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Management Issues in Global Logistics with Offshored Production Systems

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Abstract:
This paper is directed at discussing some of the management issues, problems and solutions of logistics in the context of offshored productive activities The introduction includes a discussion of the logistics topics and an introduction of the economic logic of offshoring. The main part analyses the logistics topics with regard to the internationally fragmented production. The topics of logistics include: Information flow and integration, transportation, inventory management, warehousing and materials management, packaging management, customer service, risk management, logistics strategies and supply chain design. For each of the discussed topics a company or industry example is given to illustrate the applications. The analysis is based on a review of the existing academic literature in each of these fields.
Key Words: Offshoring, International Logistics, Global Supply Chain Management, International Production

Declaration of Authenticity

I hereby declare that the Master´s Thesis presented herein is my own work, or fully and specifically acknowledged wherever adapted from other sources. This work has not been published or submitted elsewhere for the requirement of a degree program.

Prague, 28 August 2011 Signature

Content

Introduction

In a globalizing world offshoring and outsourcing of certain activities within a company are very common. Grossman and Rossi-Hansberg (2006) hold that while trade has been a centuries old mode of trade, the recent developments in technology, transportation and communications methods have led to a new strain of value-adding possibilities for the supply chain. They call this "trade in tasks".

Offshoring is defined as relocating a business process or operation activity from one country to another (Zuckerman; 2008). It should be mentioned that offshoring occurs within a company. This is not to be confused with outsourcing, where activities or processes are contracted out to another company, in the same or a different country. Furthermore it should be noted that the relocation of processes or operations activities from one firm to another firm in a foreign country is called offshore outsourcing.

In the existing literature much attention has been spent on offshoring outsourcing. Offshoring itself receives attention to a lesser extent. Furthermore, when discussing the effects from offshoring or outsourcing the majority of the literature concerns itself with the effects on labor markets, wages, and profitability of companies, productivity impacts and similar issues. Less attention has been spent on offshoring in a logistics perspective. This paper will try to shed more light on this topic.

In contrast to the many published books about global supply chains, this paper will take a more focused look upon a more specialized area. In particular, this paper will try to elaborate on the specific issues related to relocating activities within a company to another country. The management issues and problems related to this topic will be discussed in this paper. In particular, light will be shed on the logistics management issues in internationally fragmented production systems.

The ELA (European Logistics Association) defines logistics as the "planning, execution and control of the movement and placement of people and/or goods and of the supporting activities related to such movement and placement, within a system organized to achieve specific objectives"[1]. On the other hand, supply chain management is defined by the ELA as the "organization, planning, control and execution of the products flow from development and purchasing, through production and distribution, to the final

[1] http://www.elalog.org/download/ELAstandards.pdf

customer in order to satisfy the requirements of the market cost-effectively"[2]. In contrast to supply chain management, logistics is concerned with the management of information and/or resources, while supply chain management is concerned with the management of relationships. One should however not make the mistake to think that the supply chain is necessarily comprised of many organizations. On the contrary, many organizations have integrated on a vertical (each member produces a different product) and horizontal (having the ownership of all stages, which combine the production process of a final good) level and are managing the complete supply chain internally. In addition, it is important to note that supply chain management and logistics management are closely related. Many operational activities are overlapping and common resources and information are used on many occasions.

To make global supply chains possible extensive planning and logistics support is required. The main question of this paper will be **what issues and problems should be considered in the management of logistics with internationally fragmented production systems.**

These aspects of logistics which will be covered in this regard are:

- information flow and integration
- transportation
- inventory management, warehousing & materials management
- packaging management
- customer service
- risk management

Other related topics might be covered as well. For example, the effects from offshoring on reverse logistics might be discussed.

The above mentioned topics cover all the individual parts, which belong to logistics. However, purely discussing the changes in each of these parts is not enough. Obviously all of these individual parts of logistics are interrelated and form a system. Hence, this paper will also discuss logistic strategies and supply chain structures. Some commonly used strategies and structures will be discussed in the introduction and the

[2] http://www.elalog.org/download/ELAstandards.pdf

international/ global strategies and structures will be elaborated on in the main part of this paper.

All the topics under consideration will be analyzed with the help of the existing literature and will focus mainly on the management issues. No technicalities will be discussed, since those are very specialized and company adapted and the outset of this paper is rather general and directed at giving an overview of management issues. Also no data, quantitative analysis and statistics analysis will be used. That is, because data availability in the field of logistics on a national or international level is hard to come by. Hard data is mostly available on a company level (if it is even made public). Hence, most of the analysis will be supported by the existing literature of academic research and text books. In addition, company examples will be given when available and appropriate. It should also be mentioned that the analysis of the research topic will be based on general theory. That is no specific technicalities of individual countries or companies will be elaborated, except for examples given. Specifically, this means that no software solutions or mathematical and stochastic models are discussed.

This paper will start with an introduction to the topics in logistics and will then outline logistics strategies and supply chain design structures. This is followed by an introduction to the economics of offshoring. Then the research question will be developed. The main part of the paper will then go on to discuss all the logistics topics in light of the management issues of an internationally fragmented production system and for each topic a company or industry example is given. Finally, a conclusion will be given and come of the limitations, shortcomings and suggestions for future research will be outlined.

Introduction to Logistic

An introduction to the individual topics in logistics is given, in order to provide some general information to build up on later. The introductions are on a general level and no distinction is made for international or national dimensions.

After having introduced the individual topics in logistics, some of the common logistic strategies will be outlined in more detail. Furthermore, the basic supply chain

structures will be introduced. In the latter part of this paper the global/ international structures and strategies will be highlighted.

Introduction Information Flow and Integration

Information flow management is a relatively new element in the management of logistics. Information management has gained significant importance through the increased availability of advanced technologies in this area (Mangan, Lalwani, Butcher; 2008). Information flow is one of the three key flows in a supply chain (the other two are materials and resources). It is crucial that information is available in a timely fashion and that this information is usable throughout the company's adopted form of technology.

Other aspects of information in light of logistics management are the complexity and accuracy of information (Mangan, Lalwani, Butcher; 2008). It is important that in all stages of the production process and the supply chain, information is available in the form that it is needed. Specifically, information might be required in different stages of the production in differing levels of depth. Hence, it is crucial that this information is available where needed.

Another attribute of information in this context is the visibility and transparency of information (Mangan, Lalwani, Butcher; 2008). It might not always be clear who needs which information and in which format. Also at different stages of the supply chain, differing information systems might be used. It is very important to ensure visibility of information throughout the supply chain, in order to guarantee that members in the supply chain are able to act and react to all events. This greatly helps the collaboration across different stages. In order to increase visibility across stages it might be necessary to integrate information systems or even switch to a uniform information system, which then can transmit all the information to all participants in a timely manner.

Programs that align differing information systems and enable these systems to integrate and translate the information into the according systems are called business process reengineering (BPR), according to Mangan, Lalwani, Butcher (2008).

Finally, before discussing the specific information technology applications, the advantages of supply chain spanning technologies will be mentioned. Such advantages include time compression, decreased schedule variability, increased synchronization and

coordination across different stages, single point of control, better focus on customer, shorter planning periods and of course an integrated information system (Mangan, Lalwani, Butcher; 2008).

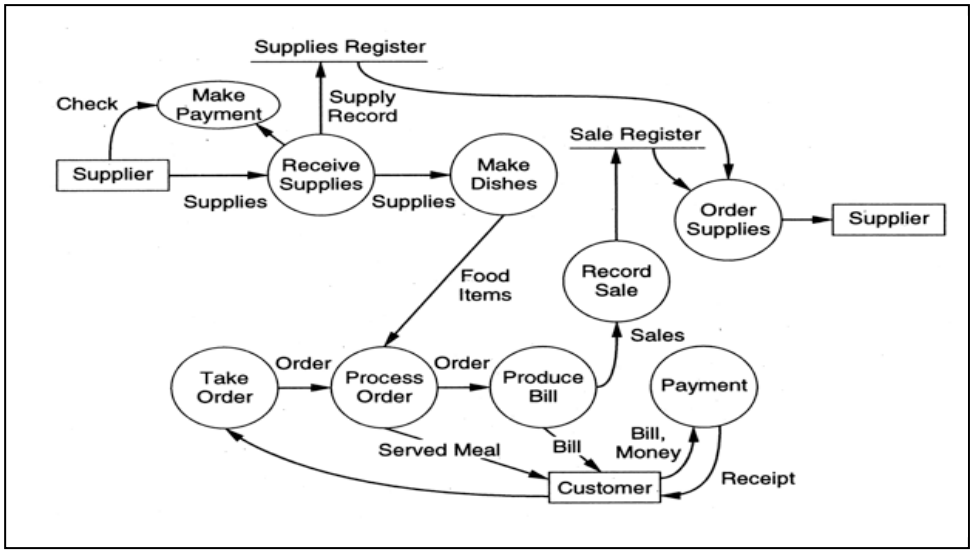
Information technology applications have several dimensions (Mangan, Lalwani, Butcher; 2008). They can be either inter-organizational or intra-organizational. In addition, these applications can be directed towards planning or executing. Not all systems can be discussed here, but a few will be mentioned.

One of the most known applications is probably the electronic data interchange (EDI), which help with the transfer of information ranging from purchase orders, delivery schedule data, payment instructions and invoice payments. Once the data is entered into the system, it is transmitted to all the access points automatically. EDI is an inter-organizational application, which is used for execution.

Enterprise resource planning is an inter-organizational tool, which is used as a company wide planning tool. As the name already says, this application is used to plan and schedule resources between the production processes. An enterprise resource system is a quite extensive system, because all processes need to be aligned in order to make this application work efficiently and effectively. In many cases, this means that the implementation of an enterprise resource system is very expensive and complex for the company to handle.

Other applications in the information management field of logistics include collaborative planning, forecasting and replenishment, warehouse management systems and vendor managed systems.

Figure 1: Example Information Flow Food Orders



Source: logisticsglobal.com[3]

The above figure gives an example of a possible information flow system. Such diagrams are also called data flow diagrams (DFD). Figure 1 shows the example of possible information points and flows of a food company. In this case information flows between suppliers, the company and customers and is used for example for demand forecasting (in the sale register), production plans (in the order processing and dish making) and invoicing (in taking the order). Of course information flows can be more complex and between more parties. In addition, inventory management can also be included in the information sharing system.

Introduction Transportation

Five essential modes of transportation exist: air, water, road, rail and pipeline. These are all modes of transportation for tangible goods. Another mode of transportation might also be the information highway, through telecommunications equipment (Mangan, Lalwani, Butcher; 2008).

As should be clear the main objective of transportation in logistics is to link the flow of goods between sellers and buyers or between different stages of production, within one company (Coyle, Bardi, Langley; 1996).

As one might not naturally think, transportation can even be a means of adding value in the production process (Coyle, Bardi, Langley; 1996). Because it is advantageous for the company to transport goods to other locations, the activity of actually doing so creates value by itself. In other words, it is a money generating activity for the firm.

As there are differing modes of transportation it is important for each company to decide, which is the most suitable. Obviously one of the most important selection determinants is the transportation cost (Coyle, Bardi, Langley; 1996). A trade off analysis is made by each company to compare the different modes and their cost implications. The implications include also factors such as differing packaging or loading requirements with different modes. Other determining factors in the decision making are transit time

[3] http://logisticsglobal.blogspot.com/2011/07/how-to-draw-dfd-inventory-management.html

and reliability, inventory and stock out costs, product differentiation, capability and accessibility and security.

In transportation there are different cost relationships which should be considered. For example, while the fright rate increases with distance (at a decreasing increasing rate) the fright rate per kilo decreases with the total weight (at a decreasing decreasing rate), (Mangan, Lalwani, Butcher; 2008).

Figure 2: European Freight Transportation Figures 2009

	(million tkm)			(tkm per inhabitant)			National air freight and mail transport (tonnes) (4)
	Road (1)	Rail (2)	Inland water-ways (3)	Road (1)	Rail (2)	Inland water-ways (3)	
EU-27	:	442 738	144 953	:	889.6	291.3	591 286
Belgium	36 174	8 572	8 746	3 365.0	803.6	819.9	326
Bulgaria	17 742	4 693	5 436	2 332.5	614.2	714.6	26
Czech Republic	44 955	15 437	33	4 294.7	1 487.0	3.2	2 157
Denmark	16 876	1 866	-	3 065.3	340.8	-	1 975
Germany	307 547	115 652	55 652	3 790.5	1 406.7	678.7	119 042
Estonia	5 340	5 943	:	3 983.8	4 432.0	:	0
Ireland	12 668	103	-	2 846.7	23.4	-	9 267
Greece	28 890	786	-	2 572.7	70.1	-	12 670
Spain	211 895	10 475	-	4 623.7	231.3	-	81 290
France	173 621	40 627	8 673	2 697.4	634.8	134.7	136 255
Italy	179 411	23 831	:	3 034.1	399.7	:	54 895
Cyprus	963	-	-	1 208.5	-	-	178
Latvia	8 115	19 581	:	3 588.7	8 622.6	:	0
Lithuania	17 757	14 748	:	5 300.8	4 381.0	:	0
Luxembourg	8 400	279	279	17 021.3	576.7	565.3	0
Hungary	35 373	9 874	1 831	3 526.4	982.9	182.5	0
Malta	:	-	-	:	-	-	0
Netherlands	71 566	6 984	35 656	4 341.1	425.7	2 162.8	2
Austria	29 075	21 915	2 003	3 479.8	2 634.5	239.7	782
Poland	180 742	52 043	202	4 739.4	1 365.4	5.3	6 859
Portugal	35 808	2 549	-	3 369.5	240.1	-	20 049
Romania	34 269	15 236	11 765	1 594.0	707.7	547.2	217
Slovenia	14 762	3 520	:	7 363.5	1 751.0	:	0
Slovakia	27 705	9 299	899	5 118.9	1 721.7	166.1	1
Finland	27 805	10 777	:	5 220.3	2 033.2	:	3 921
Sweden	35 047	23 116	-	3 786.3	2 517.3	-	15 732
United Kingdom	171 477	24 831	:	2 821.2	405.9	:	124 741
Liechtenstein	263	17	:	7 389.9	480.8	:	:
Norway	18 447	3 621	-	3 843.7	764.4	-	17 095
Switzerland	11 882	12 265	:	1 542.7	1 615.2	:	4 092
Croatia	9 426	3 312	727	2 125.3	746.6	163.9	1 163
Turkey	:	10 552	-	:	149.5	-	:

(1) Greece, 2008; Italy and the United Kingdom, 2007; road transport is based on movements all over the world of vehicles registered in the reporting country.
(2) 2008.
(3) EU-27 and Belgium, 2008.
(4) Data based on departures; France underestimated as freight transport at Paris Charles-de-Gaulle and Paris Orly is incom
Source: Eurostat (road_go_ta_tott, rail_go_typeall, ttr00007, tps00001 and avia_gooc) and Directorate-General for Mobility and Transport

Source: Eurostat[4]

Magan, Lalwani and Butcher (2008) also mention that air, road, water, rail and pipeline transportation are all based on a fixed cost part and then to varying degrees have a variable component. In 2008 road transportation was the most predominant mode of transportation in the EU, followed by sea transportation (Eurostat). Figures from Eurostat

[4] http://epp.eurostat.ec.europa.eu/statistics_explained/index.php/Freight_transport_statistics

of road, rail and waterway transportation of the EU-27 members are provided below. The figures are provided in tonne-kilometers. According to Eurostat 2.400.000 million tonne-kilometers of freight were transported in the EU-27 in 2009. Of this more than 75% was transported via road ways.

What should be mentioned is that transportation is a derived demand (Mangan, Lalwani, Butcher; 2008). This means that all demand for transportation comes from the final demand of the goods in specific areas. Even for the transport of unfinished goods, the demand for transportation is derived demand, because it is value adding for the company and the customer to transport the unfinished goods to a different production site.

Introduction Inventory Management, Warehousing and Materials Management

Inventory management is another crucial part of logistics management. Inventory management is concerned with managing the materials in the production process (Mangan, Lalwani, Butcher; 2008). Not only does that include storing materials or finished products for further use or shipment, but it also includes the management of materials which are currently used in the production process.

Inventory takes up enormous sums of money. That is not only the materials, which are currently processed are costly, but also providing appropriate storing room costs money. This is why much effort is spend to optimize inventory.

Inventory cannot be zero though. That is because inventories are needed in the production process. Another reason, why firms hold inventory is that buying in bulk can lead to pre-price unit reductions and hence lead to economies of scale (Stock, Lambert; 2001). Other needs for inventory include being able to balance supply and demand, specialize in production, avoid uncertainty of price changes or demand and buffer throughout the supply chain.

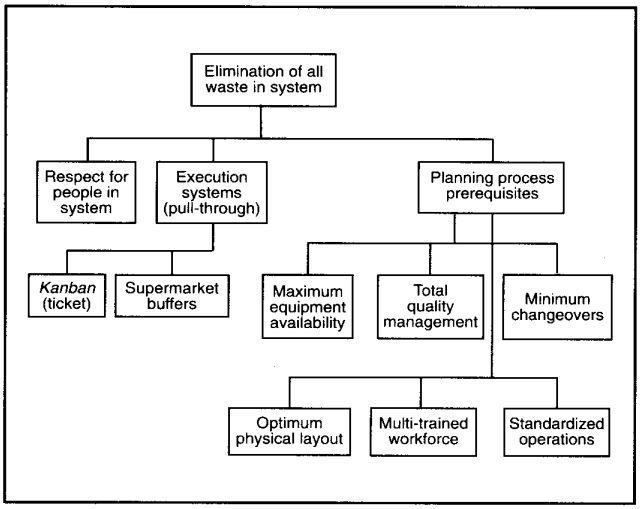
Inventory management distinguishes a couple of different inventory types (Stock, Lambert; 2001). For example, cycle stock is a type of inventory that is used to meet demand under conditions of certainty. On the other hand, safety or buffer stock is inventory held in excess of cycle stock and is used to meet demand under uncertain conditions. In-transit inventories, are all inventories, which are currently relocated. Speculative stock is held, because of future price uncertainties of the materials. Seasonal

stock is a type of inventory that is accumulated in advance of a season, so that smooth production runs can be ensured. Finally, dead stock is some inventory which is no longer in demand and hence might be obsolete.

Reducing inventory to an optimal level is one crucial objective in inventory management. Different methods of calculation can be used to arrive at the optimal, efficient level of inventories. One method is for example the economic order quantity (EOQ), (Stock, Lambert; 2001). The EOQ calculates the optimal level of inventories, taking into account the ordering cost, demand for the product, inventory carrying cost and the value of the inventory. This is a method mostly used when environmental conditions are stable and the firm faces little uncertainty. Other methods are used under uncertain conditions or other assumptions.

Text Box 1: Close-up JIT (Just-In-Time) Management

Just-in-time management was first developed by the Toyota Company and is hence sometimes called the Toyota production system (TPS). Just in time management of the material flows does not only relate to inventory management as such, but is rather directed at eliminating waste. This includes not only materials and production capacity, but also time. In addition, JIT is also concerned with the continuous improvement of the system.
The process of JIT focuses on the integration of all parts of the system, which means that the performance of each part is connected to the other part of the system.
To implement a successful JIT systems three crucial elements have to be considered: respect for the people, the executive system and planning process prerequisites for continuous improvements to the system. Explaining the complete JIT functional system goes beyond this paper, however, for a figurative depiction please see below.



Source: Daugherty, Rogersand, Spencer (1994)

In order to improve the efficiency of inventory management, firms can for example adopt a just-in-time inventory system (Mangan, Lalwani, Butcher; 2008). Under such a system, inventories are held at the minimum and components and materials are delivered on timely demand. Another adjustment might be to pool inventory into one location; reduce variation in demand, supply, safety stock and lead time, which will reduce the total inventory held.

Warehousing is the part of the logistics system that stores products at any point between the start of the process and the final consumption (Stock, Lambert; 2001).Warehousing also is concerned with providing information about the status and condition of the goods and materials in storage. Warehousing is used for all storage of inventories, which are raw materials, parts and components or finished goods.

Generally, warehousing has two specific purposes. Firstly, it s used as an inbound consolidation point (Stock, Lambert; 2001). This means that warehousing is used to receive shipments from suppliers. Inbound warehousing is hence mostly used in close proximity to the production facility. Secondly, warehousing has an outbound consolidation function, which means that finished products are collected and shipped further to the customers. In case a company produces several brands or products, these are often collected in distribution centers (DCs) for assembling product mixes and further shipment to customers.

Several types of warehouses exist: Distribution warehouses, fulfillment and consolidation warehouses, warehouses providing value added services, cross-docking and trans-loading warehouses, breaking bulk warehouses, refrigerated warehouses and storage warehouses (Stock, Lambert; 2001). All types of warehouses perform particular functions and are directed at a particular purpose. Distribution warehouses handle goods in bulk consignments and are used for distribution services for customers. Fulfillment and consolidation warehouses have the purpose of receiving products in large bulk consignments and breaking them down into smaller mixes. Warehouses, which provide value added services, add packaging, labeling or further process activities in the warehouse. Cross-docking and trans-loading warehouses greatly reduce the time that stock is held in the warehouse. Products arrive at one point of the warehouse are mixed into product mixes and then shipped further at another point of the warehouse. Cross-

docking warehouses are sometimes shared between companies. Breaking bulk warehouses are often used to break down large shipments, repackage them and ship them further to final customers. Storage warehouses have the function of holding goods for a longer time. Often storage warehouses hold raw materials and non-perishable goods, which are awaiting further shipment. Storage warehouses are also used by manufacturers for storing raw materials and components used in future production. Finally, refrigerated warehouses often handle perishable or delicate goods, which have to be moved quite fast along the supply chain.

The tasks of warehousing range from receiving the stock, managing its storage and loading it for further shipment. For example, packaging, labeling, tracing, real estate management, transportation, order entry, storing, and cross-docking (transferring items directly from the inbound receiving dock to the outbound shipping dock) are all activities of warehousing.

Warehousing can be distinguished into three specific functions: movement, storage and information transfer (Stock, Lambert; 2001). Movement (the processes in the distribution centers) can be subdivided into receiving stocks, transferring them and putting them on shelf, order picking, cross-docking and shipping. Storage is mostly temporary. This means that the stock is only hold until it is needed in the production or until it is assembled into product mixes and shipped further. Sometimes stock is stored for a longer period as a buffer or as a kind of safety stock. It is very important that information transfer is accurate and in a timely fashion. Most organizations rely on bar-coding and EDI (electronic data interchange) to administer the warehousing activities. As mentioned above, this information can be shared with customers and suppliers to better manage the flow of goods and better respond to demand fluctuations or any other disruptions in the supply chain.

What should be mentioned is that the value adding activities of warehousing include: creating bulk consignments, breaking bulk consignments, combining components and smoothing supply to meet demand (Mangan, Lalwani, Butcher; 2008). Value is added through these activities, because they enable customer cost reduction or higher service provision, administration costs reductions, quantity price reductions, reducing lead time and other activities.

Facility development is another crucial part of warehousing. Decisions have to be made about the warehouse size, materials handling equipment, location, layout and design and number of warehouses (Stock, Lambert; 2001). One macro approach from Edgar Hoover identifies three different strategies: market positioned, product positioned and intermediately positioned. Another macro approach is: the product warehouse strategy (only one product in the warehouse), market area warehouse strategy (warehouse per market territory) and the general purpose strategy (full product line warehouse with complete market coverage in one geographical area). Other models are also based on cost-minimization, profitability location choice, center of gravity (minimizing transportation costs), micro analysis and other factors.

Materials management, which is also often called materials handling, is defined as the efficient short-movement of materials, usually within one building (such as a warehouse or a distribution center), Coyle, Bardi and Langley (1996). Basically this movement of materials can be done mechanically or manually, the importance is that it is done efficiently. According to Bowersox and Closs (1996), materials handling is an in-warehouse activity.

According to Coyle, Bardi and Langley (1996), materials management has four important dimensions: movement, time quantity and space. Materials management has to be coordinated according to those four dimensions. Movement concerns the transportation of the stock within the facility. In materials management time is of the essence. As discussed above, storing inventories is expensive and some materials might even be perishable. In materials management different quantities of different stocks have to be handled, according to the current derived demand of customers. In addition, the fixed space of the storage facility has to be used efficiently. This is also sometimes called capacity management. It is important that materials which are used in combination are located close to each other. The objective is to minimize transportation ways.

The objectives of material management are to increase the effective capacity, improve operating efficiency, develop effective working conditions, reduce heavy labor, improve logistics service and reduce costs (Coyle, Bardi, Langley; 1996).

Materials management equipment plays a major role in making this activity efficient. Equipment can be sorted into three categories, according to design (Coyle,

Bardi, Langley; 1996). Flexible path equipment includes manual hand trucks, forklifts and other picking equipment. Continuous-flow equipment includes conveyors and draglines. The third category is the intermittent-flow fixed path equipment, which includes cranes and monorails

Of course as one should guess, materials management is also a process, which is partially to heavily automated and relies on and generates a constant stream of information (Bowersox, Closs; 1996). Material management can be, depending on the handling considerations of the materials, be done by mechanized systems (employs a wide range of handling equipment), semiautomatic handling systems (mechanized system supplemented by automating specific handling requirements) and automated handling systems (materials are handled completely automatic).

Introduction Packaging Management

Packaging is another warehousing and materials management concern (Stock, Lambert; 2001). Packaging has two main functions: marketing and logistics. These again can be subdivided into more categories. The marketing function is to provide customers with information and promote the product through shape, color and so forth. The logistics function of packaging includes containment, protection, apportionment, utilization, convenience and communication.

Again as in all logistics activities the major concern is efficiency and effectiveness (Stock, Lambert; 2001). This basically means that the design and the packaging materials are selected in such a way that these requirements are fulfilled. For example, as mentioned above one function of packaging was utilization. In this respect packaging can be used as to maximize space utilization in storage or transportation and minimize handling.

Obviously there are trade-offs in packaging. For example, while optimal packaging in light of saving packaging materials and transportation and storage space, these considerations are not always optimal for safety and protection issues (Cole, Bardi, Langely; 1996). Additional cushioning materials might be used to protect the goods in transport.

Other considerations relate to the standardization of packaging in transportation in transcontinental sea shipments container shipments only transport pallet packet goods.

Introduction Customer Service

Although customer service is predominantly thought of as a marketing activity, the influence of logistics is undeniable. Customer service is the output of logistics management (Stock, Lambert; 2001). It is the main goal of logistics management to achieve customer service. This is because in most organizations logistics perform support activities rather than the core activity of the company. In addition, within logistics lies the great opportunity to create extra value, offer customization or cost advantages to customers. This is why logistics activities perform the most crucial function in creating customer service.

Specifically, Bowersox and Closs (1996) mention that for logistics the customer is the destination for any delivery. This can mean that the customer is an individual, an organization, or even a different department or facility within the same company at a different location in the supply chain. Important is that the customer takes ownership of the goods at delivery.

One of the objectives of customer service in logistics is to develop logistics performance requirements, so that customer needs are met (Bowersox, Closs; 1996). Customer service is sometimes seen in three different ways: as an activity, in terms of performance levels and as a management philosophy. Some companies have even developed their own customer service philosophy.

The three basic fundamental dimension of customer service are: availability, performance and reliability (Bowersox, Closs; 1996). Availability basically means that the product is in inventory when the customer requires it. This can be managed through forecasting demand and then managing inventory and warehouses in appropriate locations accordingly. Other important factors influencing the availability of products are the stock out frequency, the fill rate and orders shipped complete. Operational performance is achieved though speed of delivery, consistency of delivery time, flexibility to handle orders and malfunction and recovery handling of errors. Reliability

of standards and quality reliance is managed through measurements of performance variables, unit measurements and base measure comparison.

Another view on customer service dimensions is that the three dimensions are pre-transaction, transaction and post-transaction phase. Pre-transaction relate to the policies and code of conduct standards, written by the company. Flexibility and accessibility are also related to pre-transaction customer service. Transaction elements relate to the direct performance of the company in providing the goods or services. This can include order cycle time, inventory availability, order information status etc. Finally, post-transaction refers to warranties, repair services, maintenance, complaints handling, product replacements etc.

Text Box 2: Perfect Order Concept

The perfect order concept is a way to measure performance of the company by customer satisfaction. The perfect order rate can be calculated by giving customers a scorecard of specific items to rate and how much they have been satisfied with each item of the logistics activity.
For example, the perfect order can constitute on time delivery, completeness of the order, damage free, and correct documentation. Each item can be weighted in accordance with the customers or companies preference and an index calculation can be made from all orders, ranking the company (as a percentage of 100%) in its perfect order performance.

Source: Novak, Thomas (2004)

Customer service in logistics also has the capability of adding value for the customer (Bowersox, Closs; 1996). In particular, value-adding services are mostly those which exceed the basic requirements of meeting customer needs. These are unique services, which companies collaborate on in order to increase their joint efficiency and effectiveness. Examples of value-added services are customer focused services (offering alternative ways of delivery), promotion-focused services (unique point-of sale displays), manufacturing-focused services (unique-product assortment and delivery), time-focused services (e.g. time delivery) and basic services (unique tailored program).

Introduction Risk Management

Risk management in logistics has concern for all the activities of logistics. The risks, companies face, are similar on a global and national level (Simchi-Levi, Kaminsky, Simchi-Levi; 2008). Although, the risks in an international and national environment are

similar, the risk scale is much higher in an international environment, because risks are less controllable and uncertainty is higher.

Risks can be categorized among two dimensions: risk sources and characteristics (Simchi-Levi, Kaminsky, Simchi-Levi; 2008). Risk sources can be unknown-unknown (e.g. hurricanes and other natural disasters) or known-unknown (e.g. forecast accuracy). Characteristics of risks can be uncontrollable or controllable. Obviously known-unknown sources of risk can be more controllable than unknown-unknown sources of risk.

One of the pressing issues in risk management is to manage the unknown-unknown. This is particularly difficult, since those are disaster events, which can hardly be foreseen (Simchi-Levi, Kaminsky, Simchi-Levi; 2008). Three general strategies suggested by the authors are investing in redundancy, increasing velocity in sensing and responding and creating and adaptive supply chain.

Other strategies for managing more of the known-unknown risks are speculative strategies, hedge strategies and flexible strategies (Simchi-Levi, Kaminsky, Simchi-Levi; 2008). Speculative strategies involve betting on a single possible scenario. Hedge strategies involve designing the supply chain in such a way that losses in one part can be offset by gains in other parts. Finally, a flexible strategy enables a company to take advantage of several scenarios.

Managing risk in the operational part of the logistics activities can mostly be done through insuring against it.

Introduction Logistic Strategies and Supply Chain Structures

In order to get a better understanding of logistic strategies and the supply chain structure the respective elements have to be examined and then put together.

According to Ernst, Fender and Kouvelis (1998) the structural characteristics forming the operations and logistic strategy are the facility network, the operations process technology, the logistic process technology and the vertical integration. Of course these structural characteristics need infrastructural components to put into work. The main categories of the infrastructural support elements are the work force, operations planning and control, quality, organization, distribution planning and control, transportation policy, organization, sourcing, customer service quality.

Because the individual discussion of the structural and infrastructural elements would take too long, the elements will be summarized in a table.

Table 1: Operations and Logistics Strategy Elements

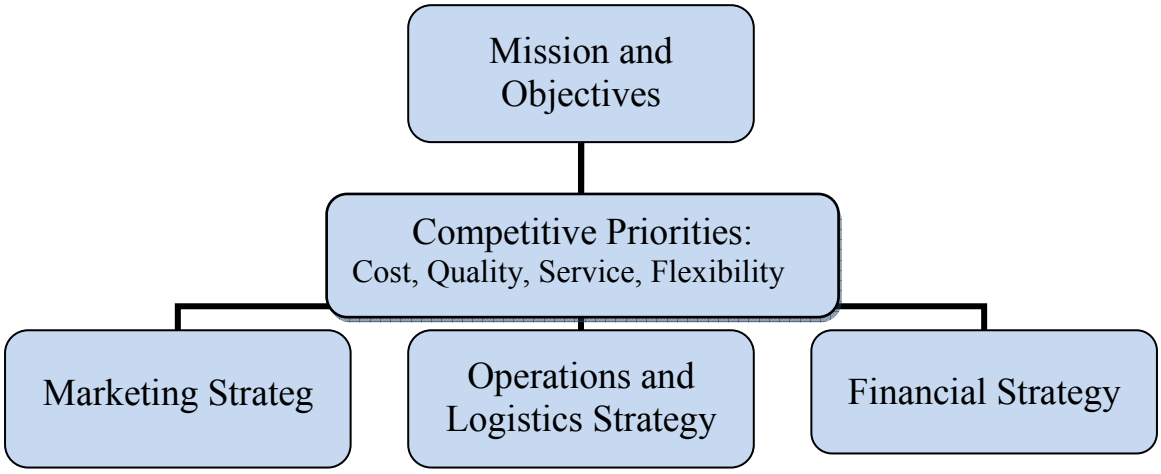
Structure		Infrastructure	
Facilities Network	Supply chain structure, number of echelons (number of facilities, size, location, focus), links between facilities (information flows, sourcing patterns)	Work Force	Training/ recruiting, payment system, job security
Operations Process Technology	Equipment, extent of automation, investment timing	Distribution Planning and Control	Centralizaiton/ decentralization, distribution channel selection, inventory coverage level, inventory location
Logistics Process Technology	Storage/transportation technology, extend of information technology	Operations Planning and Control	Centralization/ decentralization, computerization, rules of inventory coverage level, inventory location
Vertical Integration	Extend of integration, direction (forward/backward), balance of capacity	Quality	Improvement programs, control standards, measurements
		Transportation Policy	Logistics alliances, subcontracting, transportation modes
		Organization	Performance measures, structure, reporting, support groups
		Customer Service Policy	Pricing/ discounts, frequency of delivery, ordering methods
		Sourcing	Offshore sourcing,

	purchasing, supplier selection

Source: Dornier, Ernst, Fender, Kouvelis (1998)

The next step in developing a corporate strategy then is to integrate these elements with the other elements of the other function of the corporations. Specifically, logistics and operations strategy elements will be aligned with the marketing and financial strategy design elements. These will then build the companies competitive priorities and relate to the mission and vision of the company. The relationship of the individual elements is shown below.

Figure 1: Logistics Strategy in the Corporate Strategy



Source: Dornier, Ernst, Fender, Kouvelis (1998)

Having discussed the individual elements of the operations and logistics strategy and how they integrate into the corporate strategy, specific logistics strategies should be discussed. Of course there exists a wide set of logistic strategies, which can also differ with respect to regional location or industry. However, as an introduction to logistic strategies, the strategies which correspond to some of the most know corporate strategies will be illustrated here.

Table 2: Summary Logistic Strategies

Corporate Strategy	Logistics Strategy	Strategic Logistics
Cost Leadership	Reduce logistic costs	Reduce overall costs with logistics
Differentiation	Quality of logistics service	Logistics factor of differentiation
Innovation	Logistics support for innovation	Logistics as a source/ vehicle for innovation

Alliance	Logistics as a means of alliance	Logistics as a source/ vehicle for alliance
Profession expansion	Logistics as a source for profession expansion	Logistics as a new profession
Mission expansion	Logistics as a source for expansion	Logistics in order to win new clients
Diversification	Use of logistics synergies	Diversifying through or in logistics

Source: Waters (2007)

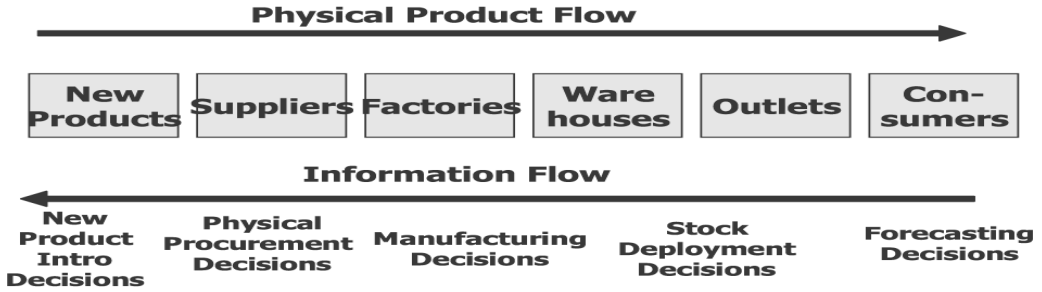
Text Box 2: Examples specific Logistic Strategies

A mentioned above, the intend of this introduction to logistic strategy cannot go into so much detail. However, two specific examples of logistic strategies will me outlined here.
Two popular logistic strategies are: flexible production and concentration of production and storage locations. The concentration of production and storage is mainly based on cost advantages. That is, economies of scale can be achieved in the production process and inventory management and warehousing. However, concentrating production and storing in one location will lead to higher transportation costs and these have to be balanced against the gains of the economies of scale effects. On the other hand, it is more complicated to measure the cost implications from a flexible production system. Flexibility of the production system refers not only to the production facility as such, but also to the work force, the company's relations, mobility of goods and factors of production etc. A flexible production system is in most cases based on a JIT system.

Source: Brown (1993)

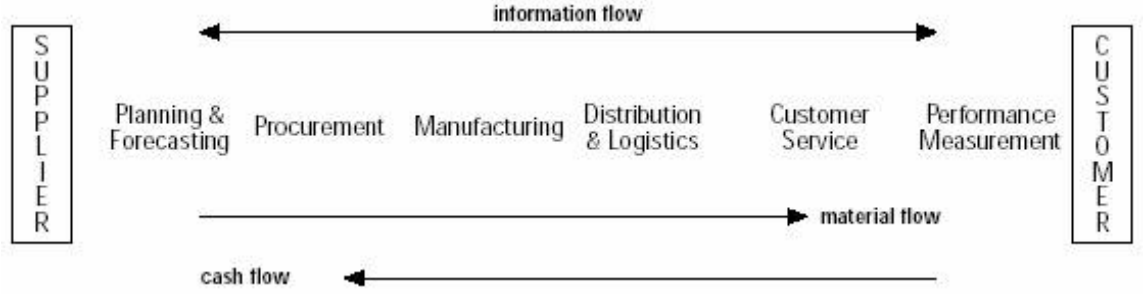
The supply chain structure can be discussed with regard to the internal company structure and the complete supply chain structure raging from first-tier suppliers to final consumers. To give an overview of both, please see the figures below.

Figure 2: Supply Chain Structure



Source: Sherer (2005)

Figure 3: Internal Supply Chain Structure



Source: Sherer (2005)

While Figure 2 gives more detail on the physical flow of the materials and goods in the supply chain, Figure 3 provides a better insight into the information flow within the company. It should be noted that these two figures mainly provide an overview over supply chain structures. Of course these can differ with respect to company, country and industry.

The two figures above, give a good outline of how the basic supply chain for most if not all companies look like. However, there are many differences as to the determinants and the objectives of the final supply chain structure and how well it performs.

Text Box 3: Examples Supply Chain Network Designs

The supply chain structure design above is the most simple and common depiction the network structure. Though it roughly applies to most companies there are other network types, which describe more aspects of a company's network. Three such designs will be discussed below.
An internal network is one where the company owns most of the assets on the supply chain network. Specifically, the supply and distribution activities are integrated into the company.
A stable network is one where, suppliers, company and distributor are not integrated and do not belong to one company, but in which the whole design is concentrated around the core producing company.
A dynamic network is one in which the producing company relies on many outside companies for supplies and distribution and where many activities are outsourced.

Source: Lysons, Farrington (2006)

Lysons and Farrington (2006), list the main determinants of the supply chain structure. These include age and size, technical systems, power, the environment and strategy and organizational structure. For example, if a company ages and becomes larger in size its procedures become more standardized and less flexible. The power of an organization relates to the internal organizational power of for example rewarding power, and personal power, which relates to expert and referent power (how well others can

identify themselves with the organization). The environment determines the structure of the supply chain, through a stable to dynamic setting, a simple to complicated, integrated to diverse, and liberal and friendly to hostile. Finally, the strategy and structure of the organization influence how the supply chain will be organized.

Introduction to Offshoring

The purpose of this section is to shed light on the logic for offshoring. Until now offshoring was defined in rather board terms. Offshoring actives, the relocation of actives from one country to another (where the firm keeps ownership of the assets it uses to carry out the relocated activities), is some form of foreign direct investment (FDI). FDI in turn is defined as the investment in a foreign country, where the investor owns at least ten percent (Navaretti, Venables; 2004).

Firms, which invest in foreign markets and offshore activities, do this for two reasons. First, they want to gain market access or second they want to take advantage of factor cost differentials (Navaretti, Venables; 2004). Investments for the reason of gaining market access are called horizontal foreign direct investment (HFDI). On the other hand, investments which are made for the reason of taking advantage of factor cost differentials, like capital or labor costs, are called vertical foreign direct investment (VFDI). Of course, these two are not mutually exclusive. A firm entering a market to gain access of factor cost differentials may or may not sell its product in the entered market. On the other hand, a firm entering a market to gain access might be lucky enough to face lower factor costs in some parts of its production. The distinction between HFDI and VFDI is merely the primary reason why firms start production in a foreign market in the first place and to what extend production will be moved to the foreign market (as will be explained below).

This paper will not discuss the whole economic theory behind FDI. However, the main characteristics of the specific investment forms and the implications behind them are outlined for reasons for further analysis.

Trying to gain access to a market though HFDI means that the firm has to invest in an operating facility in this foreign market (Navaretti, Venables; 2004). Specifically this means that all production actives are duplicated in the other country and the company

incurs a fixed cost for the operating facility and some marginal operating costs. The headquarter activities, such as finance or marketing, are not duplicated in the foreign country. This form of FDI takes place when trade is rather restricted (the foreign country has strong import restrictions, or the domestic country has strong export restrictions) or trade and transportation costs are very high. One disadvantage of this form of FDI though, is the plant-level economies of scale. That is because production now takes place in two locations; possible economies of scale of larger quantity production cannot be realized.

On the other hand, a company that invests into a foreign market to take advantage of factor cost differentials (VFDI), will do so only for the actives in which factor costs in the foreign country are cheaper and only in the event that these costs savings outweighs the additional transportation and trading costs (Navaretti, Venables; 2004). In the economic theory production activities are usually split into component production and assembly. It is assumed that component production is capital intensive and assembly of components is labor intensive. In addition, transportation and trade costs are not the same for components of assembles products. In particular, transportation and trade costs for assembled products are higher than for components. That is because import taxes for finished products are higher than for components and transportation can be managed more efficiently for components, due to for example packaging and weight advantages. The major disadvantage of VFDI is that the production process is disintegrated and the firm loses the advantage of economies of scale in its production system as a result of managing the fragmented production processes.

The definition of offshoring in the introduction stated that offshoring is the relocation of specific processes or activities from one country to another, whereas the activities will stay in-house (within the company). Hence, even though HFDI has been explained in some detail for the sake of completeness of the economic model, HFDI is not the investment, which is considered here. This paper concerns itself largely with internationally fragmented production systems of operations.

Of course, foreign investments in order to offshore activities, can also be subdivided into Greenfield and Brownfield investments (Navaretti, Venables; 2004). Greenfield investments are the investments into completely new production facilities. This means that a company entering a market is building a completely new production

facility. On the other hand, Brownfield investments are the acquisition or merger of an already existing facility or company. The following analysis will not distinguish further between those two types of investments, because the type of investment is not considered a major impact on the effects of the management issues and topics in international logistics.

FDI Empirical Evidence

In order to be better able to define further research and gain a better understanding of conditions and characteristics, some empirical evidence of FDI will be given.

FDI mostly takes place within developed countries (Navaretti, Venables; 2004). That is FDI does not only originate predominantly from developed nations but also, contrary to many believes, flows into developed countries. Furthermore, mergers and acquisitions count for the largest hare of FDI. Another interesting fact is that most FDI is concentrated in skill and technology intensive industries.

In addition, HFDI used to be a predominately happening into developed countries (Navaretti, Venables; 2004). That is because developed markets are considered very attractive in terms of market potential for sales. However, recently purchasing power in developing countries (primarily Asia and South America) has been increasing and hence their market attractiveness has been increasing. HFDI into developing countries has been on the rise in recent years.

On the other hand, VFDI has been known for a long time as predominantly happening in North-South patterns (Navaretti, Venables; 2004). North hereby means the developed countries and south means the developing countries. In other words, developed countries have traditionally relocated parts of their production activities in developing countries in order to take advantage of factor cost differentials. This trend however is also currently changing. Especially, with the development of the Asian economies, companies from these countries specialize in specific production processes and offshore others to other Asian countries, to also take advantage of factor cost differentials. The clothing industry is a famous example. While high-skill sowing processes are located in Hong-Kong, Vietnam specialized in sowing on buttons and Thailand in adding the zippers.

Research Topic Description and Limitation

This part of the paper will explain the research topic in more detail. In particular, the previous parts of the logistics introduction and the economic explanation of offshoring will be connected in order to define the specific research objectives.

The objective of this paper is to discuss the management issues, topic and problems in logistics management with regard to internationally fragmented production systems. Specifically, all the logistics topics, which were discussed previously, will be looked upon in this regard. For example, what should be considered in the information management structure and in the methods used when the firm operates facilities domestically and internationally. The issues can be considered in terms of management of the home facility actives and of the newly moved foreign activities.

It is not the objective of this discussion to give a complete overview of all of the topics of logistics management in the international environment. This is because the width of the topics is too broad, to be able to examine all of them in close detail. Neither is it the aim of this discussion to give a complete overview of the existing literature. Rather, some of the literature is used to discuss the interesting and pressing issues and topics in this field. Thereby the topics will not be weighed against each other and evaluated or ranked in importance. The focus merely lies on giving an introduction to the topics in this context.

The introduction of this paper has been directed at giving an outline and overview of the management issues and topics in logistics management. The analysis has been mainly based on text books of logistics and supply chain management. In contrast, the analysis of the research question will be mainly based on research articles of academic journals.

Hence, this paper will make use of the existing literature of academic research journals in the field of international logistics management by mentioning some of the issues, models, problems and topic in the field of international logistics management, with a specific focus on international production systems, as far as possible.

One great limitation of this paper is the amount of possible considerations in each topic. Specifically, there are hundreds of countries from which FDI originates and just as many countries where actives might be relocated to. In addition, there are many different

industries, which can be even broken down into sub-industries, which all have different operating characteristics in terms of logistics management. Of course, it is beyond this paper to discuss all of the possible combinations of countries and industries and the logistics management issues in each specific setting. Rather, the research will focus on a theoretical general level and only seldom refer to countries or industries.

In order to clarify each logistic topic an example for each is given. This example will describe a particular company or industry. The intention of the example is to illustrate specific structures, forms or strategies which can apply to each of the discussed topics of logistics management in an international production system.

Information Flow and Integration

Information management for international/ global logistics is a key function in the operational system of a company, which has offshored production activities. The final customer satisfaction greatly depends on how well a company is able to provide information about the supply operations and physical distribution and the ability to transfer that information (Dornier, Ernst, Fender, Kouvelis; 1998).

Basically the main activities in information management remain the same after operations have offshored activities. That is the key functions of information management are still collecting data, data transfer, storing of data, processing data into useful information and transferring data to users (Dornier, Ernst, Fender, Kouvelis; 1998). On the other hand, the objectives of the information system are also still the same. Namely, the basic objectives are forecasting and planning, operations tracing and product locating, and providing control reports.

What is different in an international logistics system is that information and telecommunication systems become much more important. Mainly the logistics information telecommunication system (LITS) becomes the center of the global logistics information management system (Dornier, Ernst, Fender, Kouvelis; 1998). Before offshoring activities, information management could be handled in a more informal way. Specifically, when activities are located in one place, information sharing can take more informal and less organized ways, by for example employees talking to each other in

their lunch break. However, when activities are relocated to another country, information sharing is required to be far more organized and planned. This is why a LITS is needed.

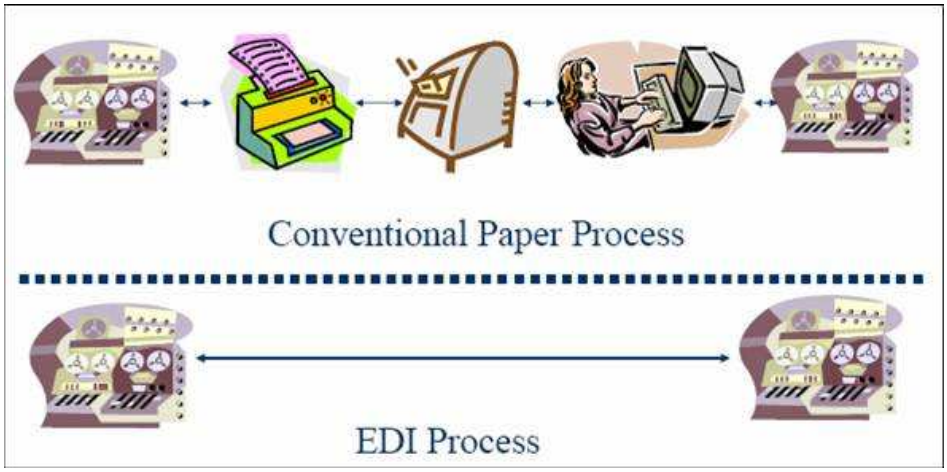
Having a LITS, fulfills more functions than a traditional national system. Namely, databases of different locations have to be connected and pooled into a design outlay that is understandable to all employees at the different access points and between the different functions in the logistics system (Dornier, Ernst, Fender, Kouvelis; 1998). This means that the interface of the system has to be standardized in some way.

Furthermore, the information transfer between the different activities in the supply chain has to be coordinated and guaranteed (Dornier, Ernst, Fender, Kouvelis; 1998). All members of the supply chain system need to have access in a timely fashion to the data. Hence, if activities are relocated to countries in other time zones, the information has still to be accessible to all users and maybe time codes have to be standardized, so that no misunderstandings will happen.

Another issue of the LITS, is the compatibility of the system. This is not only with respect to the interface used and the pooling of databases, but also with regard to operation practices (Dornier, Ernst, Fender, Kouvelis; 1998). In particular, this can imply that accounting standards in the foreign subsidiary have to be adapted to the home standards. Other implications could be with respect to packaging of goods, monitoring standards, labor practices etc.

Obviously one important topic in global information management, with regard to international logistics is technology. Probably one of the most important pieces of technology for information management is EDI software (Gunasekaran, Ngai; 2003). Some of the advantages in global logistics management from EDI systems are improved harmonization to market movements, inventory reductions at all locations, shorter delivery times, higher effectiveness of product promotions and effects on overall productivity gains. Further advantages include, having greater knowledge of the business, saving money of intermediate information transfer points, lower error factors in the database/s, reduced delivery times and increased service levels.

Figure 4: EDI Process



Source: icc.net[5]

Text Box 4: Global Information Technology System

The definition of an information system is: it is a set of interrelated components that, collects, processes, stores, filters and distributes information, which is used for decision making within and across partners.
Middleware and integration technology: Integration technology is used to synchronize information in the supply chain access points. It increases the flexibility of the system by increasing coordination and exchange of data. Information is flowing upstream, within one production point, and downstream between production points. Basically upstream integration technology enables efficiency gains in production schedule synchronization, capacity management and inventory management. On the other hand, middleware and integration technology improve downstream information sharing by delivery schedule sharing and synchronization between production activities in the supply chain.
Web service and SOA (service-oriented architecture): Web-service information technology plays a huge role in global logistics information management. In a global logistics system distributed production facilities have a great need for web-communication. These web-services are specifically well suited for proactive supply-chain event management SCEM. This is because they are used to support decision making by providing information which improves the anticipation abilities of information users and delivering service anywhere anytime. In contrast to middle and integration technology web service technology does not integrate differing systems of production points. It is rather a framework for supporting information sharing from application to application. This is, not all information among access points is shared.

Source: Pereira (2009)

The figure above is a diagram depiction of the traditional information processing and EDI processing. Obviously, the traditional data and information processing of providing information in written reports and mailing them to the relevant access points in

[5] http://www.icc.net/en_US/oc/icc.net/Resources/EDITutorial/

the systems and then reentering them is not feasible any more. This is because today's environment is changing very fast and to be able to react to in means having the relevant information immediately. Particular in an internationally fragmented production system, errors of data entering can have huge consequences for operations in all locations. In the EDI information processing, information is transferred from one location to the other in no time, over the internet. This way data errors though entering them manually are avoided.

Example 1: Information Technology Food and Beverage Industry: EU Market

The EU is the world's largest producer of food and beverages (Eurostat). In addition, the food and beverage market in the EU is highly integrated. Some areas of the food and beverage market in the EU are dominated by a few large players. For example, Tesco has built a European wide supply chain. However, small players take a large share of the food and beverage market in the EU.

Food and beverage products are perishable goods, which have specific logistic requirements (Mangina, Vlachos; 2005). The average life-cycle of food-products ranges from 25-90 days. This means that transportation and warehousing are very time-critical activities. In addition, the high consumer standards in food and beverage production also increase the need for better logistic operations in this industry.

Some of the main current issues in the food and beverage industry include: safety and consumer standards, seasonality, agriculture is one of the largest national economic activities and price pressure on agricultural products (Mangina, Vlachos; 2005).

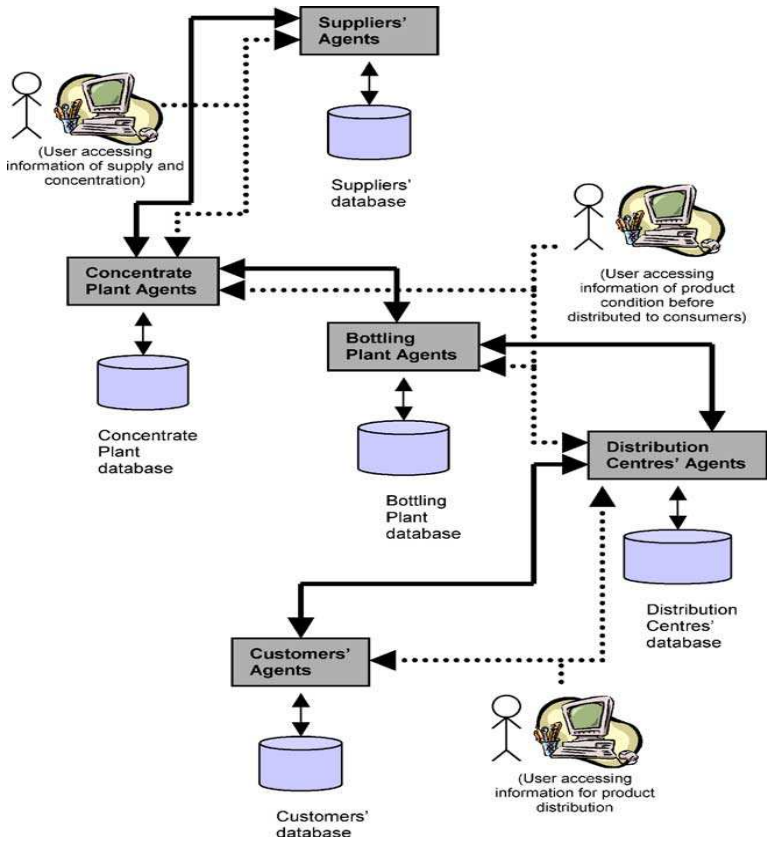
Many food and beverage companies have started to implement a logistic management strategy to gain competitive advantages (Fearne, Hughes; 2000). Because of the short life-cycle of food and beverage products, information management has an increased importance in fulfilling customer service and satisfaction.

As has been mentioned above, small and medium sized enterprises (SMEs) take a large share in the food and beverage industry in the European market. Those SMEs operate many times in isolation (Mangina, Vlachos; 2005). This generally leads to inefficiencies in the production and distribution networks. In addition, these fragmented food networks fail to implement consumer and safety standards. For example, food-

traceability, which is largely based on accurate information collection, has a high error rate, due to these fragmented food networks.

In addition, the implementation of coordinated and integrated food networks in the EU could lead to large cost reductions in for example inventory costs (Fernie, Pfab, Marchant; 2000).

Figure 5: Agent Based Supply Chain Network: Beverages



Source: Mangina and Vlachos (2005)

Mangina and Vlachos (2005), describe that agent technology for information management is very useful in the food and beverage industry. The authors suggest that such an agent technology is highly applicable to the Euopean food and beverage market and will bring by great efficiency gains. Such an agent technology is a means to integrate the fragmented food and beverage network. The definition of an intelligent agent is: "an encapsulated computer system that is situated in some environment, and that is capable of flexible and autonomous action in that environment in order to meet its design objectives", Wooldridge and Jennings (1995).

Agent technology is used for managing business processes, based on the functionality of the system design. Each agent is a specific entity with problem-solving activities and a specific set of tasks. The agent technology then collects the information and analyses it for decision making within and between agents of the network.

The above figure describes how information flows in the agent technology based network. This figure shows that at all stages in the beverage production and distribution, the agents which are the software applications installed at each stage access and distribute the data. The users access the information, which enables them to process the goods in the system.

The agent based technology has particular value to the European food and beverage industry. As mentioned the market is largely dominated by small and medium sized enterprises. Probably most of the food and beverage producers have their own individual operation system and information management technology. The agent based technology is able to integrate the different technologies used and share information across the users in a standardized way. This way efficiency can be achieved in the production, planning and distribution of food and beverage products in the EU.

Transportation

Transportation greatly increases when operations are offshored as opposed to previously one-location point of production. That is unfinished goods have to be transported from or to the offshored production activity site and finished goods have to be transported to final customers.

The role of transportation in a global or international supply chain network is greatly increased. The important transportation capabilities related to global transportation are: time compression, reliability, just-in time delivery and information support systems, standardization, flexibility and customization (Morash, Clinton; 2002). These capabilities can lead a company to excel in transportation activities and ensure maximum customer satisfaction. Because activities are internationally dispersed, these capabilities are particularly important, because physical distance is larger between locations and more control over the good and stock in production, storage and transit is needed.

In a supply chain which is not owned by one company, integration is needed to achieve efficient coordination. However, in a supply chain which is owned by one company, which is the case with offshored activities, integration is already given. Time compression means more deliveries and hence lower cycle stock (Morash, Clinton; 2002). In addition, the velocity of stock movements is higher

Reliability is achieved through structural integration. This means that the information at all production sites is shared. Delivery schedules and low damage rates are often more important than fast delivery (Morash, Clinton; 2002). This is because the cost from damaged goods and unpunctual deliveries are often higher than the benefits of a faster transportation between productions locations would be.

Standardization means that the practices, safety requirements, transportation policies etc. at each point in the system should be the same (Morash, Clinton; 2002).

Just-in-time deliveries and information support systems have the function of synchronizing all activities (Morash, Clinton; 2002). This is with respect to global transportation and production. This way it is ensured that production in one country is matched to the transportation capabilities and production capacities in other countries. This way bottle-necks are identified early and are accounted for.

Flexibility in an international transportation system is achieved by information sharing in within the different locations of production sites and goods in transit (Morash, Clinton; 2002). In addition, information should be shared and be accessible at every point for customers. This way changes in delivery times can be easily accounted for by all members.

Finally, customization in transportation refers to the different offers in transportation for customers (Morash, Clinton; 2002). This means that the customer can choose how, when and how goods should be delivered.

Having discussed the main capabilities for a successful international transportation system, some of the aspects of a global production network and the physical distribution attributes will be discussed.

Vidal and Goetschalckx (1997), discuss the role of transportation in a strategic production and distribution model. Decisions of transportation mode, fleet size and vehicles have to be made in an international distribution model. What further complicates

the matter is that at an international level, taxes, import and export barriers and exchange rates differ between countries. This complicates the transportation planning and managing. Hence, even though the offshored activities are kept internal in the company's operations, transportation is mostly sourced out.

Text Box 5: 3PL- Third Party Logistics

Third-party-logistics is defined at the outsourcing of logistics activities. Sometimes it has been described at the sourcing of logistics activities at arm's length. It does not only refer to the outsourcing of transportation activities, but also all other logistics activities, such as warehousing, inventory management etc.
While companies which operate at a national level, many times manages their logistics activities in-house; organizations that become international start using external services for the management of their logistics activities. This refers particularly to transportation. Activities such as fleet management, when good have to be shipped across continents are no longer feasible to manage. This is mainly due to the fact the companies many times do not have the financial or operational capacity to operate and buy ships or airplanes for such transportation.
On the other hand, activities such as warehousing, inventory management or packaging management are of course more sourced out to third party logistics providers at a level of internationally dispersed operations, but are less sourced out than transportation activities. This is because when production facilities abroad are owned by the company, warehousing, inventory management, packaging, information management etc., closely interconnect with the production activities of the company and are even needed for production activities.

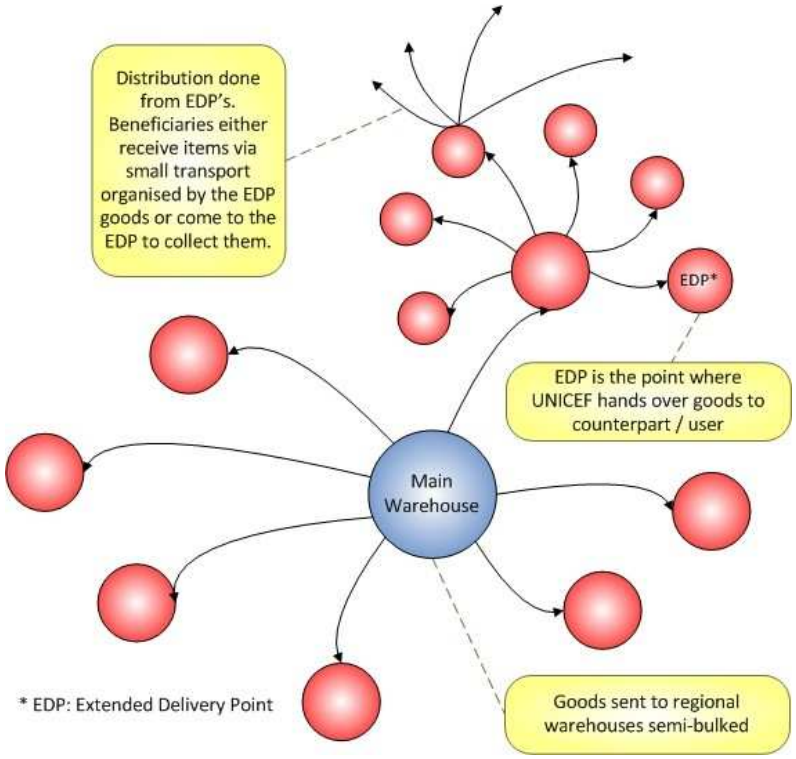
Source: Marasco (2008)

One of the effects from internationally fragmented operations on transportation activities is increased CO2 emissions. Green logistics, with respect to transportation management has been a long discussed topic in global supply chain management. Especially in international transportation CO2 efficiency has been discussed (Leonardi, Baumgartner; 2004). This has led international organizations to adopt measures to implement freight performance measures, which also relate to CO2 emission goals. Efficiency in transportation has been increased in recent years. However, Leonardi and Baumgartner suggest that internationally operating companies should increase efficiency in CO2 emissions further through back-loading or sharing transportation units.

Logistics hubs also play an important role in international transportation. When offshoring, activities, companies have to plan their network of transportation routes (Ishfaq, Sox; 2011). Such hubs can be airports, ports like in Singapore or Rotterdam or distribution centers. Especially, when operations are offshored, transport logistics change

from single mode to intermodal networks. This is, when in a nationally production system only road transport was used to move goods from production to distribution centers or warehouses and then final consumers; in an internationally dispersed operation system several modes of transportations will be used. That is in inter-continental transportation ship, road and or aircraft transportation can or will be used in some combination. The design of such a network is much more complex than a national single mode network design. What is crucial for the success of such a network is the location of the logistic hub.

Figure 6: Logistic Hub



Source: logcluster.org[6]

Mostly the location allocation of a logistic hub is planned strategically. This means that at points where transportation modes change, such logistic hubs are located. This is why airports or ports are many times assigned as logistic hubs. However, other determining factors in the decision making of the hub location are transportation costs, connectivity costs, location costs and service requirements (Ishfaq, Sox; 2011). In

[6] http://log.logcluster.org/response/distribution/index.html

addition, as the figure above shows, warehouses are often located in logistics hubs. These are used to smooth capacity capabilities between transportation modes.

Example 2: Dell Computers Environmental Initiative in Global Transportation

Dell Computers is one MNE, which has operations across the globe. Some of the operations are offshored (owned within the company) and some activities are outsourced. The same holds for its logistics management. Dell operates some of its logistics activities, such as inventory management itself and some activities such as inter-continental transportation are operated by third-party logistics operators.

The Dell Global Fulfillment and Logistics (GF&L) organization has been set up by Dell in order to make its logistics operations network efficient and effective. The overall goal is to build a sustainable transportation future for its distribution network.

Transportation has been optimized and quality of service has been improved to meet ever increasing customer demands. The Dell logistic team has made changes in 2011 to the distribution of inbound materials and delivery of finished products. In particular, the inbound transportation networks have focused on improving efficiency in all modes of transportation and the environmental initiative has been widened. Furthermore, the collaboration with 3PL providers has taken a new step. The environmental initiative has been implemented within logistic service providers.

The optimization of the transportation network in order to meet the goals of Dells green initiative have been implemented across the globe. Some of the optimization changes have included more product adjustments, closer collaboration with transportation network partners, expanding the distribution network in Europe, reengineering truckloads, multi-packing to reduce waste, more use of ocean shipments in Asia and reverse logistic management. The Dell's logistics team Green Initiative has received the Newsweek's Greenest Company in America award in 2010.

The areas, which Dell is planning to improve on in its transportation environmental initiative, are:

- the optimization of further trailer, aircraft and see container usage,
- reducing further emissions by increasing usage of sea shipment instead of road or air freight,

- better packaging for optimal container usage,
- less wood pallet use and more alternative material pallets,
- increasing reverse logistics by reusing old parts of returned products
- sharing the environmental initiative with 3PL partners
- cooperating with and participating in other green transportation initiative of the US government, ISO (international organization for standardization), greenhouse gas protocol and others
- optimizing the transportation fleet though making use of innovative technologies
- trying to change behavior of customers: customer participation in the environmental initiative

Source: Dell.com[7]

Inventory Management, Warehousing & Materials Management

In an internationally fragmented production system inventory management, warehousing and materials management are taken to a whole new dimension.

Golini and Kalchschmidt (2011), hold that in a globally dispersed production system it is very important to moderate the impact of inventories on the supply chain. The authors discuss the impact of a fragmented production system on inventory holdings. Because of internationally fragmented production the inventory levels should initially increase. This is because geographic fragmentation leads to longer transportation and lead times. Hence, in order to overcome longer lead times and increased risk, more inventories have to be hold. However, companies can limit this effect by investing into the integration of their facilities. Of course JIT systems would be one solution, however in a global production system JIT can be difficult to achieve (as compared to a national production system).

Text Box 6: Pull Ordering Systems in Global Production Systems

[7] http://content.dell.com/us/en/gen/d/corp-comm/earth-transportation-logistics.aspx

The pull-type ordering model is based on final consumer demand. In a globally dispersed production system inventories have to be managed by taking into account final demand, transportation times and production capacities. Two types of pull-type ordering models exist.
Product oriented ordering model depends on the forecast of the final demand. Component oriented ordering depends on the forecast of the demand for the component instead of on the final good. Both ordering systems are designed to keep inventories in the internationally fragmented production system at a minimum.

Source: Hiraki (1996)

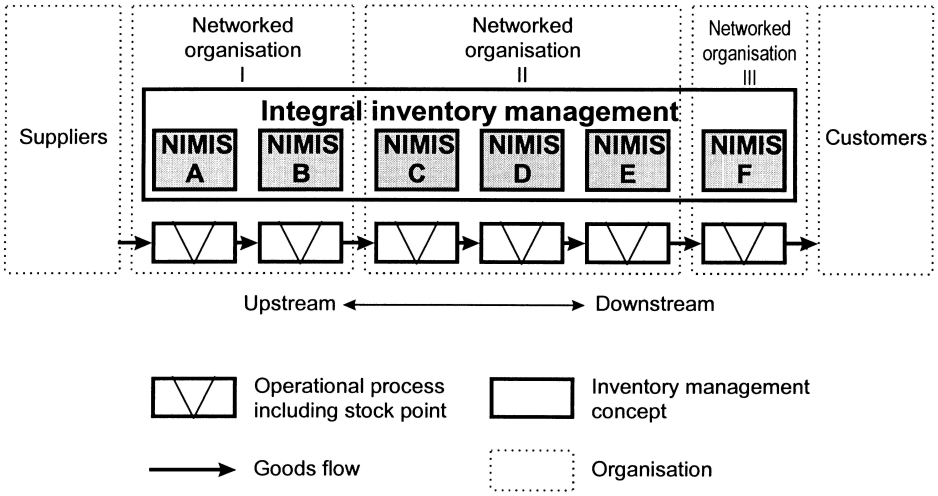
Another aspect of international inventory management is the coordination of inventory policies across the supply chain stages (Giannoccaro, Pontrandolfo; 2002). The inventory order system has to be optimized for all inventory holding locations. This is because with offshored activities the finished or unfinished products have to be further transported and total inventory should be optimized. This is because demand at each production stage is derived demand from the final product or the demand for the component. Hence, in order to avoid inefficient inventory or even obsolete inventory the inventory policies have to be synchronized across countries.

Korhonen and Pirttilä (2003), describe a cross functional approach for inventory management between operational functions. When a company offshores some of its production activities inventories arise at the cross-functional or facility boundaries. Hence, one way to deal with inventories in an international production system is to take the functional dispersion of activities into account. The inventory objectives between each functions should be defined and a decision rights matrix (DRM) should be developed for managerial decision making. Such a matrix consists of the relationships between the different functions. Rights for decision making are assigned for each functional activity.

Obviously efficient international inventory management is highly dependent on information sharing and management. The adoption of an appropriate inventory management technology system is just a logical step in implementing the international production system. One of such international inventory management systems is the networked inventory management information system (NIMIS), according to Verwijmeren (2000). Such an information system is directed to organize inventory across the supply chain. This includes organizing the base stock, material requirement planning

and line requirement planning. The NIMIS is flexible with regard to changes in its configuration, time scheduling, and production planning. The NIMIS consists of three design models, which are the object model, functional model and the design model. The object model describes the relationship of each inventory object through its product life cycle. The dynamic model describes the relationship of all inventory objects and how they change. The functional model describes the transformation of the system, how all inventory inputs transform into outputs.

Figure 7: Network Inventory Management



Source: Verwijmeren (2000)

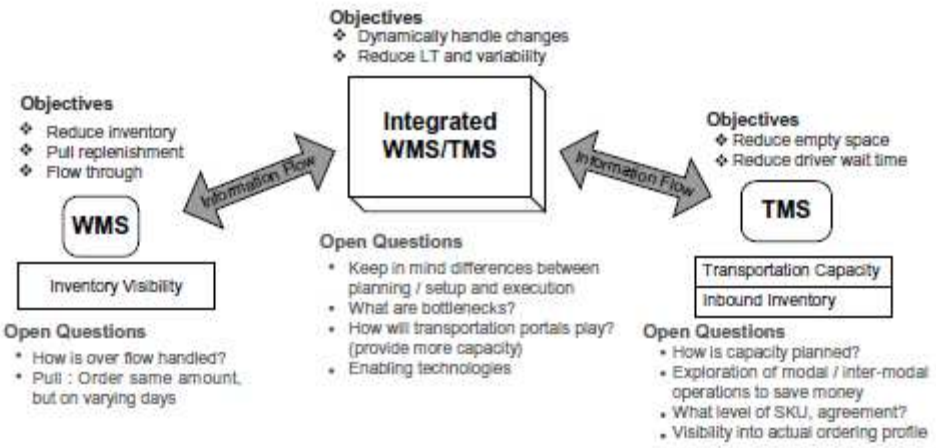
Finally, with regard to inventory management, the bullwhip effect should be mentioned. The bullwhip effect is the information bias in customer demand to downstream suppliers (Bayraktar et al.; 2008). Even though this does not purely apply to inventory management only, but also has effects on warehousing and other logistics activities, it is nevertheless discussed in this context. The bullwhip effect in an internationally fragmented production system can have immense consequences. Because production is disintegrated forecasting has to be done for each production location separately Demand is forecasted from the final consumer backwards in each step of the production system within the company. While the variation of forecasted demand is low in the final production step close to the final customer, the demand forecast variation is high in the first step of the production. Hence, the further the production activity away from the final customer in the supply chain, the higher the variation in forecasts and the larger the inventory to smooth demand. This is particularly true for internationally

fragmented production systems, because communication and disintegration complicate forecasting as an integrative activity (Sodhi, Tang; 2011).

When a company moves operations abroad warehousing has to be adjusted to keep the flow of products smooth. Because in a global supply chain inventories are increased, which obviously comes at a cost, warehousing at an international level has the function of adding-value to the supply chain (Mangan, Lalwani, Butcher; 2008). Value can be added by improving quality of the goods in storage (e.g. some goods improve in quality when they are stored longer, like vine), improving service (e.g. increased data availability for customers), reducing cost (e.g. reducing administration) or lead time (e.g. making use of cross-docking).

Furthermore, warehousing in an international production system can also add value by creating bulk consignments, breaking bulk consignments, combining components and or smoothing supply and demand (Mangan, Lalwani, Butcher; 2008). They hold that these functions have specific importance in the global production system, because products have to be assembles and distributed in several countries.

Figure 8: Objectives for an Integrated System of Warehousing and Transportation Management



Source: Mason, Pibera, Farris and Kirk (2003)

Mason, Ribera, Farris and Kirk (2003), hold that in a fragmented international production system, global warehousing has the function of global inventory visibility. The authors develop a model of integrated materials flow, which results in reduced costs for the whole supply chain. Mainly the effects of the integrated materials flow, due to

inventory visibility in the warehousing activity, are increased customer service, decreased shipping rates and cycle times; also the lead time variability is greatly decreased. The advantages of the suggested model are that the model is based on a fragmented production system and that a multi-product system is assumed.

Text Box 7: SAP

SAP (systems applications and products) is one of the largest business program development companies. It provides business and software solutions for companies. It is the market leader in developing enterprise resource planning (ERP), customer relationship management (CRM) and supply chain management (SCM) software.
SAP also provides software and business solutions for integrated transportation and warehousing management. This includes a web-integrated management system. The transportation systems analyses the best solutions to the incoming orders, while the current inventory levels and status at all warehousing locations are integrated in its decision making. Inventories and shipments are automatically tracked at each point in time and new-order filing on forecasting calculations are automatically made by the system. In addition, the system is able to synchronize shipments in such a way that transportation between facilities can be used optimally.
The information of the transportation management system is shared in real time with the warehousing management system. This means that orders and schedules are shared with warehousing facilities, so that orders can be made ready to ship and labels, invoices etc can be printed.
The system includes an automated data collection (ADC) system and an advanced ship notice (ASN). This way customers can access information shout their orders and status.

Source: Mason, Pibera, Farris and Kirk (2003)

Virtual warehousing is a phenomenon, which has arisen especially in the face of global supply chain management. The virtual warehouse is a logistics application, which relies on "information technologies and real-time decision algorithms to provide efficiencies and global inventory visibility comparable to that achieved in a single-location world-class warehouse" (Stuart et al.;1995). The conceptual framework of the virtual warehousing includes software and hardware to collect data in real-time. The data is collected and analyzed to filter it in such a way that decisions for operational use can be made (Landers et al.; 2000). To collect data wireless communication, global positioning technologies, automatic identification, standard interfaces and integrated databases and geographic information is used. These technologies are responsible for collecting and analyzing data, based on programmed algorithms. The algorithms are used

for decision support. They provide information about stock and inventory levels. The virtual warehouse is very often connected to customers and material suppliers. This makes the system capable of providing information on real-time orders and order planning. In addition, the virtual warehouse is also able to provide information about cost, performance and quality issues.

Childerhouse and Towill (2003) hold that a simplified material flow is the key to international supply chain integration. The authors analyze 32 trans-European value chains and develop 12 simple rules for integrated, simplified materials management systems.

Table 3: Twelve Rules for Simplifies Materials Flow

Rule	Description and definition
1	Only make products which can be quickly despatched and invoiced to customers.
2	Only make in one time bucket those components needed for assembly in the next period.
3	Streamline material flow and minimise throughput time, i.e. compress all lead times.
4	Use the shortest planning period, i.e. the smallest run quantity which can be managed efficiently.
5	Only take deliveries from suppliers in small batches as and when needed for processing or assembly.
6	Synchronise "Time Buckets" throughout the supply chain.
7	Form natural clusters of products and design processes appropriate to each value stream.
8	Eliminate all uncertainties in all processes.
9	Understand, document, simplify and only then optimise (UDSO) the supply chain.
10	Streamline and make highly visible all information flows throughout the chain.
11	Use only proved simple but robust decision support systems.
12	The operational target is to enable the seamless supply chain, i.e. all players "think and act as one".

Source: Towill (1999)

These 12 rules, listed above, will lead to a more effective supply chain integration and management. Basically the authors find in their research that the better these 12 rules of simplified materials management are implemented in the international material management, the more uncertainty in the value chain decreases. This is the variation in performance is minimized.

Text Box 8: Reverse Logistics

Reverse logistics is certainly one of the increasingly discussed topics in international logistics management. With an internationally fragmented production system and growing consumer awareness of environmental issues, reverse logistics is already implemented by many if not even most of the international cooperation's.
Many different issues are related to reverse logistics in an international setting. However, not all of them can be discussed here.
Conceptually, reverse logistics is the flow of materials, semi-finished products or finished goods from the point of consumption back to the point of origin. This can entail that materials are re-used in the production of new products again or that they are properly disposed of by the company.
Many governmental institutions have implemented directives about the collection and proposal of waste. The EU has for example installed a directive about the Waste Electronical and Electronic Equipment (WEEE). In addition, organizations have also recognized the cost benefits of reverse logistics.
Common steps in the reverse logistics system include the recognition of the product return, the classification and grouping of the returned product into material components, the collection of the materials and the decomposition for re-use or disposal of material components. In an internationally fragmented production system, the implementation of these steps are more complicated than with a nationally integration system. This is, because material components might have to be shipped back to the production sites, in which the specific components were used. However, as mentioned above this is already implemented by many companies as a way to fill returning containers and shipments.
The systems, which are used to support the reverse logistics system are the information management systems and disposal systems. The information management systems are responsible for managing the returns of materials and components, while the disposal systems manage the safe and appropriate clean up.

Source: Lambert, Riopel, Abdul-Kader (2011)

Example 3: Inventory and Warehouse Management at Amazon.com

Amazon.com is the largest online retailer for books. It also sells CD's, DVD's electric appliances, health care and beauty products, clothing and accessories and many more items. Amazon is a good example of inventory management integration across different supply chain members and how outside services of inventory management can be used. In addition, because Amazon is a global retailer, international availability of inventory is quite important.

As Amazon.com is an e-retailer, inventory and warehousing management have somewhat different characteristics as other retailers have. Because Amazon.com's core business is e-retailing and not inventory management or warehousing the company has

outsourced these activities in 2001. They have adopted a drop shipment model in order to integrate information of manufacturers, publishers and suppliers into their retailing website. In the drop shipment model, the retailer does not keep the stock itself, but rather transfers the customers' orders directly to the manufacturer or supplier. This was a way in which Amazon.com greatly reduced its inventory.

The drop shipment model in Amazon.com's inventory management implementation included only holding stock of those items, which are very popular.

Amazon's inventory management (AIM) includes the option for (business) sellers to upload their files and items into Amazon.com directly. Status reports about the sales are provided in real-time to the sellers.

Another option offered by Amazon is that sellers and merchants can place their physical inventory within Amazon, rather than keep it themselves. This is registered merchants have the option to send their inventory to one of Amazon's fulfillment centers after they have placed the offer on Amazon.com. This way the merchant keeps ownership over the item, but Amazon (or rather it's logistic service provider, who organized the inventory and warehousing management) stores the item until it is bought by a customer.

Of course Amazon.com offers the option for sellers to make choices about the regions in which sales offers are placed. Hence, while books or other items are stored in warehouses in America, they might very well get sold to buyers from Europe.

This has led Amazon to implement close relationship management techniques with shipment providers. It has implemented a SAP system for the efficient integration of shipments and warehousing information.

Finally, in order to enable Amazon sellers (even small sellers) to manage their inventory effectively and integrate within the larger Amazon system, they advise a software solution to all sellers. ChannelMax.Net is one of the software solution Amazon advises to use for integrated inventory management, pricing and shipping solutions for even small businesses. The software is particularly directed at integrating to the seller's needs. This also entails that multiple platform offerings can be integrated. For example, this system also recognizes and manages the options of selling several platforms, such as eBay, Amazon and or Buy.com. However, Amazon's operation system is able to handle

and integrate different seller software and hence, Amazon advises sellers to use other software solutions as well, based on their differing needs for inventory management.

Source: Amazon.com[8]

Packaging Management

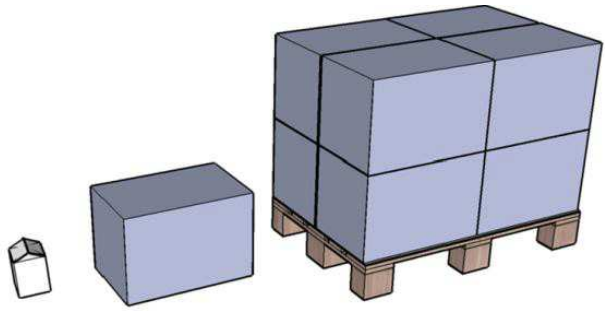
Saghir (2004) emphasizes the importance of packaging in the international logistics system for the other logistics activities, such as inventory management, warehousing and materials management. Namely, in the transportation activity packaging has the role of giving information about the materials and components. This will lead to better tracking, less error shipments and decreased shipment delays. Further, packaging provides protection for the goods and materials transported. This means that the damage rates are lowered and ultimately customer satisfaction will increase. In addition, packaging is used for standardization in the transportation process. Goods or materials are packed in standardized units, which are easier to ship and store. In the inventory management activities, packaging fulfills the role of product protection during storage. Through efficient packaging, product theft can be prevented and carrying and holding costs can be reduced. In warehousing, the packaging information increases efficiency in order fillings and labor. Also products are better protected through packaging during the warehousing process. Standardization in warehousing will lead to cost decreases in material handling equipment. Finally, for communication packaging has the important role of providing packaging information. This will easily communicate all relevant information, such as what is in the package, where does it come from, where is it supposed to go etc.

In international logistics the considerations in packaging are related to three broad areas: logistics, marketing and environmental aspects (Garcia-Arca, Prado; 2008). There is a tradeoff between those three functions. The authors propose a packaging design control system with regard to the primary, secondary and tertiary packaging options. The primary packaging is to protect the package content and is also called the consumer packaging. The secondary packaging has the function of bundling several primary

[8] http://www.amazonsellercommunity.com/forums/forum.jspa?forumID=30
http://aws.amazon.com/fws/
http://aws.amazon.com/search?searchPath=all&searchQuery=inventory+management

packages together and protecting them during transport. The tertiary packaging bundles several secondary and primary packages together for transportation in for example pallets.

Figure 9: Primary, Secondary and Tertiary Packaging



Source: Garcia-Arca, Prado (2002)

Text Box 9: Global Barcoding

Even though barcoding is an issue in information management and is highly related to inventory management and warehousing it will be discussed here, because it also relates to packaging. Namely, barcoding in packaging is extremely important in that every package from product to bulk consignment has to be labeled with a barcode so that packages, their content, where they come from and go to can be identified at every step in the distribution system

The problem with internationally fragmented production is that barcoding differs substantially around the world and across industries. Most international companies use industry standards for their barcoding. This makes it easier to unify the barcoding across a company and to trade with organizations in the same industry.

Regions like Asia-Pacific still lag behind in their barcoding standards, but as far as international companies with production locations there are concerned, the barcoding standards from abroad are implemented, so that within company goods transfers flow smoothly.

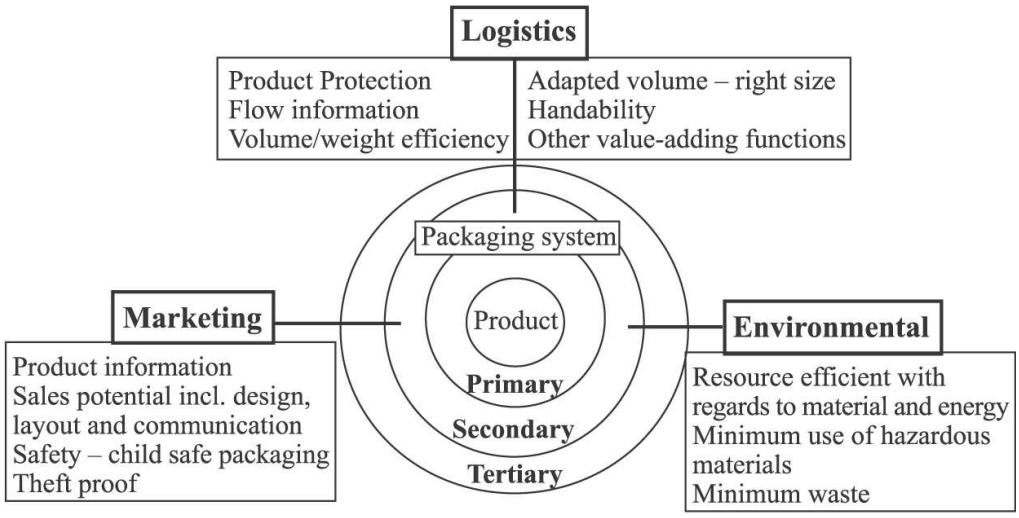
Obviously one of the functions of barcoding is tracking of the goods in storage, transit or production. Barcodes of goods or bulk consignments are scanned at every point of the supply chain, so that a record is kept of the flow of goods and materials.

Source: Closs, Xu (2000)

Other packaging issues in international logistics and distribution refer to environmental pressures, marketing related issues in packaging and customization of products (Jahre, Hatteland; 2003). The authors hold that because physical distance between production points and end consumers in an internationally fragmented production system become increasingly larger, efficient packaging becomes more important. The issue becomes to integrate efficient packaging in international transportation with consumer demands for more environmentally packaging and less waste. The authors argue that an integrated packaging system with standardization across

international operations can greatly achieve efficiency within the trade off in environmental issues, packaging for efficient transportation and storage, and the marketing function of packaging.

Figure 10: Logistic, Marketing and Environmental Requirements in Packaging



Source: (Jahre, Hatteland; 2003)

Example 4: Packaging at Ikea

Ikea is a Swedish furniture and interior design manufacturer with production locations around the globe. Especially, in furniture design, packaging is a major challenge. This is because, designing furniture in such a way that it is easy to package for transportation to sales points and for final customers to their homes, is often limited by the design and the functionality of the furniture itself. The challenge for Ikea is to package goods in an environmentally friendly and efficient way and to prevent damage to goods in transportation.

More than 31% of Ikea's products are produced in Asia. Ikea has chosen those production sites, because of cost considerations and capacity issues. Shipments from Asia are outsourced to third-party logistics providers.

In order to increase customer satisfaction, increase efficiency and reduce damage rates though packaging, Ikea has recognized the need to take packaging considerations into account in the furniture development process. This stands in contrast to the traditional way to first designing the product and then developing the packaging material

and management strategy. Furthermore, Ikea has implemented the packaging function into the logistics process

The initial concept of Ikea, with regard to furniture packaging, was the "flat package, home assembly" concept. This entailed that furniture such as shelves, desks etc. were designed in such a way that they could be packages in relatively flat packages and space would be optimized.

Due to the increasing globalization of Ikeas operations, packaging became a more pressing issue. The ready to sell shelf packaging solutions were generally less cost efficient in international transportation and additional protection was needed in long distance transportation. Hence, Ikea switched to a ready to sell pallet packaging solution. This made stocking and transporting the goods more time and cost efficient. Another aspect of Ikeas packaging solution are standardization of packaging designs. The objective is that packages can be used for several products.

Another aspect of Ikeas packaging strategy is the recycling and reusing of packaging materials. Ikea stores provide the option for consumers to dispose of the packaging materials in their stores. In addition, no hazardous materials are used in packaging.

Source: Ikea.com[9]; Kleasson, Lundgren (2009)

Customer Service

Customer service is the final outcome of the whole logistic activities. One of the main considerations in an internationally dispersed production system are the trade offs between logistics costs and customer service. This is, many companies, which source operations from other countries, do so by entering low-cost countries. While this leads to increased economic performance of the company, the challenge for the now internationally organized cooperation is to balance logistics cost and customer service (Bygballe, Bø, Grønland; 2011). Cost options can run from high logistics costs, which result in high customization options for customers and increased service options, to low cost logistic operations, which result in less customization options, but are still good in generating customer service.

[9] http://www.ikea.com/ms/en_US/about_ikea/our_responsibility/products_and_materials/index.html

Table 4: Implications for Logistics Cost and Customer Service

Configurations	Logistics costs	Customer service
Alternative 1	High transportation costs. High inventory costs and risk of obsolescence for customer/retail store.	Long lead times result in low supply chain agility. However, the one-to-one relationship between producer and retail store enables customisation.
Alternative 2	Lower transportation costs in Norway because of consolidation but high inventory costs at the DCN and risk of obsolescence.	Agility in the supply chain due to the role of the DCN, enabling quick responses to customer demands.
Alternative 3	Low transportation costs in the route from China to Norway because of consolidation at the DCC. Low inventory costs because of consolidation at the DCC.	Long lead times result in low supply chain agility.
Alternative 4	Lower transportation costs in the overall supply chain. High inventory costs because the final and most labour-intensive consolidation takes place at the DCN.	Agility in the supply chain due to the role of the DCN, enabling quick responses to customer demands.

Source: Bygballe, Bø, Grønland (2011)

Text Box 11: Customer Service of Global Third-Party Logistics Providers

In an international environment logistics operations have increasingly become a source of competitive advantage. Global logistic service providers (of third-party logistics) have increased and customized their service offerings to meet increasing demand for internationalized operations. Logistics service quality components can be used to identify different segments of logistics service customers. In addition, differing cultural and organizational characteristics across countries lead to modified customer relationship management. Two main customer segments are identified in the global market. Namely, customers can be organized horizontally - across national markets and vertically- within national markets. The international offering to customers can be better customized and cost savings can be made through the segmentation of logistic service customers.

Source: Mentzer, Myres, Cheung (2004)

Another aspect of service in international logistics operations comes from relationship management with suppliers and customers. As operations are relocated abroad, inputs might also be sourced from other countries. This leads to an increased international supplier base. Furthermore, as the cooperation operates facilities in several countries, customers might also come from more than just one country. Providing service to customers and creating value from cooperation of suppliers is certainly one objective in international logistics (Li; 2011). Relationship management in international logistics will create value and profit. The key is to transform suppliers and customers into strategic partners. Strategic partners can be created though for example loyalty programs. The benefits of having strategic partners are that the logistics services can be highly customized for each supplier and customer, because these are ongoing services and processes, which are repeated on a continuous basis. In addition, information sharing and

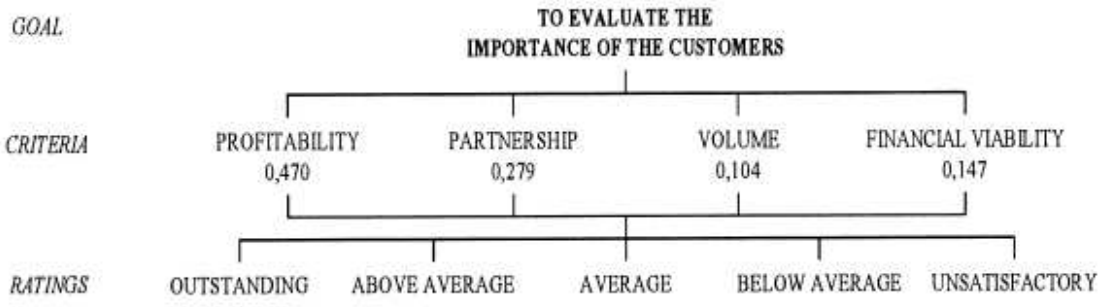
standardization and integration of technology in the logistics activities between partners and customers become more feasible.

Ellinger and Daugherty (1997) find that customer service is greatly increased if the logistics functions are well integrated. This holds particularly, with regard to companies which have internationally dispersed operations. The authors have identified eight major service areas, which are examined in light of service achievements with integrated or non- integrated logistics operations. The eight service areas are: sales/ marketing incentive programs, customization of service to markets or customers, product introduction, product modifications of unfinished goods, special customer service requests, product recalls, returned products, product phase outs. The linkage between integrated logistics activities and service achievements between all eight service areas has been strongly confirmed by the authors. In the next step, the authors suggest that not only logistic s activities should be integrated with each other and internationally, but also services should be integrated within the logistics activities. This is because service is the ultimate outcome of the logistics activities. The authors suggest that service integration within logistics activities will lead to a higher accommodation of customer requests.

Another research by Korpela, Lehmusvaara and Tuominen (2001) suggests that the distribution network of the international logistics operations should be designed according to customer service management. They go even further, than the previously mentioned authors, to suggest that not only the logistics activities should be integrated to create higher customer service, but that also production locations should be chosen in such a way that the logistics distribution network is based on customer service requirements. This is also in contrast to the firstly presented paper, that service in logistics managements is a decision based on costs (cost minimization approach). The international plant location problem is thought to be solved by evaluating it in several steps: (1) defining the problem, (2) determining the strategic importance of the customers, (3) analyzing the customer's preferences for service, (4) evaluating the possible nodes, links (transportation linkages) and alternatives in the logistics network design, (5) optimizing the network design. This decision making process is supported by analytic hierarchy process (AHP), which is used to make the evaluation of steps two to four, and mixed integer programming (MIP), which is used to make an evaluation of step five. The

AHP, is a hierarchy decision process in which different criteria's are rated and a hierarchy for each criterion and its importance is set. The MIP is a program, which evaluates the different network design options and calculates the best outcome, with the criteria and hierarchy of each criterion given.

Figure 11: Example AHP- Strategic Evaluation of Customer Importance



Source: Korpela, Lehmusvaara, Tuominen (2001)

Example 5: UPS Customer Service

UPS (United Parcel Service) is a large global cooperation. It offers parcel services to individuals, as well as companies. UPS has also started to offer integrated supply chain logistics to cooperation's. This holds in, that complete solutions for international freight and transportation activities are offered to clients.

UPS has implemented a strategy of offering complete supply chain solutions to customers and thereby adjusting its operations to the customer. Quick solutions are offered on an industry bases, such as for the automotive industry, consumer goods enterprises or even governmental and defense departments. The main objective of UPS is thereby to create customer service.

The company of course also offers customized supply chain solutions. For example, in 2006 UPS received a contract from STERIS, which is a company providing equipment for health care, consumables, pharmaceutical production and industrial production. STERIS had just incurred an increased freight shipment and decided to integrate its distribution network. Previously, the international company had worked with national logistic providers, to achieve a locally adjusted distribution network, fit to the local needs and regulations. But with increase freight, the company needed a new solution in which ultimate customer service was the main objective. Because the products

of STERIS include sensitive equipment, which has to be transported internationally, UPS designed a unique distribution network solution for STERIS, fitted to its product and market needs. This included technology updates and integration at both companies. In addition, UPS sourced two employees out to STERIS to make the transition. The results of this close cooperation were that on-time deliveries were increased from 96% to 98.5%, tracking was simplified and labeling standardized for both companies. In addition, transit times reduced by a great amount, especially, for international shipments.

Another example, of how UPS increased customer service, is the cooperation of UPS with Adidas. Due to Adidas globally dispersed production facilities and customers; it needed an integrated supply chain solution to upgrade its logistics performance. UPS worked out a full solution for the international distribution network of Adidas final goods. This includes regular updates on shipping requirements for new products. UPS has also developed a system for Adidas's customers to track their ordered sports apparel and choose from several ordering options. Further, the cooperation between the two companies has increased customer service, by increasing the accuracy rate of shipments and improving on-time deliveries. This had the total effect of increasing customer satisfaction for Adidas.

Hence, though ready-made customer industry solutions and customized solutions, UPS has greatly enhanced customer service, for its own customers and for the end-consumers of their customers. By offering complete solutions for the entire supply chain, UPS brings value to its customers. The options in ready-made or customized solutions range from IT applications, packaging, transportation options, inventory and warehousing management, tracking and order planning to even consulting options of product design and cash management.

Source: UPS.com[10]

Risk Management

Risk management of logistics activities in an internationally dispersed operation system, is taken to a new level, as opposed to national production and distribution

[10] http://www.ups-scs.com/solutions/case_consumer.html

systems. The risks in an international cooperation are different and more complicated than for national companies.

Tang and Musa (2011) have examined the risks in an international supply chain associated with the flow of materials, cash and information. Risk in an international supply chain has two main components: risk- the unreliability and interruptions of the supply chain, and uncertainty, which is the risk of demand and supply matching activities. The main risks in material flows, which are identified by the authors, stem from the sources of materials, their making, delivering and the supply chain scope of materials. Some of the under categories of these risks (but not all), will be listed in the table below.

Table 5: Material Flows Risks in an International Supply Chain

Risk	Solution
Source of Materials	
Single source	- Use multiple sources
	- Alternative sources
Sourcing flexibility	- Resilience supply chain
Supply capacity	- Alternative sourcing
	- Flexible web of partners
Making of Materials	
Product and process design risk	- Engineering systems integration
Delivering of Materials	
Demand volatility	- Information technology
	- Increase number of channels
	- Lean manufacturing
	- Best-practice application
	- Operation heading
Supply Chain Scope	
Logistics	- Reduce transport content
	- More efficient transportation
Environmental issues	- Supplier initiative
	- Invest in environmental protection
Political Issues	- Operational hedging

Source: Tang, Musa (2011)

The risks associated with cash flows are: exchange rate risks, price and cost risks, financial strength of partners and financial handling and practice. On the other hand, the risks in information flow management are: information accuracy, information system

security and disruption, and the intellectual property aspect of information (information outsourcing).

Another aspect in risk management of the international logistics operations is to assess risk and manage it correctly. In an international environment, risks have to be assessed at every location and every point, where goods of the company pass through. The challenge today is to develop risk assessment models for the global supply chain (Tuncel, Alpan; 2010). The authors evaluate a computer risk assessment pool of global supply chain risks. They discuss a Petri net (PN) displaying method of dynamic events to evaluate complex behavior of multi-agents in the supply chain network. Petri net modeling is a stochastic method of modeling activities such as multilayer resource sharing, routing, flexibility assessments, buffer management etc. In PN risk management, the supply chain network is entered as the basic function and in the second stage the disruptive factors are added to the network specifications. In a simulation, the possible risks of the network and the key challenges and weak links can then be identified. In addition, to the possible risks, the PN system is also able to work with possible supply chain flexibilities, which can overcome possible risks. The PN system implements the following steps for risk management: identifying the risks, assigning probabilities to each risk, risk management steps and monitoring risks. The monitoring activities of the PN system also have the function of warning supply chain members and detecting errors and misconduct early.

Another perspective to risk management in international supply chains is to manage the increased complexity of the fragmented production network through the use of modern information technology (Giannakis, Louis; 2011). The authors hold that an integrated communication network of the production and administration facilities will help to manage risk better. The approach is to decentralize the production approach. This means that the communication architecture is integrated for every agent in the network. This way, agents not only communicate with each other and receive the information of the following or the previous process, but of all process and activities in the network. The communication integration will be able to improve the capabilities of production fulfillment, supply chain event management and disruption risk management. Response

to disruptive events will be faster and because actions of risk management have been determined beforehand, responses will be more efficient.

Tang (2006) evaluates several perspectives in supply chain risk management (SCRM) in an internationally dispersed production system. Four basic approaches to SCRM are supply management, product management, demand management and information management. Those approaches are mitigation approaches, which are used to manage the risks arising from the operational and disruptive risks of the supply chain. The strategies of how to deal with disruptions are summarized in the table below. These are not risk avoidance strategies, but rather strategies to handle risk and disruptions as they happen. Supply management strategies to mitigate risk, include having "back-up" suppliers in case a disruption occurs with the current supplier. Demand management strategies for disruptive event management entail pricing strategies. This means, in case of demand changes, strong increases or decreases, prices can be adjusted to mitigate demand. Product management strategies include, offering a product line with product variation, instead of only having one product offer. Information management strategies include collaborating among suppliers, sharing information and making it more visible to all access points in the production system.

Table 6: Supply Chain Risk Management

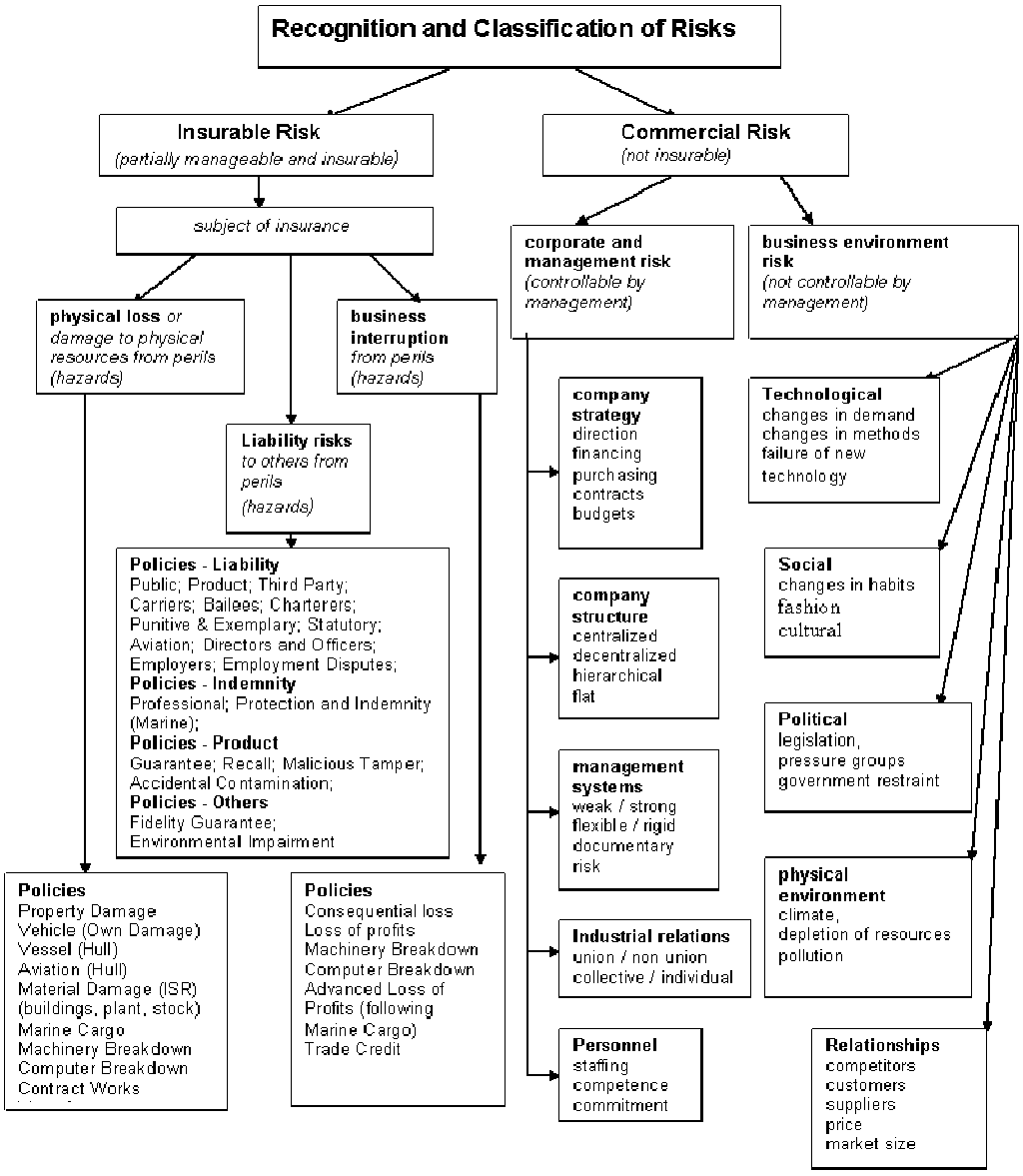
Strategic and tactical plans for managing supply chain risks

	Supply management	Demand management	Product management	Information management
Strategic plans	Supply network design	Product rollovers and product pricing	Product variety	Supply chain visibility
Tactical plans	Supplier selection, supplier order allocation, and supply contracts	Shift demand across time, markets, and products	Postponement and process sequencing	Information sharing, vendor managed inventory, and collaborative planning, forecasting and replenishment

Source: Tang (2006)

Text Box 12: Classification of Risks: Insured vs. Managed

Risks in supply chain management can be classified into insurable and non-insurable risks. Insured risk should not be mistaken with managed risk. This is, while with insured risk insurance is bought, managed risk is minimizing the exposure to losses and costs associated with risks. It is necessary to manage risks, because not all risks can be insured against.



Source: shipperscouncil.co.nz[11]

[11] http://www.shipperscouncil.co.nz/SupplyChainRiskManagement.htm

Example 6: Supply Chain Risk Management at Cisco

Cisco is a world leader in networking solutions and information and communication technology. Cisco has provided countless networking solutions for corporate and government partners. Sometimes Cisco is even called the "backbone" of the internet. Some of its products include data, voice and video transport.

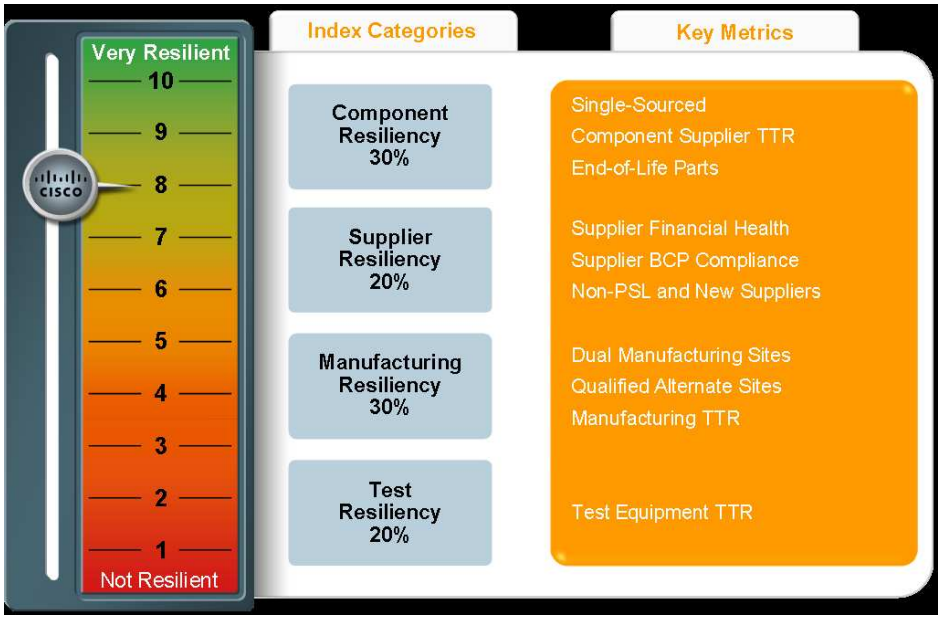
Because Cisco is a global company, it faces many risks in its supply chain. Specifically, Cisco has outsourced more the 95% of its approximately 12,000 products, which means that Cisco is working closely with many suppliers. In addition, most of Cisco's products are custom made, which also means that cooperation with customers is very high. This exposes Cisco to a lot of supply chain risk. Furthermore, risk is particularly high, because the company follows an acquisition growth strategy.

The approach taken by Cisco, to manage the many risks it faces from the international supply chain, is to have a business continuity plan (BCP), a crisis management dashboard, product resilience and supply chain resilience. The BCP entails that Cisco assesses on a bi-yearly basis the risks of its partners. The steps is this assessment process are: (1) identifying the nodes of high impact, (2) evaluating how prepared the company is, (3) mapping components of suppliers, (4) identifying recovery times, (5) auditing and practicing for worst case scenarios. This process helps Cisco and its partners to identify risk and disruptions before they happen. In addition, because the critical components and nodes are identified the most important issues are accounted for.

The crisis management dashboard is an IT solution to list external news to products and locations of Cisco and its partners. This is, news from for example NC4 are mapped on a Google earth map, on which also Cisco's operations are shown. This way employees are always informed at which part of the world anything extraordinary has happened, like a storm, earthquake or political disruption, and where the nearest Cisco location or of Cisco's partners is. The dashboard is updated on a two-hour basis, which makes reaction times quite quick.

Supply chain and product resilience at Cisco consist of proactive programs to react to disruptions in a minimum of time. All suppliers are assessed in their resilience. They are scored from 1- not resilient, to 10 very resilient.

Figure 12: Cisco's Resilience Index Definition



Source: Cisco.com

Finally, Cisco has also started a derisking program of its products. The top revenue generating products have been identified and engineered in such a way that these products exhibit relatively low risk indexes. The steps that have been involved in derisking the top revenue generating products are: Selecting alternative suppliers, selecting alternative components, substitute high risk components with low risk components, identifying alternative production sites and testing products.

This analytical approach, which uses a process of risk prioritizing, of Cisco has already paid off. For example, due to the supply chain resilience and BCP Cisco was able to avoid losses during the financial crisis, even though some of its major suppliers filed for bankruptcy.

Source: Cisco.com[12]; Miklovic, Witty (2010)

Logistics Strategies for Global Operations

Stock and Lambert (2001) identify some of the key issues in building a global logistics strategy. The authors name five main elements of the building block of a global logistics strategy: Environmental analysis, planning, structure, plan implementation and controlling the logistics program. Having analyzed those factors, companies should take some basic guidelines into account for developing a global logistics strategy. Namely, the

[12] http://www.cisco.com/web/strategy/docs/finance/risk_mgmt_C11-521656_wp.pdf
http://www.cisco.com/web/about/ac227/csr2010/governance-and-ethics/management-approach/risk-management.html

logistics strategy should be implemented within the company's strategy. The company's vision should also be implemented within the logistics department and results should be measured on a regular basis. Another useful guideline is to implement the import and export management in the logistics function, so that all movements of goods and materials managed from the origin to the end. Finally, it is important to take opportunities in the national and international context into consideration in order to achieve the full potential of the company.

Dornier, Ernst, Fender and Kouvelis (1998) analyze three important dimensions to which the logistics strategy has to be adapted in the global environment. The three dimensions are the functional (marketing, finance etc.), sectorial (industry) and geographic (country, continent etc.) dimension. The logistics strategy has to be adapted to those three dimensions to maximize profitability of the company. The authors identify three possible orientations within the three dimensions: resource-oriented logistics, information oriented logistics and user-oriented logistics.

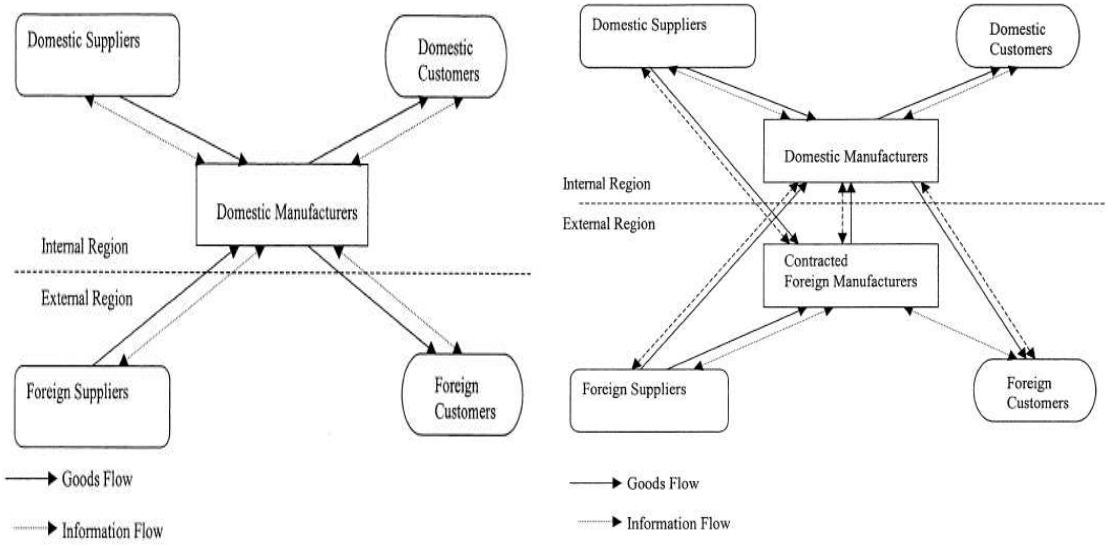
Resource oriented logistics focuses on the functional and geographic dimension and how they interact. The management of resource logistics involves the management of people, materials and cash. Many times the strategy setting in a resource oriented logistics approach is focused on cost management. This can involve centralization of logistics activities and operations to achieve economies of scale. The resources are managed on a global scale to achieve efficient operations.

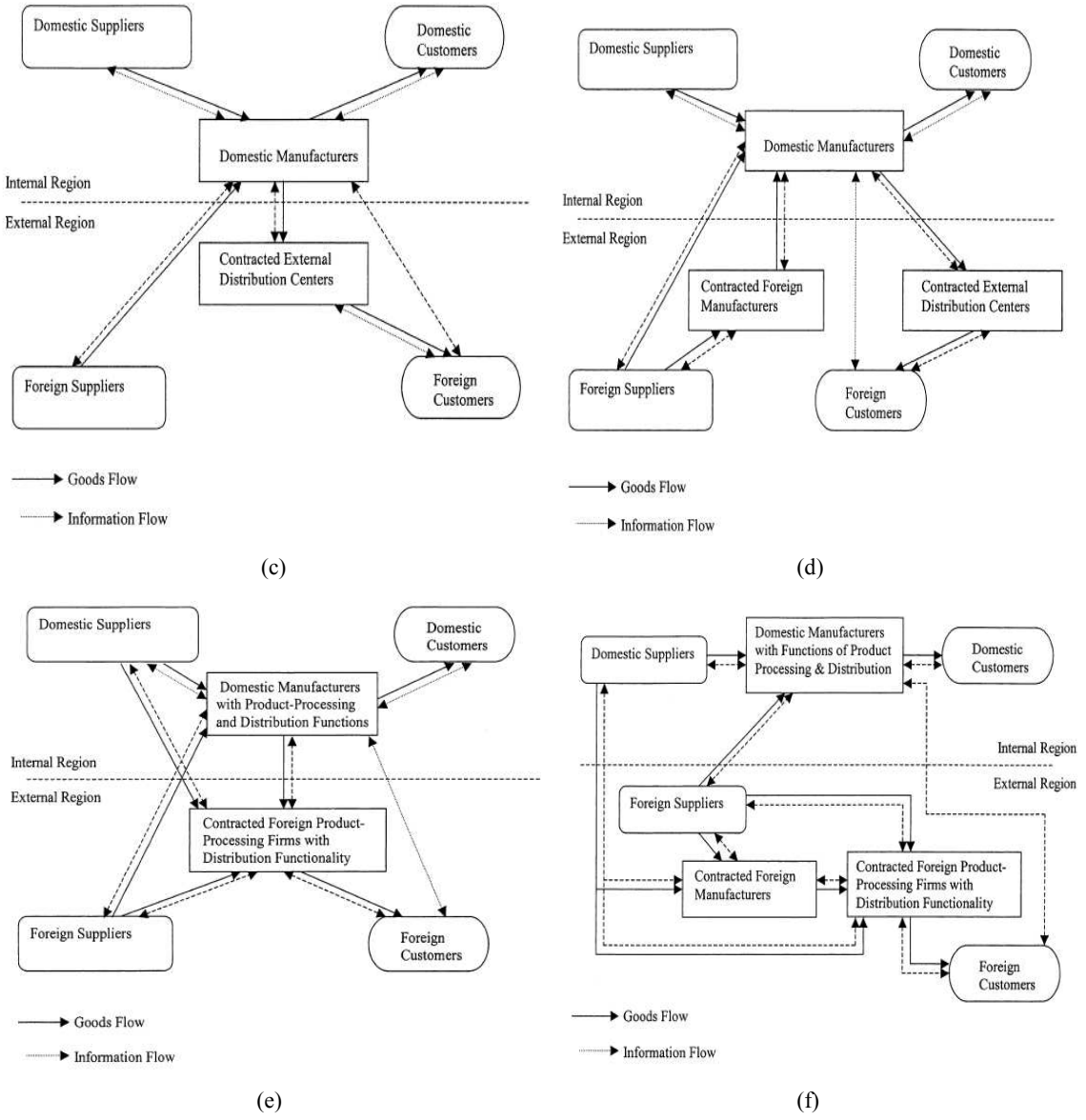
Information oriented logistics focuses on the management of information. This includes high-technology information and communication equipment to achieve availability of information in the global production system Information oriented logistics involves the sectorial and geographic dimension and how they interact. This means that the logistics strategy is adjusted to meet customer needs and requirements and many times global customers are segmented to offer a better product variety. Customization strategies are very common in this form of logistics orientation.

User oriented logistics focuses of the customer. This entails maximizing customer satisfaction and service. User oriented logistics are designed to manage the relationship with existing customers and cooperate with them. The objective is to develop solutions and technologies together, to increase flexibility and the response to final consumers.

Sheu (2004) discusses an approach to identify global logistics strategies. The author calls this the hybrid fuzzy-based approach. Sheu argues that global strategies for logistics operations are different from national logistics requirements, because the international environment is more complex and bears more uncertainty. To overcome the complexity and uncertainty of the global setting, a fuzzy multi-agent decision-making (fuzzy-MADM) and fuzzy analytical hierarchy process (fuzzy-AHP) technique is suggested. This is the decision making model is set under uncertainty with a limited number of decision alternatives and performance criteria of the model. Six different global logistics modes are compared and an analytical process of pairwise comparison matrices, weights determination and determining the decision-making criteria, leads to the final decision of the global logistics strategy mode. This is a highly technical analysis. Obviously the evaluation criteria are adjusted to the functional, sectorial and geographical setting of the company and the weight determination of the decision-making criteria are matched to the overall organizational strategy, goals and capabilities. Examples of evaluation criteria include: applications of IT, R&D, inventory control, management control, response to external environment and many more. These criteria are ordered and weighted and the MADM analysis will calculate the scores of each modal function within the set of given criteria. The mode of the highest score is then fit for the global logistics strategy setting. The modes will be discussed in more detail below.

Figure 13: Global Logistics Strategies





Source: Sheu (2004)

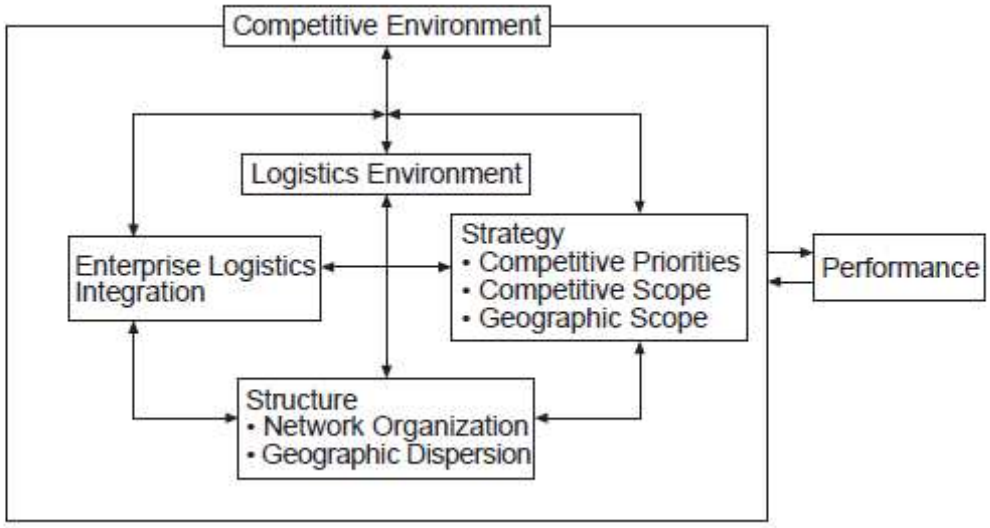
The above listed global logistics modes have all particular setting. Mode (a) represents a centralized global logistics approach, in which production, assembly and all logistics functions are internalized. Mode (b) is similar to (a) with the distinction that assembly is partially outsourced. In mode (b) all logistics activities are controlled by the firm. Mode (c) depicts a centralized production approach in which the firm owns all of the production activities, but some of the logistics functions, such as warehousing, transportation and inventory management for the overseas market are outsourced. Mode (d) refers to a production system in which some of the production functions have been outsourced to the foreign market and some of the foreign distribution functions of

logistics, such as warehousing or transportation have also been contracted out to foreign logistics providers. In mode (e) partially finished products are finished by foreign manufacturers, which also take the responsibility of logistics activities in the foreign market. Finally, mode (f) shows a truly global logistics system in which nearly all activities of production, assembly and logistics are also conducted in the foreign market.

Stock, Greis and Kasarda (1999) shed some further light on how logistics is used and incorporated in a strategy designed for internationally fragmented production systems. To develop a logistics strategy the competitive environment has to be analyzed first. This includes technological advancements, global competition etc. In the next step those competitive elements have to be related to the logistics activities and it has to be assessed what logistics capabilities the firm will need in this environment. The structures of the possible network and the geographic location settings and variations have to be assessed. Possible network configurations and dimensions can include vertical integration (to what extend the company owns the supply chain), flexibility (the ability to react) and cooperation (the relationship between supply chain actors). Enterprise logistics planning is another element of the proposed framework of the authors. It refers to the planning, implementation and controlling of materials, goods, cash and information from the start to the end of the flow. Integration could be either internal or external. Internal integration means that the firm operates the logistics activities and manufacturing activities itself and hence has the control over all such activities. On the other hand, external integration refers to when the firm does not operate all logistics and production activities itself. The strategy in this framework setting contains three main elements: the competitive priorities, competitive scope and geographic scope. Competitive priorities can be based on cost, quality, delivery and flexibility considerations. The competitive scope refers to the width of a firm's strategy. This means that the firm has to decide on how many of the competitive priorities to focus and how to trade them off against each other. The geographic scope is defined as the area, which is serviced by the company and in which it operates. This means the company has to strategically choose is production locations, the transportation routes and the markets it will provide with its goods and or services. Finally, it is important to measure and control performance at all steps in the process. This is used to assess how profitable and or successful the company finally is. Internal

performance and external performance measures should both be applied. All of the discussed elements in the framework have to be integrated, since they interact with each other.

Figure 14: Framework: Logistics in Strategy and Structure



Source: Stock, Greis, Kasarda (1999)

Example 7: DHL Global Logistics Strategies

DHL is a global German logistics service provider (though today it's headquartered in the US). It started out as a postal service, but has broadened its operations to include full logistics services and even strategy consulting in logistics operations.

DHL provides readymade strategy solutions for its customers. One of the strategy solutions is based on the degree of internationalization and the mode of entry of their customers. They advise their customers to integrate their logistics strategy within their overall international strategy. DHL has identified five major internationalization types and gives logistic strategy advice for them. Another strategy solution, provide by DHL, focuses on growth opportunities and how logistics is implemented to foster growth. Another strategy solution by DHL involves the analysis of business strategies of differentiation and cost-leadership and how logistics is used to support these business strategies. Finally, logistics can also be adjusted to a functional strategy.

Basing the logistics strategy on the degree of internationalization, has led DHL to distinguish between five major types of internationalization.

Indirect exports by a domestic company should not be complemented with a special logistics system. This is the company is advised to use its national logistics system as far as possible and outsource the international logistics activities to a logistics service provider.

If a company is exporting though licensed production, DHL advises it not to create a special logistics system for international operations. This is because the costs of building such a system would far outweigh the benefits. However, the company is recommended to control the licensee and set performance and operating standards that are entailed in the contract.

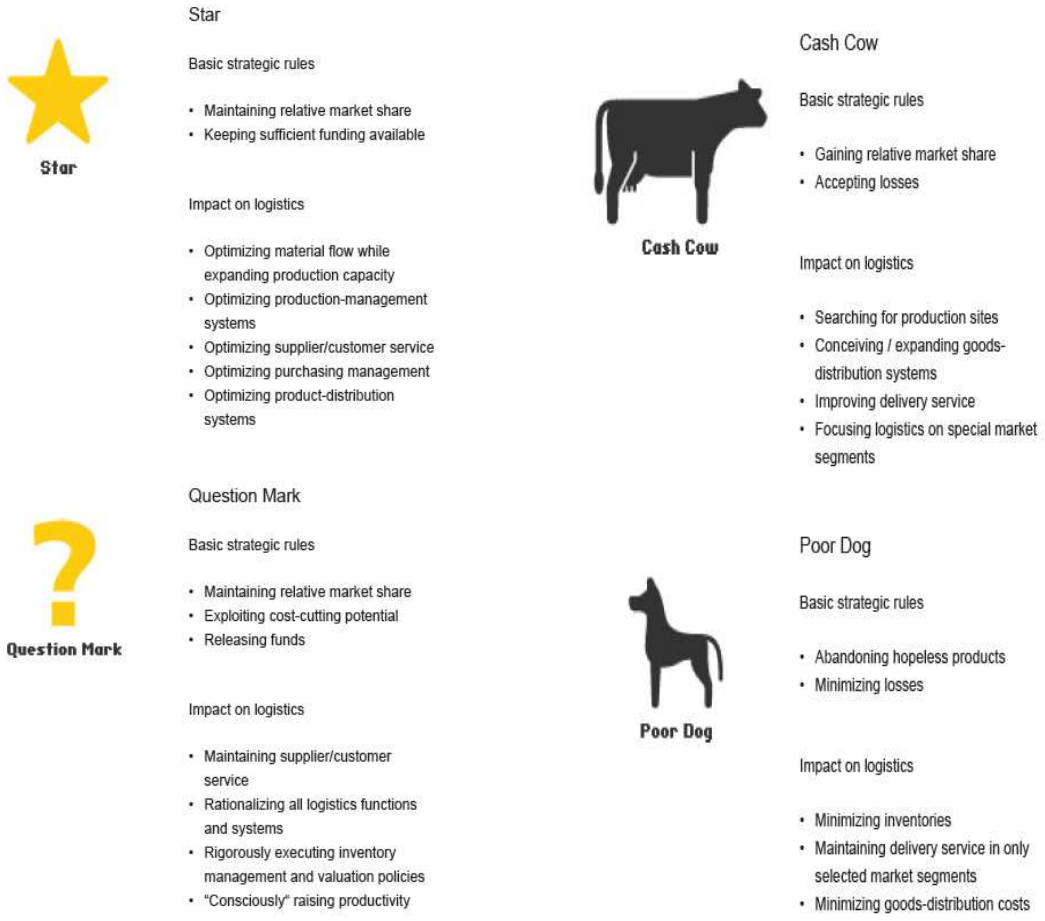
Directly exporting with investments in an international logistics system should be complemented with investments in warehouses, inventory management abroad and building an international distribution network. This way overseas customers are served though production from domestic operations.

If assembly or production is disintegrated and operated through a joint venture or owned by the company, the logistics strategy should include full logistics operations in the foreign country. In particular, because plant investments are made abroad by the company, the logistics activities of exporting back to the home country and providing the foreign market through this production facility are directly included into operations when planning and building the foreign operation. This includes packaging, warehousing, inventory management, distribution activities ect.

Finally, in case of a global company with decentralized management activities, DHL advises to focus on lowering logistics costs, by providing homogenous products to different markets and hence standardizing global logistics activities.

The growth based strategies are adjusted to the BCG matrix of the star, cash cow, question mark and dog. DHL suggests logistics strategy solutions for companies in each of these growth stages. These are summarized in the figure below.

Figure 15: Logistics Strategies in a Company's Growth Cycle



Source: DHL.com[13]

Finally, the logistics strategies suggested by DHL to adjust to the corporate strategy are the comprehensive cost leadership, sector-wide differentiation and concentration on focal areas (market niche).

In the comprehensive cost leadership the company is advised to restrict costs in its logistics operations. This can be done by handling large volumes and spread out geographically. Technological applications can greatly achieve cost reductions in the material and goods handling in the logistics processes. Material flows should be used to full capacity.

With sector wide differentiation the company should implement a high customer focus in its logistics strategy. This means that flexibility, assessability and market-

[13] http://www.dhl-discoverlogistics.com/cms/en/course/management/strategic_log_plan/overarching.jsp

segmentation are the key success factors in the logistics operations. Also relationship management in logistics activities is very important. Customer and supplier contact and communication will increase ultimate customer satisfaction. Even though logistics activities in this strategy setting are more expensive, profit is generated, because customers are willing to pay higher prices for the increased services of logistics operations.

The concentration of focal areas, such as niche concentration, requires logistics activities to focus on very small segments. This means that some costs in logistics might never occur. For example, companies might never need a warehouse, because local customers are directly serviced from the plant.

Adjusting logistics to a functional strategy means that the logistics activities are adjusted to serve the needs of the product. This can be a consumer product or a productive good. The strategic logistic planning for both categories is summarized in the figure below.

Figure 16: Functional logistics strategy: Consumer and Productive Goods

Sought-after or comparison products

For sought-after or comparison products, the consumer makes a purchasing decision after carefully weighing various products' strengths and weaknesses. Two approaches can be taken in this process: "inter-shop" and "intra-shop" comparisons. In "inter-shop" comparisons, the consumer visits several stores. In "intra-shop" comparisons, he focuses on a single store that has a concentrated assortment of products.

The chances that a manufacturer will lose sales are smaller in "inter-shop" comparisons than in the "intra-shop" approach. This is because the consumer who likes to search for products is likely to find an item that is unavailable in one store someplace else. As a result, the role of the delivery service is smaller for the manufacturer in the first instance. It remains the same for the individual retailers in both cases.

Specialty products

Specially purchased products are characterized by highly distinct product features and strong brand loyalty. To the consumer, the product is so unique that he is willing to put off his purchase when the item is out of stock and wait until a new delivery is made.

The delivery service has little significance for such products.

Urgently needed products

No particular brand loyalty is associated with urgently needed products. Rather, the buyer has little interest in comparable products because he needs the item immediately. As a result of this urgent need, the consumer will select from the available goods when the preferred item is out of stock. In terms of such items, the retailer is in a position of increasing the delivery service by having acceptable substitute items on sale. Because the unavailable good results in lost revenues only for the manufacturer, the delivery service becomes a top-priority matter for him.

Customer-specific productive goods

Customer-specific productive goods are used by only one user, and they must meet particular specifications. Such goods include parts and components that are specially made to meet customers' needs. They usually have a relatively long production period.

Because the share of the dispatch time within the overall delivery time is rather small, the requirements placed on the delivery time of these goods are also rather limited. Important factors that go into the selection of a supplier are deliver reliability and flexibility. This is because the supplier's deliveries are integrated into customer's processes.

Relationship-specific productive goods

Typical characteristics of relationship-specific productive goods are repeated orders over a specific period of time, and high demands are placed on delivery reliability and the nature of the goods.

As a result of long-range requirements planning, delivery times are short. A high level of delivery reliability and certainty is particularly required for items with assembly- or application-synchronized "just-in-time" delivery. In the short term, problems with the delivery service generally result in contractual penalties. Over the middle term, inadequate logistics performance can mean that the supplier will not be considered as a future partner for new delivery components.

Unsought goods

In externally initiated purchases, the consumer knows nothing about the products, or he is acquainted with them but has no intention of buying them. Marketing efforts are the primary approach to selling such goods. Delivery service is also very important. The products must be immediately available once advertising campaigns or personal buying considerations have prompted the consumer to make a purchase. Otherwise, the awakened demand cannot be satisfied.

Source: DHL.com[14]

For all of these functional product strategies, DHL offers delivery solutions. In each functional setting, the logistics strategy is adjusted in an economic, technical and legal way, so that logistic efficiency orientation is achieved.

Souce: DHL.com[15]

Global Supply Chain Design

Before starting to discuss the considerations in building global supply chain design and networks some of the competitive issues in global supply chains will be discussed.

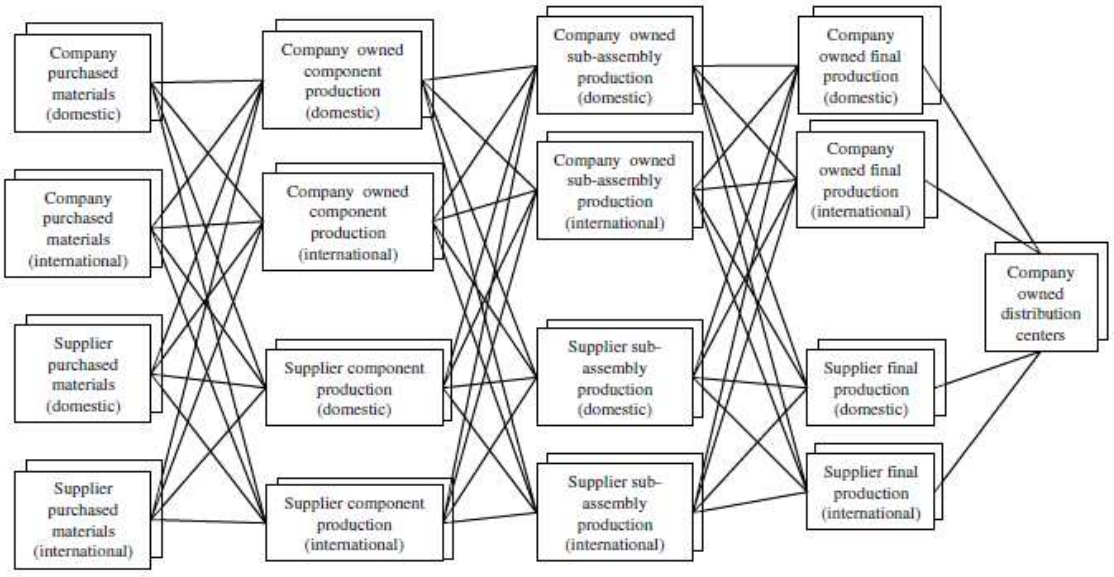
Hülsmann, Grapp and Li (2008), hold that global supply chains should use autonomous cooperation and control management (ACC), to overcome competitive threats of the environment. The authors argue that because global companies are confronted with hyper-competition (extensive competition in the global environment), they have to take special measures to deal with these threats. Flexibility is considered to enable the company to take this threat and develop it into an advantage. The tool to do so is to make uses of the supply chain to balance flexibility with stability. The ACC management too is considered to enable the company to do so. ACC management consists of five important parts: Autonomy, decentral decision making, non-determinism, heterarchy and interaction. Autonomy is the ability to control the supply chain and the

[14] http://www.dhl-discoverlogistics.com/cms/en/course/management/strategic_log_plan/functional.jsp
[15] http://www.dhl-discoverlogistics.com/cms/en/course/management/management/international.jsp
http://www.dhl-discoverlogistics.com/cms/en/course/management/strategic_log_plan/business.jsp

external elements, which have impact on it. Decentralized decision making implies that the supply chain operates as a system and the internationally fragmented production system should make decisions according to local competences. Hence, decisions are made at lower hierarchy levels. Non-determinism refers to the unpredictability of the environment and the behavior of system. Heterarchy is the varying influence of each part of the system on its development and performance. This means for example that even a small part of the supply chain can have an enormous impact on the whole performance in times of a crisis. Interaction means that information is shared between all units of the supply chain. This enables better control and decision making for all actors. The authors suggest that these five characteristics of ACC will lead to the better adaptability and greater advantage of a global supply chain.

Possible global network designs can have many forms. Meixell and Gargeya (2005) list some of the options firms face in building a global supply chain network. The stages, which the authors considers as the main building blocks are: material purchasing, production, assembly, final production and distribution. Each of those stages can be company owned (domestic or international) or supplier owned (domestic or international). A summary of the possible combinations is given in the figure below.

Figure 17: Alternative Global Supply Chain Designs



Source: Meixell, Gargeya (2005)

Global supply chain design models often exhibit similar decision variables. Many of the design characteristics involve facility selection, production and shipment quantities and supplier selection. Other characteristics also include financial options, capacity considerations and transportation options (Meixell, Gargeya; 2005). Other issues are related to performance, integration and globalization (e.g. outsourcing).

One very popular supply chain structure approach is the build-to-order supply chain (BOSC) management (Gunasekaran, Nagi; 2005). BOSC management has arisen in the light of mass-customization. Manufacturers and retailers have been under pressure to configure their offerings to customer needs. This had led to significantly lower product cycles, shorter lead times in manufacturing and faster distribution. Build-to-order is largely based on the integration of information and telecommunication technology between actors in the supply chain. To develop a successful BOSC in an international production system IT, operations, organizational competitiveness and the development of BOSC has to be integrated among the participating firms or units of a company. Some of the logistics properties under this approach are low inventory holdings of final products. Because production is only started after the order is received, inventory will be low. In addition, distribution is critical to the success of BOSC. Because customers do not want to wait for their ordered product a long time, distribution has to be fast. Finally, partnership management is also crucial to the success of the BOSC management.

Another approach to international supply chain design is a mathematical solution proposed by Nagurney (2010). The author provides a network solution based on a system optimization perspective with regard to capacity, product flow, storage, shipment and investment optimization. The author proposes a specific network design possibility with a number of interaction nodes and transportation linkages. The stages in the proposed network are manufacturing, distribution center storage and retail outlets. The author then develops a mathematical model to calculate the optimal design of the network, given a specific set of assumptions of the company. Explaining the whole algorithm is too far beyond the scope of this paper though. It should just be noted that the literature offers algorithmic solutions to supply chain design problems.

Harrison (2001) discusses global supply chain design as one of the two building blocks of supply chain management, the other being supply chain execution or operations.

Supply chain, according to the author, is "determining the supply chain infrastructure", this entails decisions about the location of facilities such as warehouses, plants, distribution centers, decisions about the mode of transportation and production processes and techniques. According to Harrison the solutions to the problems of global supply chain design can be categorized into optimization, heuristic and simulation solutions. Optimization refers to the efficient use of all materials and resources in the supply chain. Heuristics means that heuristic computer algorithms should be used to model the supply chain design. Simulation refers to the assessment of the model. It is used to find the risks and possible problems of the supply chain design and to assess the performance of it.

Example 8: Zara's Global Supply Chain Design

Zara is not only one of the largest fashion retailers in the world, with outlets around the globe (in 2011 it even opened stores in Australia), but also one of the most efficient producers of clothing and garments. The fashion retailer and producer belongs to the Inditex group.

Zara's vertically integrated supply chain has enabled the company to bring more than 12,000 designs each year from the design to the final customer in stores in about 15 days. Although Zara is labeled a fashion imitator, rather than a fashion creator, this strategy has been proven highly successful.

Zara certainly has revolutionized the fashion industry, by making extensive use of supply chain design modifications and logistics strategies. While many of Zara's competitors take a make to stock approach and have a cycle from planning to final customer of six month or more, Zara clearly takes a different approach. With its very short lead times and JIT management approach the company has managed to regularly bring more fashionable cloth to the customer.

Each week a new collection is introduced by Zara, with limited production quantities. This way, Zara attracts customers on a regular basis, not only when seasons start or end. Items are imitated from leading high fashion brands and Zara is often able to beat those brands to the market. In addition, because the company offers many of the garments in different colors and up to seven sizes, the company has to manage up to 300,000 stock-keeping units (SKUs) a year. Of course Zara has implemented a bar-

coding system to track all of its items companywide from the prototype design to the store location.

The design center of Zara is centralized at the headquarter in La Coruña, Spain. This makes production decisions quite easy and fast. The coordination between the design unit and the other management functions is quite easy since all are located under one roof.

In order to bring new designs to the customers in such a short while, Zara takes a tight control over its supply chain. It owns production sites in Europe, Asia, Africa and even the US. Fabric is sourced from Italy, Japan, China and India. The production sites have all varying degrees of specialization. Garments have different requirements in their production and are hence handled by different facilities. This way production can be managed faster. Certainly this specialization of production also helps to manage the extremely high volume production of different items, as compared to the industry standard (competitors like H&M produce up to 4000/5000 garment designs each year). For example, standardized garments such as each season reoccurring cardigan in seasonal colors, is always managed by the same facility. On the other hand, complicated high-fashion items are mostly produced in Europe, because high-skilled labor is applied in its production.

On the other hand, as opposed to some other clothing chains which apply licensing, Zara also owns its shops. This means that Zara has full control over the management, inventory management and ordering of all of its stores. Up to 50% of the orders for each shop are determined by Zara's management and the other 50% can be selected by store managers. This gives Zara the opportunity to internationally plan for its production and distribution, and also gain a good overview over which garments sell best in which locations and hence adjust local stock to local demand. On the other hand, local store managers have some freedom and the opportunity to recognize local trends and preferences, before they show up in sales figures of the garment designs.

Zara produces in relatively small batches, as compared to the industry standard. The company makes use of a customer feedback system and has integrated its IT system with manufacturers and distributers, so that popular styles and designs be extended or that new desired designs can be created directly at the manufacturer.

One advantage of producing in small batches is that inventory risks associated with outdated stock is low. In addition, due to the high integration of Zara's communication network, low selling garments can be stopped in their production immediately and held stock can be moved to the bestselling location point immediately.

The advantage of such a flexible production system is that customer demands can be met on a very high level. As popular designs can be extended and unpopular ones be killed off, customer demand is truly met by this pull system.

Source: inditex.com[16], Ghemawat & Nueno (2006)

Conclusion

The issues, which have been presented in this paper, have been discussed with regard to logistics operations in an internationally fragmented production system.

The introduction has been directed at building a basis of what the individual logistics tropics contain and mean. This is because the main part of the paper was directed at management issues, problems and solutions, and no specific definitions were mentioned or explained. The basic introduction should offer a better understanding of what the discussion items in each topic of logistics entail and mean. Not always all considerations were mentioned in the main part and the reader sometimes was supposed to grasp the implications him/herself. In addition, a basis of the logistics topics in terms of definitions and concepts has been build, because the main part of the paper was not intended to offer a complete overview of the issues in the academic literature. This is because many of topics of logistics management have been discussed in this paper and there was no room for a complete discussion of all the issues in a global setting.

The discussion of the economics of offshoring has not been taken up in the main part of the paper. It's use was rather to give some economic explanation of why offshoring is happening and what its broad economic settings are.

This paper has addressed most of the relevant issues in logistics management and has discussed those issues in light of global production. The focus hereby has been on the management issues and topics and another relevant, or interesting matters related to it. It has not been the objective of this paper to make a full discussion or overview over the

[16] http://www.inditex.com/en/who_we_are/concepts/zara

literature. Neither has it been the purpose to mention all the technicalities relating to this topic. Rather, the reader should view this discussion as an introduction to the issue of logistics management in an internationally disperse production system.

It can be concluded from the foregone discussion that the main issues related to logistics management in internationally fragmented production systems are: cooperation, integration, communication and standardization. The discussion has been based on a general overview rather than being directed at a specific company, industry or country. Most of the discussed papers have suggested integrative approaches to the management considerations in international logistics. So, whatever the individual specifications of the company, industry or country settings should be, the approach taken to manage the logistics operations in an international context should be consistent across operations and facilities and even across supply chain actors in case of a disintegrated production system.

Information management in an internationally dispersed production system truly has the task of providing in-time, standardized information. Integration of information systems across production locations is one of the key issues.

Transportation with offshored production is sometimes sourced out. This is particularly the case when facilities are relocated to another continent. On the other hand, transportation in international logistics is under pressure to be timely efficient and yet offer flexibility with regard to demand fluctuations. Furthermore, companies are under pressure to take environmental considerations into account in their transportation strategy, particularly when transportation becomes international and more visible to consumers.

Inventory management, warehousing and materials management have increased importance in internationally fragmented production systems. Inventory will increase. Due to the fragmentation of production more inventory is needed in the increased amount of facilities. Again in inventory management, warehousing and materials management there is a trade-off between flexibility and cost. The risk, with regard to inventory management in an international setting is higher, because stock has an increased probability of becoming obsolete. However, internationalization can also lead to higher efficiency and better value adding activities in these areas of logistics. For example, warehousing in an international context might be used as a value adding activity in which

goods are transformed. In materials management standardized materials can lead to a simpler management and higher efficiency in international transportation and production.

Packaging management in international logistics has an increased need for standardization and protection. Due to longer transportation, protection is more important and packaging has to be traded off against possible costs, space considerations in transport and environmental issues. Labeling should be standardized in international packaging, within the company and between companies, in case the supply chain is disintegrated.

Customer service certainly offers more options in international logistics and more considerations have to be taken into account. Because customer service is achieved by directing all activities at the customer's satisfaction, the international production standards and all logistics operations should be directed at the customer. This means that offshored production facilities have to integrate the standards set for customer satisfaction achievement. In addition, measurements of customer satisfaction should be applied to all stages along the dispersed production.

Risk management in an international environment has many aspects. Since this paper was not intended to give specific details of countries or industries, none of the specific political, environmental or regulatory risks have been listed here. Rather, management approaches to assess risks in an international setting have been discussed. In addition, risk management plans for international companies were mentioned.

Logistics strategies in an offshored production system have many facets. Unfortunately not all of the possible logistics strategies could be mentioned here. One logistics strategy was to manage global logistics in terms of information, user of resource settings of the company. Further, some management approaches to develop an international logistics strategy were discussed. For example, algorithmic decision making tools are one solution to international logistics strategy problems.

The design of global supply chain structures, showed that a company could take a customer focused design approach. This way the company could set the customer requirements and then enter the possible location and distribution solutions into computer software and calculate possible network design outcomes from this.

In each of the logistics topics an example of a global company or an industry has been discussed. The examples have not always taken up the specific issues discussed in each topic. However, the example was always directed at shedding some light op possible settings or solutions in each context. The purpose of the examples was to illustrate possibilities of managing logistics in an international setting.

From the discussion above, it has become clear that in international production systems, logistics has an increased function and responsibility. International logistics nowadays is much more directed at being a competitive tool, than merely building a support block for the operations of the company. Again, as has been mentioned, the key issues thereby have become integration, coordination, communication and standardization!

Hence, whatever the adopted strategy, technology, supply chain design etc. of the company might be, the highest efficiency and best working practice is achieved when all the discussed topics in logistics management are developed in an integrative way. Each component is connected to the other and to have a consistent and smooth operation these four key issues have to be respected.

Limitations and Future Research Suggestions

This paper has discussed offhoring in light of logistics activities and the management considerations which must be made. As has been mentioned in the introduction, the majority of the academic literature concerns itself with the labor and economic affects of offshoring. This has not been the discussion here. Neither has it been discussed what the possible alternatives to offshoring are. Just to name a few: outsourcing, arm's length, licensing, franchising; other forms of FDI investments and many other forms of entering a foreign countries. The further the form of entering a foreign country is from offshoring the less similar the impacts and management issues in logistics are to those of offshoring. For example, in an outsourced operation, the logistics responsibility of inventory management, warehousing and transportation in the foreign country lies within the foreign contractor. On the other hand, in a strategic alliance, the cooperation between the foreign and domestic company is very close and the logistics concerns might be more shared. This is a limitation, but it certainly offers room for future research

Logistics activities in an international context might be distinguished between the form of entry and differences and similarities could be researched.

One of the greatest limitations of this thesis is that the discussion has been based on a general setting. No country, industry or company specific details, except for the examples, have been discussed. This was because the scope of this paper was rather broad and all the relevant logistics topics have been discussed, rather than that the focus has been on one topic only.

Logistics management and specifically the tools and applications used, are highly customized in each company, industry and country. Finding standardized data, on for example a country level, on the issues is not possible. Hence, the management issues have been discussed, rather than a data analysis.

For further analysis, performance is one of the subjects which should be discussed. For example, a performance comparison could be made in logistics activities between national and international companies. This would however require one to collect data him or herself because such data is currently not publicly available.

Another possibility for future analysis includes the analysis of logistics in a specific regional or industry setting. Thereby, specific cultural, environmental, economic, political, technological etc. characteristics could be taken into account. Also such an analysis would offer the possibility of comparison of practices between for example two different regions or industries.

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Appendix

The main topic of this paper has been discussed with regard to all the issues in logistics. Even though an introduction to the economic logic and theory of offshoring and what it consists of has been given in the introduction, nothing further specific has been mentioned. Hence, the appendix will line out some of the future trends and changes, which will happen in offshoring of productive activities.

Future Trends in Offshoring

One of the particular "hot" topics in logistics is offshoring of IT and ICT enabled services. Many academic articles have discussed this trend and even governmental and non-governmental organizations have taken it up in their discussion. This is because with the offshoring and relocation of IT and ICT services many jobs are moved abroad. The OECD has identified it as a self-dynamic, reinforcing trend (OECD; 2005). This means that when company moves activities abroad, because of costs advantages and or increasing its competitiveness, other companies will soon follow. However, on the other hand other economics have also argued that due to the job relocation of relatively easy jobs abroad, the home country effect is that more high-skilled control actives are placed domestically to support and control foreign actives. These authors have argued that the total effect on labor is not clear or that in the long term the posititive effects in the home country outweigh the negative short-term effects. That is in the long-term other effects as lower prices in the home market or higher dividend payouts to shareholders or higher wages to local employees may take effect.

The OECD has made some assumptions about the criteria for a job to be offshorable. That is: ICT intensive jobs, output can be IT transmitted, standardization of output and knowledge used, low face-to-face contact requirements. On the other hand, country characteristics for ICT offshoring were identified as by the OECD: high wage difference with the home country, low entry barriers, low requirements for social networking. From the job requirements the OECD has ranked professions in how easily they are affected by potential offshoring.

Table 7: Potentially Effected Jobs from Offshoring

3 Digit ISCO-88
123: Other specialist managers
211: Physicists, chemists, and related professionals
212: Mathematicians, statisticians and related professionals
213: Computing professionals
214: Architects, engineers, and related professionals
241: Business professionals
242: Legal professionals
243: Archivists, librarians, and related information professionals
312: Computer associate professionals
341: Finance and sales associate professionals
342: Business services agents and trade brokers
343: Administrative associate professionals
411: Secretaries and keyboard-operating clerks
412: Numerical clerks
422: Client information clerks

Source: OECD (2005)

Countries like India are particularly popular for offshoring IT services. IT and ICT hub bubbles are emerging in cities like Bangalore in India. Well educated labor in India is relatively cheap and due to this growing trend India has even started to specialize in technology and IT education. India is also particularly popular because it's bureaucratic language is English and it has a history of being an English colony, which also makes Indian knowledgeable about English traditions, history and habits. Hence, for all English speaking countries, India is a good choice for offshoring activities, and particularly service activities.

Further, the OECD (2005) has also identified sectors which are particularly prone to be affected by the offshoring trend. Manufacturing industries are influenced by offshoring the most. In manufacturing many activities are high labor intensive, low capital intensive and require only a low-knowledge of the worker. These jobs are often in factories and are highly standardized. This is also why many economic models of offshoring and outsourcing assume two productive activities in the manufacturing process: production and assembly.

On the other hand, a more recent research conducted by the OECD (2007) has found that the nowadays not only low-skilled jobs are affected by offshoring, but that there is a growing trend to offshore high-skilled labor jobs. As has been said above, particularly India has good conditions to be the receiver of offshored activities. But alos countries like Ireland have long benefitted from the offshoring trend. Ireland, in contrast to other EU coutrntries, has lower wages and the population speaks English. This has led

many American IT and technology companies to locate activities in Ireland and serve the European marked from there.

Other trend identified by the OECD (2007) included offshoring to high-wage countries. Particularly the Asia market has been going in strength and power. Many Asian companies have benefitted from this trend and are now trying to expand their markets towards Europe or the US. This has led such companies to relocate final productive activities as for example assembly in auto-manufacturing to relocate from China to Poland, so that the European market can be served from this location.

Finally, some policy measurements should be mentioned in the context of offshoring in a globalizing world. Namely, policy makers have acknowledged the trend of offshoring and have started considering the implications. Particularly, with regard to labor being lost in the home country, developed countries like the EU or the US have tried to take measures. Countries were not so much able to forbid or hinder companies to offshore productive activities, but they were nevertheless trying to make the home country more attractive and reward companies for staying (OECD; 2007). However, the OECD discusses this strategy under an economic standpoint and finds that this is largely an inefficient plan of action. That is with respect to spending taxpayers money efficiently and with respect to consumers. Analyzing policy responses and strategies in light of offshoring goes to far here, but it should be noted that an answer to the problem has not jet been found.