships between supply chain members will shorten the supply chain lead time through speeding up the data and information exchange.

7.2 Summary for the Research Questions

The primary purpose for the part of the empirical study is to evaluate the propositions set up by the authors in order to answer the research questions:

- 1) Which measures could be taken by an international fashion apparel retailer to shorten the lead-time and consequently the lead-time gap?
- 2) Which measures could be taken by an international fashion apparel retailer to enable it to respond more quickly to changes in the market?

The authors tried to contact 15 international apparel companies from different countries including America, Asia and Europe. The authors were only able to conduct face-to-face interviews with five of them. The rest of them either did not reply to the authors' e-mail or rejected the request of being interviewed. Nevertheless, the authors believe that the findings from the qualitative interviews with the five companies are very informative and helpful to this research.

Table 7.10: A summary of respondents' views towards the propositions

Proposition	<u>Response from interviewees</u>
Proposition 1	Support
Proposition 2a	Reject
Proposition 2b	Support
Proposition 3	Reject
Proposition 4	Support
Proposition 5	Support
Proposition 6	Support

Proposition 1 (Technology): The respondents agree that a sophisticated information system can be built up between the POS and the main manufacturers/suppliers. The authors and the respondents have the same opinion the response time can be shortened because the manufacturers can get an immediate response from the retail market.

Proposition 2a (Transportation): This proposition is not supported by the respondents. It is because the respondents think that there is no immediate need to deliver the product by air from the factories to the warehouse and from the warehouse to the retail stores.

Proposition 2b (Transportation): The respondents support the idea of delivering the newest and trendiest merchandize from the factories to the warehouse by air because there is increasing demand uncertainty in the fashion industry. As the transportation time is reduced, the lead-time gap can be compressed.

Proposition 3 (Transportation): The respondents believe that having their in-house trucks will not shorten their waiting time. The respondents think that the existing logistics companies perform satisfactorily.

Proposition 4 (Geographical Location): The respondents support the proposition that locating the manufacturing factories close to the main retail market region. When the factories are close to the main retail market region, the manufacturers can response quicker to the order from the apparel company. Besides, the shorter distance between factories implies shorter transportation time and shorter lead-time.

Proposition 5 (Strategy and Practice): The authors conclude that the elimination of the external distributors can be a good way to shorten the total lead-time. Without the external agent, the apparel company can directly deal with the suppliers and thus reduce the lead-time.

Proposition 6 (Relationships): The authors and the respondents have the same opinion that having close relationships with supply chain member can shorten the lead time. It is because the relationships facilitate the exchange of information between the supply chain members.

As a summary, the authors believe that this dissertation has provided some useful suggestions for international fashion apparel retailers to:

1. Shorten the lead-time and consequently the lead-time gap.
2. Respond more quickly to changes in the market.

8. Conclusions

In this final chapter the dissertation is summarized. A discussion about the applicability of the model follows. In addition, some modifications of the model are made. In the last section the authors make summarizing conclusions.

8.1 Summary of the Dissertation

The apparel and fashion industry is a rapidly changing and growing market. The need for a more time efficient model is a goal that everyone involved in the supply chain strives for. The apparel industry demands an efficient supply chain as possible due to the cyclical nature of changes in fashion and weather. The main objective of this dissertation was to come up with a supply chain model that can be used for international apparel retailers in search of a better, more time efficient supply chain. The primary objective of a time efficient is to reduce overall lead-time. The secondary objective and benefit is to enable the retailer to respond more quickly to changing market requirements, which come up frequently in the fashion apparel market.

The authors started with a review of the literature and chose four theoretical models, which contain the basic (clothing) supply chain structure and the time problem. These were *Porter's Value Chain*, Jay Forrester's *Classic Supply Chain*, Stalk and Hout's model of the *Basic Clothing Supply Chain* and finally the *Integrated Agile Supply Chain Model* by Christopher and Towill. In order to have also an example from the practice, the authors considered Zara's supply chain, which is known as one of the most successful fashion retailers with an extremely short supply chain lead-time. The authors included also time reduction practices and strategies like *time compression*, *QR* and *flexible manufacturing*, *JIT* and *VMI* and also the different *transport modes*. These theories constituted the basis for the time efficient supply chain model. Parallel to this, the authors interviewed and sent questionnaires out to people in the apparel industry asking them questions about their current supply chains. These were not directly included in the dissertation but gave the

authors useful background information. After reviewing the mentioned theories, the authors chose relevant parts from every previously introduced models or practices that were useful for the model. In the fifth chapter the model was developed based on the relevant elements. It contains five basic echelons. Furthermore, it comprises outsourced functions, geographical location and transport, various time strategies and practices, technical equipment of the supply chain members (with focus on *IT* and information exchange) and relationships (cooperation/collaboration) between the partners. The authors assume that if an international apparel retailer would adopt all elements or even only some, which seem to be relevant for the company could reduce the total lead-time of the supply chain. This would enable the company to respond more quickly to changing market demands. The authors formulated seven propositions from the model. These were necessary to evaluate the model through interviews with retail store managers.

The authors went back to some of the subjects that were interviewed and asked them to review the model that was made and to provide feedback. The interviews were analyzed in a qualitative way. The research and personal interviews have affirmed that the supply chain model for apparels includes very important parts.

8.2 Applicability of the Model

The supply chain model, which was built in the fifth chapter, contains five following echelons:

- Design (by apparel company)
- Fabric production (outsourced)
- Apparel manufacturing (in-house cutting, outsourced dyeing, outsourced sewing and in-house ironing and packaging)
- Warehouse (by apparel company)
- Retailers worldwide.

These are basic tiers, which appear in apparel supply chains. As is detailed in chapter five, there are more specific sub categories of the model but the above

points are the main parts of the model. The authors suggested that the headquarters of the apparel company should be the central supervising entity and coordinator for the whole supply chain. The authors focussed in their model also on geographical location and transport, strategies and practices, technical equipment (to speed up the information flow) and relationships (cooperation and collaboration between supply chain partners). The authors thought it would lead to reduction of lead-times and make the supply chain respond more quickly to changing market requirements. The authors find that all elements included in their model are close to reality.

The model was the fundament for seven propositions the authors set up from it. These were the starting point to evaluate the model.

The authors set up one proposition concerning the technology, three transportation propositions and one proposition referring to geographical location. Furthermore, the authors came up with one proposition for strategy and practice and one for relationships.

That the model is close to reality was proved by the interviews. Only two propositions were rejected. As summarized in chapter seven (see page 92), two propositions were rejected by the respondents. The authors conclude that their model is realistic and thus (parts of it) applicable to the practice.

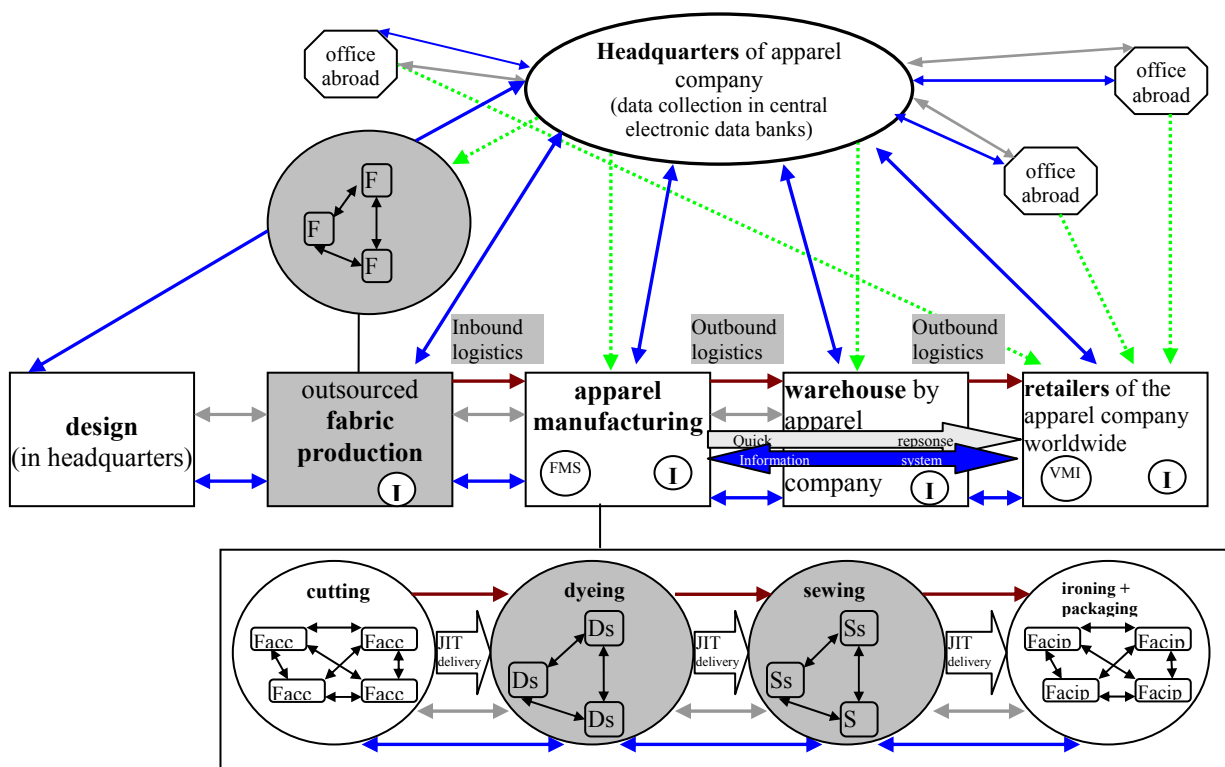
8.3 Modifications of the Model

The first proposition rejected by the respondents was proposition 2a. This proposition was to transport the apparel by airplane from the factory to the warehouse and from the warehouse to the retailers over long distances. The respondents rejected this because of the extensive costs (that might arise by adopting this proposition) and not in regard to shorten the transport lead-time. Thus, the authors believe that this proposition is indeed valid regarding the reduction of the transport lead-time. Nevertheless, because of the legimative cost concerns, the authors decided to change this in the model. The authors will not make modifications directly in the graphic figure of the time efficient model. In regard to make the model more realistic, the authors make following

modification: the apparel should only be transported by air over long distances when it is really necessary.

The second proposition that was rejected by the respondents is proposition 3, which deals also with transportation. The interviewed store managers answered that it will not shorten the lead-time simply because the transport is carried out by the apparel company's own trucks. The authors assume now that it might be better to outsource this function to competent and reliable logistics providers. These are specialized in transport (and everything what belongs to logistics) and thus, they can maybe carry out the transport much more efficient and faster than the apparel company. Thus, the authors make the modification in their model that the whole transport, either by *air* or by *motor* should be outsourced to logistics provider. The authors believe that the modifications improve the model. Figure 8.1 illustrates the time efficient model again with modifications concerning the transportation.

Figure 8.1: Modified time efficient supply chain model



Key 1:
Fp = Fabric producer
Facc = Factory of apparel company (cutting)
Faci = Factory of apparel company (ironing)
Ds = Dyeing suppliers
Ss = Sewing suppliers
I = Inventory
VMI = Vendor-Managed Inventory
FMS = Flexible Manufacturing System

Key 2:
= supporting relationship
= collaboration
= information and data exchange
= outsourced transportation
the black arrows include both information exchange and cooperation among the suppliers

8.4 Final Conclusions

This study has developed a new supply chain model for fashion apparel companies that help them to be as time efficient as possible. This is an issue of particular importance for firms in the apparel industry because of the seasonality of the business. Additionally, these companies are extremely competitive and must react very quickly to changes in styles and trends in order to succeed.

Based on the interviews, the model had to be altered slightly (see section 8.3) but most of the managers interviewed approved of the model and thought it could improve their current process. The sample size is not high enough to confirm that it is a perfect model but it is a starting point for further research.

While the bulk of the basic research in the field was done locally in Kristianstad, Sweden, additional research was also conducted via email and telephone with apparel industry experts in North America and China.

Due to about a three-month time limit and the limited amount of resources available, the authors recommend further research to be done on this topic and particularly this model. The authors of this dissertation did not have a large enough sample size in order to conduct a proper and sufficient questionnaire and the personal interviews were rather limited. The authors believe that this is a good starting point for further research to be done.

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Appendix 1

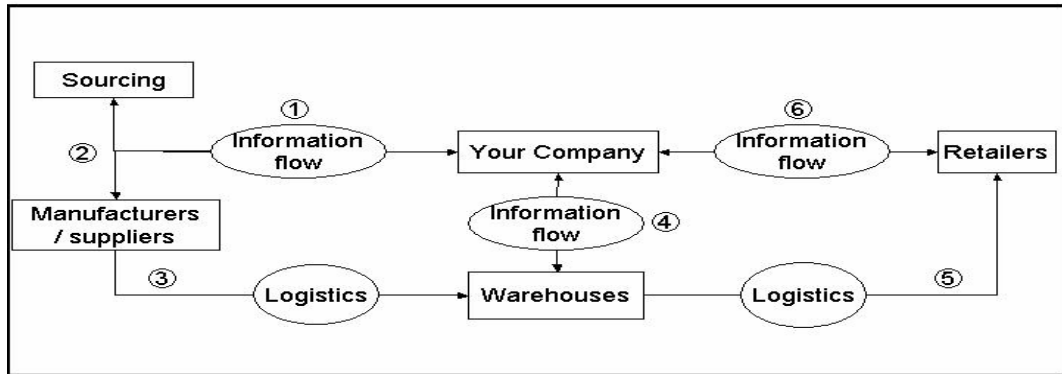
List of Interviewees:

- 1) Store Manager (Hennes & Mauritz)
- 2) Agneta & Lamila – Shop owner (Esprit)
- 3) Christina Hellström – (Blend of America)
- 4) Anders Karlberg - Shop owner – (MQ)
- 5) Michelle Crebbin – Operating Manager (Jantzen)
- 6) Wu tin long timothy - sales co-ordinator (Topform brassiere manufacturing company Ltd)
- 7) Wong Wai Chi Dawn – Assistant buyer (Genexy manufacturing company Ltd)

Appendix 2

Predistributed Questionnaire

(Note: This questionnaire was distributed prior to the development of the model.)



Note: Information flow includes information systems and the communication between the units.

1. Is the supply chain of your company similar to ours? (refer to our above model). If not, please comment on it.
2. Is (Are) there any specific characteristic(s) in the fashion industry that affect(s) the design of your supply chain?
3. What are the unique advantages in your supply chain that make it competitive?
4. What are the disadvantages in your supply chain and why?
5. What are the factors in your supply chain that your company cannot influence?
6. What factors are needed to make your supply chain move the most quickly and be the most cost effective?

7. Which part of the supply chain of your company is outsourced and why?

8. What is the managerial structure of your company?

9. What kind of information system does your company adopt and where is it adopted?

Please provide us your position and the department you work at in your company?

Appendix 3

Propositions

In this part, the authors seek to test the theoretically based proposition to four apparel companies (Blend, Esprit, Hennes & Mauritz and MQ). The primary purpose for testing the proposition is to verify if the propositions are applicable in practice. After that, the model will be modified based on the professional opinions from the interviewees.

Proposition 1. (Technology)

To introduce a sophisticated information system for sales data and information exchange directly between the point of sales (retail shops) and the main manufacturers/suppliers. With this kind of systems, manufacturers/suppliers can get immediate feedback from the point of sale and make necessary adjustment immediately so that the response time to the changing market conditions can be shorten. Do you agree? Why or why not?

Proposition 2.1 (Transportation)

Would it be acceptable for the apparel company to deliver ALL the merchandise by air from the factory to the warehouse and from the warehouse to the distributors over long distances to shorten the transportation time and the lead-time significantly. Why or why not?

Proposition 2.2 (Transportation)

To deliver the newest and trendiest merchandise by air in order to shorten the transportation time thus the lead-time to the market. Would it be acceptable for the retail chain to afford the added cost of delivery considering the potential profit that could be captured from the selling of the afore-mentioned trendiest merchandise? If yes, what kind of products it could be? If not, why?

Proposition 3 (Transportation)

Instead of outsourcing to other logistics companies to delivery the merchandise from the warehouse to the retailers, the apparel company may deliver the merchandise by the in-house trucks so as to minimise the possible time delay. Would it be acceptable for the retail chain to afford the added cost of delivery for the benefits from greater flexibility and possible shorter waiting time.

Proposition 4. (Geographical location)

Instead of locating in the traditional far-east countries, the apparel company may locate the manufacturing factories in the European low cost countries (e.g. Poland) that are close to the main retail market region so that the transportation time (from production to the warehouse/distributors/retailers) and lead-time could be reduced. Would it be worthy for the apparel company to afford the added cost of production considering to gain the ability to response quicker and to be more flexible to changes.

Proposition 5. (Strategy and practice)

The elimination of the external distributors (agents) shortens the total lead-time.

Proposition 6. (Relationships)

Do you think it's very important to have Close relation(ships) between supply chain members facilitates and fastens/speeds up the data and information exchange and this leads to shorten the supply chain lead-time. What have your company do to invest on building the relationship? Is it worthy to do so?