GreCOR
GREEN CORRIDOR
Oslo-Randstad

The Interreg IVB
North Sea Region
Programme
Investing in the future by working together for a sustainable and competitive region

Towards Green Supply Chains - Best practice and potential cases

European Union
The European Regional Development Fund

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Executive Summary

The transport system itself is very complex. It is built upon numerous parts in contact with each other in different ways. An effect in one sector can change the requirements for the whole supply chain. It is often hard to define the start and end of a chain. Often a company can play a part in several supply chains. The goals for the different supply chains are in the end to provide added value to the customer and thereby ensure the involved parties existence.

In order to direct the supply chains into a more sustainable direction it is vital that the original goals (customer satisfaction/value/profitability) remains. Environmental impact should be considered as a natural business factor like purchasing and sales to achieve best effect. Companies all over the world have adapted this way of working and environmental and sustainable aspects play a central role in their business culture.

Logistics and supply chain development can often support greener transports. For example can logistics trends for setting up fewer distribution centres (DCs) contribute to concentration of goods volumes. Concentration of volumes opens up new opportunities for volume demanding transport modes like railway and sea transports. These are transport commodities which can contribute to a greener transport system. Projects on international level like GreCOR support this development and promote creation of transport corridors with large concentrated freight flows. These corridors set the baseline for designing efficient intermodal concepts.

The road transports do and will however continue to play a dominating roll in the transport system. The transport mode distinguishes itself in particular within the area of delivery service. Rail- and seaway have difficulties to be competitive when it comes to logistics parameters like flexibility, service and lead-time. In order to even out the competition between the transports modes, intermodal solutions are a key factor.

This report delves into a case study focusing on transport parameters and successful green supply chain. The supply chain “shipping route Gothenburg-Ghent” is performed as an intermodal setup which on a yearly basis carries around 98 000 trailer equalities on the sea instead of occupying the road network. The setup has in a successful way managed to keep a strong focus on traditional logistics objectives and the sustainable outcome is added value.

Distribution of flowers is today one of the commodities within the corridor that is completely dominated by the mode road transport. This is mainly because there is a large focus on lead time and flexibility which makes it hard for other transport modes to be seen as an alternative. To make the transport chains greener and to keep the original commodity demands, an intermodal setup between the Netherlands and Sweden might be seen as an alternative in the future. This will however require a very robust railway network and a railway sector which for real puts the customer in focus.

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Content

Green Corridor (GreCOR) in the North Sea Region

GreCOR – Green Corridor in the North Sea Region – is an Interreg IVB North Sea Region project that started 1 January 2012 and will end in June 2015. GreCOR promotes the development of a co-modal transport corridor in the North Sea Region. Important in this collaborative approach, is the that the focus is not only on the corridor itself, but also on secondary networks and the hubs, and the regional hinterland around the Green transport corridor between Oslo and the Randstad area (Amsterdam, Rotterdam, The Hague and Utrecht).

GreCOR has 13 partners and a total budget of 3.7 M€. The overall aim is to improve knowledge about the logistic needs and conditions and develop a strategy for the further promotion of environmentally friendly transports in the corridor. GreCOR focuses simultaneously on infrastructure and logistics for "greening" of transport and to make the region more competitive. The activities in GreCOR and the strategy will be a contribution to the EU objectives for transport as expressed in the White paper from 2011 "Roadmap to a Single European Transport Area – Towards a competitive and resource efficient transport system"

The work in GreCOR was performed in seven work packages. More information at: www.grecor.eu

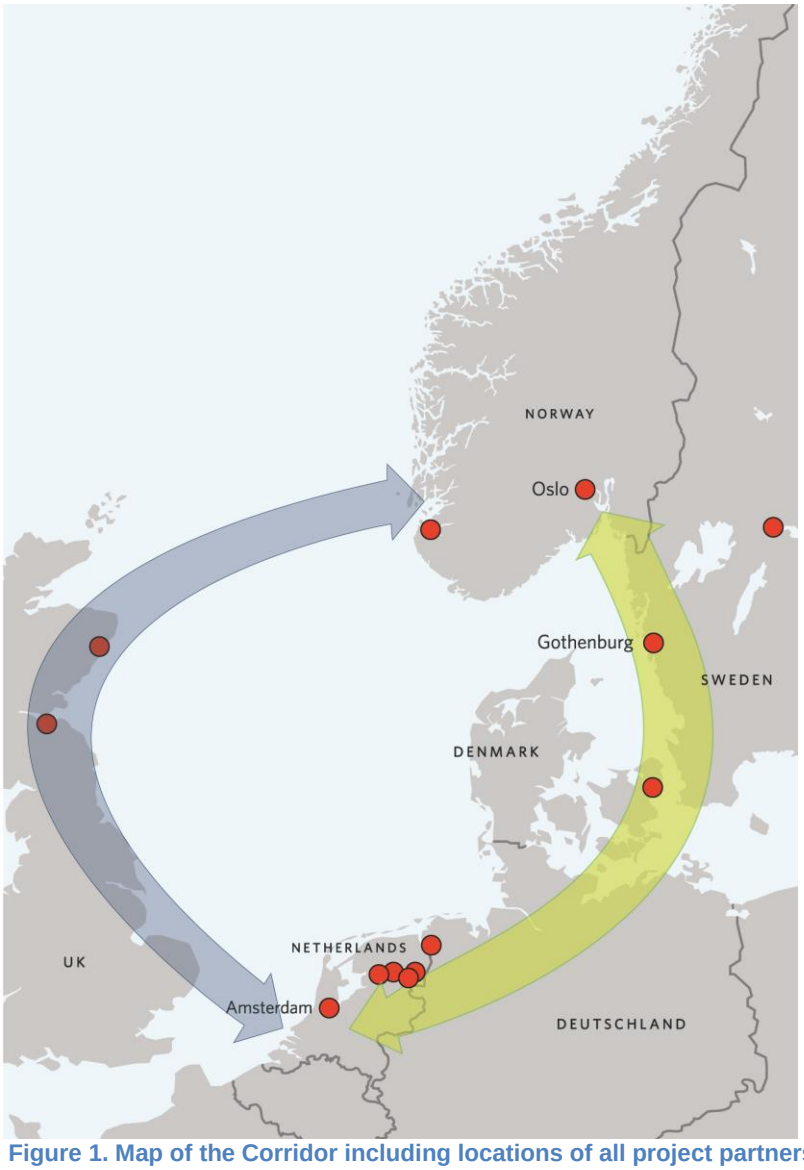

Figure 1. Map of the Corridor including locations of all project partners

Introduction to Work Package 3

This report is part of the freight flows analysis for Green Corridor development and will provide presentation and identification of goods flows in the corridor.

Developing sustainable transport corridors will increase competitiveness and contribute to a sustainable Europe. These transportation corridors and projects are so called Green Corridors. The Green Corridor concept is a European Commission initiative aiming at strengthening the logistics industry's competitiveness and to create sustainable transport solutions, also aiming at developing a "greener" transport policy, which satisfies the climate challenge while increasing European competitiveness.

Background

The Corridor is a multimodal connection between major cities. The cargo flows in the corridor can comprise complex combinations of different load carriers and modes of transports such as rail, road and sea transport. In some cases, the cargo is transported through the entire corridor, but most often it is transported in parts of the corridor to the destined market or the point for shipment. The aim of GreCOR is to improve the transports of cargo flows in a sustainable direction to minimize the environmental impact as much as possible. To be able to do this, there is a need to be able to understand how we can work towards greening of the transports.

Work package 3 consist of four different activities which results in several sub-deliverables. This report will support activity 3:2, "identification and presentation of goods flows in the corridor". It will describe an intermodal initiative which has been active for a long period of time and also analyse a businesses completely dominated by the road sector. Based on knowledge from the case studies, a proposed approach to make an existing supply chain more sustainable is presented.

- Activity 3:1 – Identification of freight flows and standard development
- Activity 3:2 – Mapping of on-going and planned projects and initiatives in the corridor and its catchment area
- Activity 3:3 – Analysis of bottlenecks and gaps in the transport system of the green corridor and the secondary network
- Activity 3:4 – Develop a general method for how to measure the environmental consequences of the operations in the green corridor including the logistic hubs

Report structure

In order to understand the changes required to initiate a more sustainable or "greener" transport solution and work towards greener supply chains, it is useful to have an overview of basic logistics terms. A basic understanding of what logistics, supply chain and supply chain management are all about facilitates the understanding of the complexity of the transport system. In order to create sustainable changes, it is not enough to change within a single parameter. Instead, the whole transport system needs to be included and processed with a holistic approach.

The development within the logistics area is further described. Will more sustainable solutions have a natural role in tomorrow's supply chains? Positive factors are highlighted but also the challenges adapting to more sustainable transport setups.

Two case studies have been undertaken in order to exemplify the paper. The ferry shipping vessel route Ghent-Gothenburg exemplifies a successful intermodal concept. The case based on the floral industry describes the fact that the road transport mode often is more successful than others and why this is the case.

Finally, with starting point from the two case studies, an exercise is undertaken to enable a greener transport scenario for distribution of flowers.

Purpose & aim

The purpose of this report is to give an understanding of the requirements needed to implement green changes in the supply chain. It will focus on logistic parameters essential for a greener solution and increase knowledge for the fact that all type of goods are not adapted to the most environmental sustainable solution.

The aim is to give understanding of the challenges in transferring a transport network into more sustainable.

Aim with the report;

To create an understanding for the challenges required to implement "greener" supply chains.

Delimitations and focus

The report has a geographical delimitation. When describing freight flows, GreCOR focuses not only on the corridor itself, but also on how the transports are being generated from the catchment area around the corridor, and the origin and destination of the transport flows

The complexity of the transport system

In order to facilitate an understanding of the complexity of the transport systems it is suitable to have a general overview upon some fundamental logistic concepts.

Logistics

The concept/interpretation of the term logistics has transformed and developed during the years. From logistics to material administration to supply chain to supply chain management to demand chain. The term logistics is thereby constantly in transformation. The definition of logistics can also vary dependent of continent. In USA the logistics concept is in high extent associated with physical distribution. In Europe more developmental and organizational factors are associated with the concept.

Logistics

The principles and approaches used to plan, develop, coordinate, organize, steer and control the material flow from supplier to final consumer. (Ericsson, 1976)

Supply chain

A wide range of definitions exists to describe the term supply chain. A supply chain can in general be described as the system involved in moving a product or a service from a supplier to a customer.

Supply chain

*A supply chain is defined as a set of three or more entities involved in the upstream and downstream flows of products, services, finances and/or information from a source to a customer. (*Mentzer *et al., 2001)*

The supply chain can be divided into, a “direct supply chain”, an “extended supply chain”, and an “ultimate supply chain” dependent on complexity (Mentzer et al., 2001). A company or an organisation can be part of numerous supply chains. A bigger retail company can for instance be part of a supply chain for food, for clothing and for hardware. A company can further possess different positions in the supply chain. It can be a customer in one supply chain, a partner in another and a supplier in a third. It is worth mentioning that the supply chains exist regardless if they are managed or not. If none of the organizations in figure 2 actively implements any of the concepts to manage the supply chain, the supply chain as a phenomenon of business still exists.

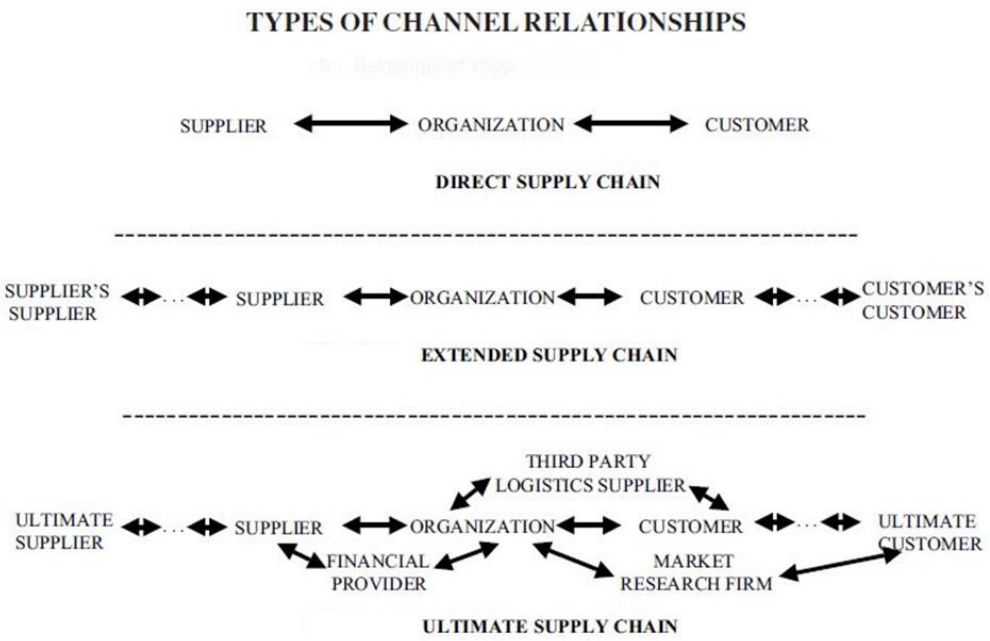

Figure 2, different types of supply chains (Mentzer et al., 2001)

Supply chains within the GreCOR area

The theoretical examples of supply chains in figure 2 can be exemplified from real cases within the geographical area of GreCOR.

Extended supply chain

The extended supply chain (figure 2) can be described with support from the floral industry. In this example the suppliers' supplier is a rose farm in Ecuador. The supplier who performs packaging of roses is a wholesaler at the Schiphol airport in the Netherlands. The organisation is a sales organisation within the floral businesses. The customer is in this scenario is a flower shop in Sweden. The person finally buying the rose at the flower shop is the customer's customer.

Ultimate supply chain

Supply chains are in general more complex. The ultimate supply chain in figure 2 has been adapted to the case study, Gothenburg-Ghent intermodal case (figure 3). The ultimate supplier is in this example a mine in China excavating the iron ore from the ground. The ore is thereafter enriched in order to facilitate the production at the pellet works. The pellets are after that sent to the steel works which produces the material required for the bolt factory. The bolts are thereafter purchased by a subcontractor in France manufacturing crankshafts for the automotive industry. The transport to the Volvo assembly in Gothenburg is managed by Volvos' own logistics company. This company do in turn contract DFDS Seaways to manage the vessel trip and other logistics parties to carry out the road transports.

The Volvo assembly plans its production program from information supplied by a market research firm. It is not common that the hauler buys the product in cash payment. A financial provider can therefore support with financial alternatives, like loans and/or leasing for the finished product e.g. the truck. Even though this example can appear to

be complex it has been simplified. More parties are present in the supply chain and between every party resources, capital and information is exchanged.

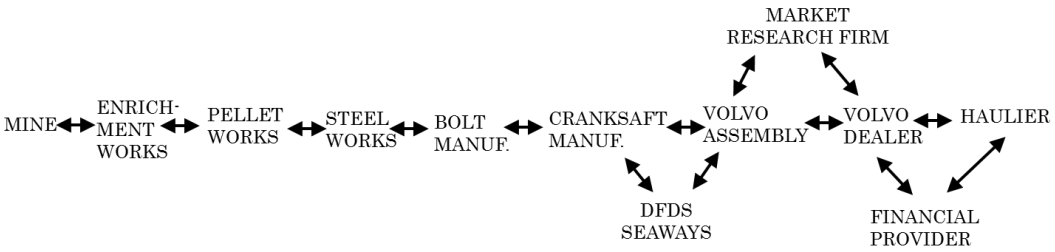

Figure 3, supposed supply chain for Gothenburg-Ghent intermodal case

Supply chain management

In order to steer the supply chains in an efficient and holistic way, the supply chain management concept is widely used. Logistics is considered to be one of the functions contained within supply chain management (Counsil of logistics management). Logistics puts more focus on efficient movement and storage to fulfill customers' requirements. Customer value and satisfaction that helps a supply chain to improve and be competitive requires more than logistics. Supply chain management means the management of multiple business processes, where logistics is one of them.

Supply chain management

The coordination of the traditional business functions within a particular company and within the supply chain, for the purpose of improving the long-term performance of the individual companies and the supply chain as whole. (Mentzer et al., 2001)

Holistic view

By considering the whole supply chain, non-value added or double work can be diminished. An example of double work is when both the crankshaft manufacturer and the Volvo assembly have inventory of the same products (figure 3). Choice of logistics setup can also affect the supply chain. For example, the crankshaft supplier can choose a new and cheaper way of importing the products from the bolt supplier (figure 3). The new transport setup proves not to be as reliable as the one it replaced. This causes disturbances in the crankshaft manufacturing and forcing the Volvo assembly to build up stock. The increased tied up capital cost exceeds the cost of saving from the new transport design, causing a negative effect for the supply chain in total.

Importance of supply chain management

It is a common expression within logistics science that real competition is not company against company, but rather supply chain against supply chain. This idea can be strengthen by the fact that many leading companies have highly developed supply chains. Wal-Mart, H&M and IKEA are examples of such. A well developed and efficient supply chain will lead to competitive advantages for the members within it.

Figure 4 gives an overview of the supply chain management concept. A supply chain can be pictured as a pipeline showing directional supply chain flows (products, services etc.) The traditional business functions like marketing and sales accomplish these flows from suppliers' supplier to the customer's customer to ultimately provide value and satisfy the customer.

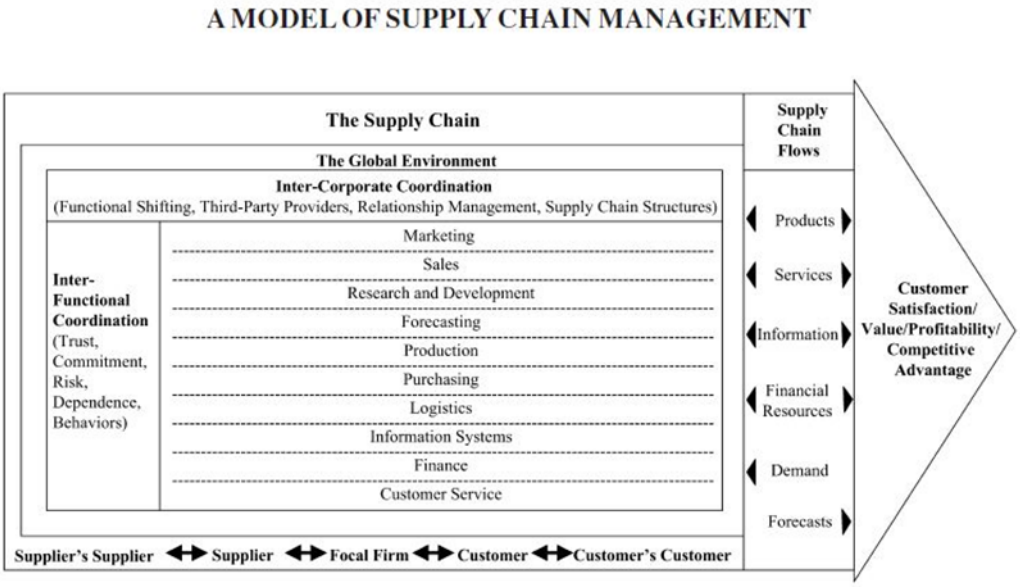

Figure 4, Supply chain management model (Mentzer et al., 2001)

Future logistics development will favour green logistics?

Recent years of increased public and government concern for the environment have intensified the companies' interests to reduce the environmental impact of their logistics operations. Environmental aspects of the transports have been a natural factor to take into consideration. A sustainability way of act has become an integrated part within supply chain management.

Green supply chain management

Implementation of environmental management within supply chain management can for instance be visible in the areas of green purchasing (one of the traditional business functions in figure 4). Green purchasing aims to ensure that purchases of goods and services come from suppliers that meet certain minimum environmental standards. The purpose of this is to minimize the liability associated with the purchasing process.

Recent years new software tools have been developed to help companies analyse their carbon footprints in the supply chain. Concrete measurement for environmental impact put pressure on the companies to deal with these questions.

A large number of surveys indicated that companies around the world are keen to promote their environmental work through the management of logistics (Green logistics, 2010). It is difficult to evaluate to what extent this reflects the true desire of the company to evolve within this field. This scepticism is based around the fact that the companies support for green logistics is as much for the potential to sell new product and technologies. On the other hand it is encouraging that companies recognize that streams of conventional business can benefit from a more green way to manage their logistics.

Green logistics

Key drivers behind company initiatives to greener their logistical systems and supply chains are often not explicit to protect the environment. Instead cooperate image, competitive differentiation, cost saving and compliance with government regulations are example of such. (Green logistics, 2010)

To implement a greener supply chain several of the business functions in figure 4 needs to be involved. Traditional business functions such as finance and marketing need to be considered as well as logistics. The traditional goals for supply chain management, customer satisfaction and value are still to be in focus. This is essential because it will lead to competitive advantage for the members within the supply chain.

Several companies (Volvo AB, Chevron, Sweco etc.) have gone further and have started to bring in environmental and sustainability aspects in their core values. This further evidences the trend where environment aspects are merged with traditional business aspects in order to gain advantages.

Future logistics concept will be more sustainable?

Supply chain redesign can imply greener logistics. In such cases, improvements in environmental performance can be viewed as positive side effects of traditional logistics methods like;

- New distribution centres with fewer nodes
- Larger warehouses
- New information system
- Improved consolidation of flows
- Standardization of load carriers
- Change of transport mode

Above points can opens up opportunities that can have positive impact on the environment. Fewer nodes and larger warehouses imply centralisation of goods volumes. This enables new possibilities for volume demanding transport modes like railway or sea to gain market shares. Development of standardized load carriers provides possibilities for improved transhipment handling which is important in co modal terminals. Improved software information system provides opportunities to have better control over the transport fleet and thereby increases the filling degree. Increased filling degree diminishes the number of units needed to perform the task and will in the end reduce congestions and transport work.

This development strengthen the Green Corridors Concept which aims to create freight corridors of excellence, where large and concentrated freight traffic flows between major hubs can be handled in the most efficient, environmentally-friendly and business-driven manner.

Logistics efficiency equals road transports?

The logistics efficiency can be described in terms of service, costs and tied up capital (Lumdsden, 1998). All three objectives in figure 5 are in connection to each other. Attempts to improve one parameter can cause negative effects on the other one. An action to decrease the transport cost, could for example worsen the delivery time and thereby jeopardise the profitability in the long run.

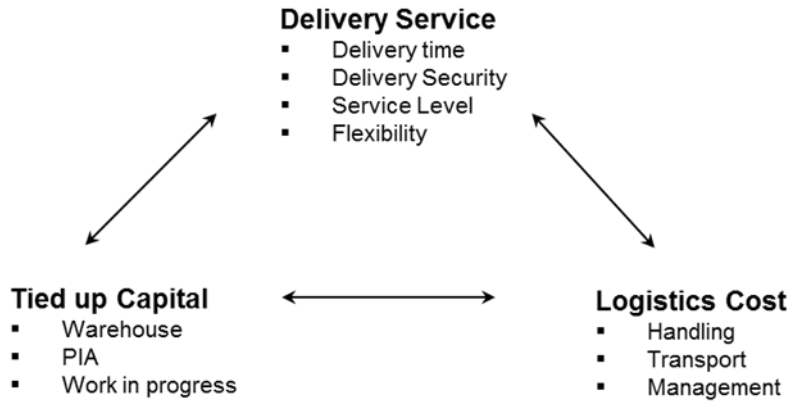

Figure 5, The mix of logistics objectives (Lumsden 1998)

Common trends within industry are to increase the flexibility in the production and decrease the tied up capital cost. This reinforces the demand for higher delivery service. The road sector has several advantages.

- *Flexibility*; the capacity is relative small in relation to other transport modes, which implies smooth adaptability to the single customer's needs. The truck can also easily be rerouted during transport allowing allocation of capacity where needed.
- *Delivery security*; as the driver accompanies the cargo the risk for damages and theft of the cargo decreases. Reliability is also helped by the fact that unforeseen stops for the cargo also imply a stop for the driver.
- *Delivery time*; the trucks, do in general perform door-to-door transports and thereby avoid time consuming transhipment.
- *Service level*; presence of a driver creates a potential to solve upcoming issues directly on spot.

The road transport sector has managed to keep a good balance between the logistics objectives. Increased Service level should imply lower tied up capital costs which should lead to increased logistic cost. The road sector has however managed to keep the logistics cost on a competitive level. One of the main reasons for this is the successive implementation of the common transport politics within EU, which have removed trade barriers and simplified rules.

Competition between transport modes

New logistics requirements have led to displacement between the transport modes. Sea transport has generally speaking lost market shares to more time efficient modes as railway and road. Thereafter have the railway sector lost transport volumes to the road transports. Some minor part of the sea transports have also been taken over by air transports.

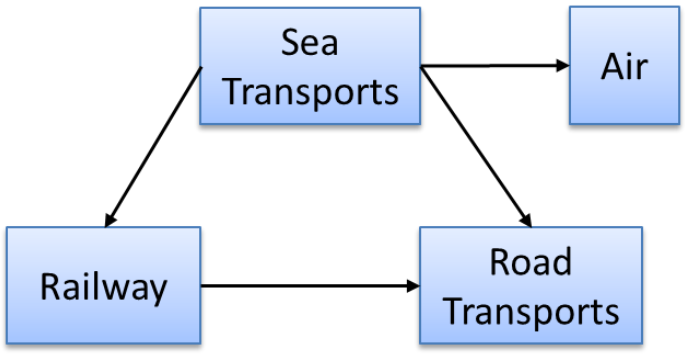

Figure 6, General displacement between transport modes (Lumsden 1998)

The competition between the transport commodities are to a high extent dependent on the value of the goods transported. The sea and railway transports are strong in the segment for low value products. Air transports are mainly competitive when transporting high-value goods over long distances. The middle segment is completely dominated by the road transports. Overview of the situation is illustrated in Table 1 below. Even though the figures are not up to date, no information suggests any major differences in recent years.

Table 1: goods value and transport mode (Lumdsen 2006)

Transport mode	1996 (Sika)	2004 (Eurostat)
Sea	0,65 €/kg	0,76 €/kg
Railroad	0,65 €/kg	0,76 €/kg
Road	2,39 €/kg	2,72 €/kg
Air	76,96 €/kg	88,70 €/kg

In order to achieve any other competition between transport modes, the sea and railroad sector need to imitate the road. A common way for both sea and railway sector to close the gap against the road sector is to involve road in their transport setup. The railway sector has for example introduced combined transports and trailers on train. The shipping route Gothenburg-Ghent is an example of how the Sea transports use the advantages from the road segment to be competitive. The conclusion is that stand alone, Railway and Sea transports cannot compete with the road transport mode. The way forward is instead to implement road element in the parts of the supply chain where they are superior (Lumdsen 1998), i.e. go intermodal.

Intermodality

Intermodality enhances the economic performance of a transport chain by using the modes in the most productive manner. Thus, the line-haul economies of rail may be exploited for long distances, with the efficiencies of trucks providing local pick-up and delivery
(Rodrigue et al., 2006)

Intermodal development

The latest report from Eurostat[1] regarding freight transports effort on European level to better integrate and improve connectivity between road, rail and waterways leaves room for improvement. In 2012 74,5% of the freight transports were carried out by road in EU, a level that has remained almost unchanged since 2007. The market share between railway (18,6 %) and waterways (6,9%) also remain on a stable level (EurActiv.com). The data suggests that longstanding EU efforts to improve intermodality, or the use of "at least two different transport modes in an integrated manner", have yielded little

[1] Directorate-General of the European Commission, main responsibilities are to provide statistical information to EU

results. The reason behind the non-existing development for intermodal transports can be tracked back to some main areas:

- *Investments*, insufficient investments in infrastructure, including building of the "last miles[2]" and of intermodal terminals.
- *National Administrative rules* which complicate cross-border travel via railway and a railway sector which in general needs to improve its efficiency.
- *Unfair competition between railway and road.* Distance-based charging and external expenses such as pollution cost are currently not applied to road transport.

[2] Connection between rail networks and freight customers gate

Case studies

Two case studies have been carried out in order to make the report more concrete. The first case, ferry shipping route Gothenburg-Ghent, exemplifies a co modal setup which has been active for decades and aims to explain the reasons for its success. It is an example of a logistics solution where they have succeeded in creating a sustainable and environmental friendly transport setup. The second case describes the distribution of flowers from the Netherlands to Sweden and Norway. The focus in the second case study is to explain the difficulties for other transport modes than road to be competitive. Knowledge from the two case studies has thereafter been used in order to propose a greener supply chain for flower distribution.

The intermodal ferry shipping route Gothenburg - Ghent

DFDS Seaways have during several years managed a ferry shipping route between Gothenburg and Ghent. Once a week the route add on an extra stop in Brevik, close to Oslo in Norway. The route has its origin from the early 1980 when the current shipping company and Volvo started to cooperate.

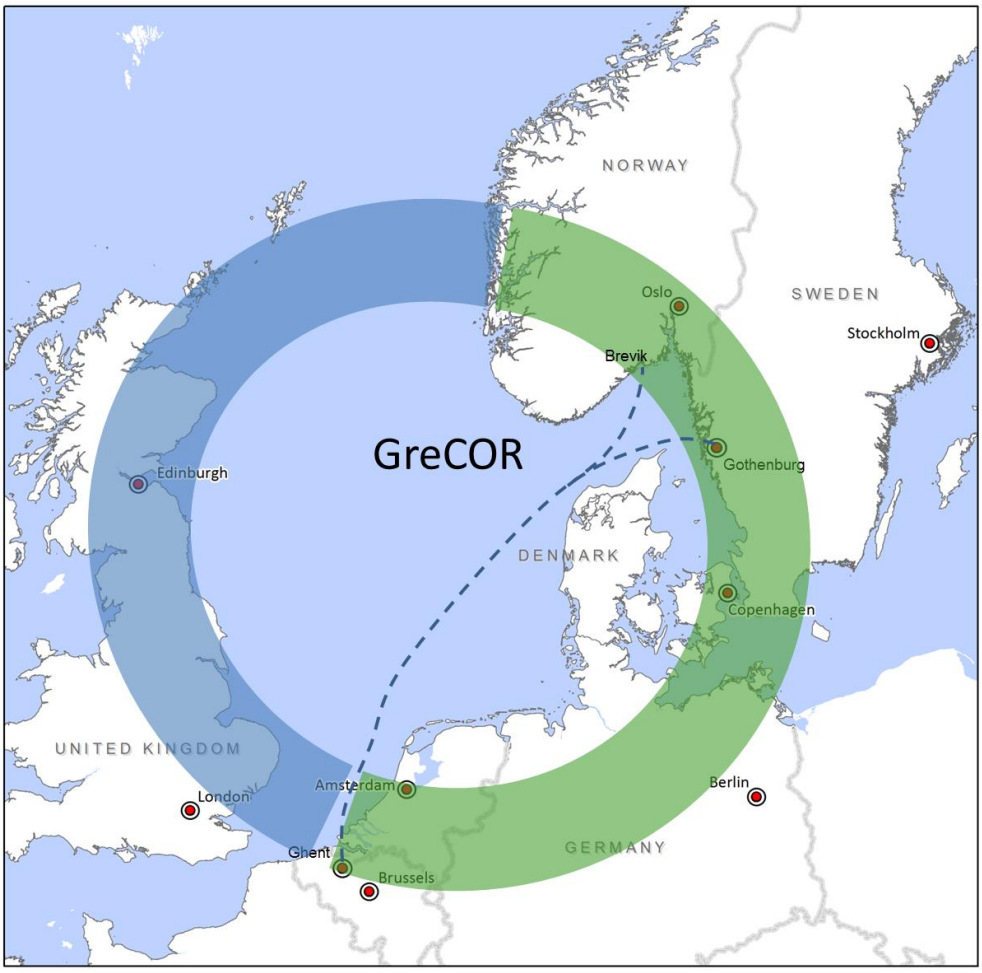

Figure 7, Ferry shipping route Gothenburg – Ghent and Ghent-Brevik (dashed lines)

Delivery time

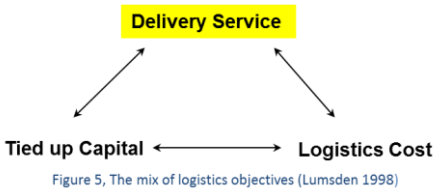

Figure 5, The mix of logistics objectives (Lumsden 1998)

The route is operated by three modern Ro-Ro (Roll on – Roll of) vessels which have been in traffic since 2005. These vessels can carry all types of goods loaded on units with wheels such as vehicles, semi-trailers and cassettes. Ro-Ro implies horizontal transfer of goods which is considered to be the most efficient and fastest way to move goods from a transport mode to another. A significant feature for this generation of Ro-Ro ships is the big angled ramp at the stern, called Jumbo ramp. The size of the ramp allows two-way traffic which further reduces the time in harbour since it makes it possible for simultaneously load- and unloading.

Short stops in the harbours are important for short distance sea routes like Gothenburg-Ghent. Less time in harbour implies shortening of the lead time which is crucial in the competition against the road transport mode. In circumstances where the units to be loaded already are located in the harbour, the vessel can be ready for departure 6-8 hours after arrival. The route has an approximately crossing time of 32 hours between Gothenburg and Ghent. The handling time in the harbour has to be added to the total delivery time which is a logistic parameter belonging to the group *delivery service* (figure 5).

Tied up capital & logistics cost

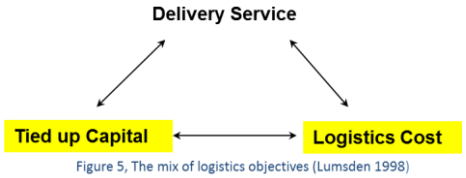

Figure 5, The mix of logistics objectives (Lumsden 1998)

Moving volumes completely to road transport would imply diminished lead time and diminished *tied up capital cost*. However, the transport costs (subgroup to *Logistics cost*, figure 5) are most likely to increase most likely to increase. Otherwise should there be hard to motivate a business case for the ferry shipping route. The delivery time and the logistics cost are thereby considered to be sufficient enough to motivate higher warehouse or tide up capital cost.

Delivery security

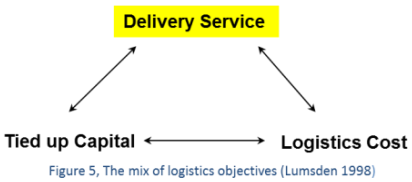

Figure 5, The mix of logistics objectives (Lumsden 1998)

95% of the vessels transports are considered to be on time according to the time table (DFDS seaways). This makes the delivery security (subgroup to *delivery service*, figure 5) sufficient for automotive industry even through the industry aims for figures around 97-98%. 95% delivery precision is also a decent figure for road transport and it cannot be guaranteed that road transports would increase this central parameter or standard KPI (Key Performance Indicator). As delivery precision and reliability of the transports are very central for automotive and industry in general, it is crucial for the sea transport route to keep this high level and focus on improving it further.

Transport frequency

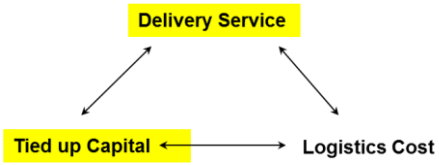

Figure 5, The mix of logistics objectives (Lumsden 1998)

Another factor which contributes to the competitiveness for the Gothenburg-Ghent route is the high transport frequency. Six departures are carried out from each port every week. According to general logistics development, high frequency makes it possible for the industry to keep warehouse cost down and lower the average shipment size to gain *tied up capital cost* (figure 5). High frequency does also compensate for the relative low flexibility (subgroup to *delivery service*, figure 5) compared to the road alternative, if a departure deadline is missed another one is ready the next day.

Low warehouse levels and flexible productions, increase the demand for the supply chain to be flexible as well. This can lead to situations where a shipment needs to speeded-up. To gain flexibility, routines exists allowing volumes dedicated to a vessel to be transferred to a truck within short notice. The truck can with support from two drivers reach Gothenburg around 15 hours later. This compared to the vessel which has a crossing time of 32 hours.

Figure 8, Ro-Ro Vessel Begonia Seaways (source: dfdsseaways.com)

Adapted to future logistics concepts

Even though the Gothenburg-Ghent intermodal concept has been up and running for a long time, it supports many new logistics ideas. Improved consolidation of flows and distribution centres with fewer nodes are example of such.

Central prerequisites for the Gothenburg-Ghent vessel setup are volumes and balance. Without the volumes for Volvo AB and Volvo Car as a base, the design of the route would be a lot different. It would possibly not even exist.

The service attracts all different kinds of RoRo cargo. To be able to collect the desired volumes an extensive hinterland is required. The north going vessels (Ghent →Gothenburg) collects cargo from Belgium, France, south Germany, Spain and Italy. The south going vessels (Gothenburg→Ghent) carry goods from Sweden and Norway.

Ghent and Gothenburg have shown to be good ports for the DFDS Seaways service between Sweden and Continental Europe, and one of the reasons has indeed been that Volvo AB and Volvo Cars have their main factories close to these ports, more specifically in Ghent, Gothenburg and Skövde. Economy of scale factor implies that the production sites have many suppliers in common and therefore significant transports of goods between each other. This means that there is a balance in the goods flow between north and south (Gothenburg ←→Ghent). Finding balance in the goods flow in both directions is however often hard to achieve, which prevent many new intermodal concepts from being realized.

Green logistics

The Gothenburg-Ghent route is an example where traditional supply chain improvements in the terms of customer value and satisfaction also result in greener logistics. A rough estimation indicates that the vessel route carry around 98 000 trailers or trailer equivalent units back and forth Sweden and Belgium each year. Thereby the route contributes to significant saving of energy consumption and emission compared to an alternative where the goods volumes go the whole journey by truck.

If the volumes were to be carried on the road they would pass cities where traffic congestion is a big problem and they would probably contribute to further worsen the problems. The trucks would for example most likely pass Hamburg, which according to the INRIX[3] report is in the top 25 of the most congested cities in Europe.

Changed conditions

According to the International Maritime Organisation (IMO), a stricter environmental regulation for shipping will be introduced within the Baltic Sea, North Sea and English Channel in 2015, the area is called; the classified Issue Control Area for sulphur with abbreviation SECA. This regulation stipulates that the allowed sulphur content in fuel shall decrease from 1 % to 0.1 % in 2015. DFDS Seaways will use a method called scrubber to deal with the new directives. This method is an example of after-treatment of exhaust gas and uses water to wash sulphur out of the exhaust gases.

The new sulphur directive will increase cost for the sea transport mode as whole in the affected areas. The logistics objective "logistics cost" will increase and the competitiveness for the Gothenburg-Ghent route against other transport modes will decrease. The effects of the new regulations are a general concern in the maritime industry. The full effect can only properly be evaluated when it is up and running.

[3] Company working with Big data analyses for cities.

Flower distribution within GreCOR

The Netherlands is the centre of production and trading for the European floral market. From the Netherlands, flowers and plants are distributed to the whole Europe. Both Denmark and the south of Sweden also have considerable cultivation of flowers and plants.

Delivery time

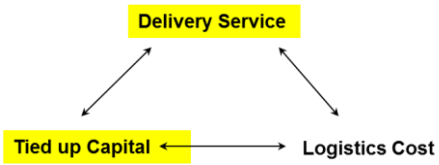

Figure 5, The mix of logistics objectives (Lumsden 1998)

Short delivery or lead time (subgroup to *delivery service, figure 5*) is considered to be the most important logistic objective by the businesses. Fresh products are essential for a satisfied customer. Every extra hour of transport for a tulip means an hour less at the customers table before fading. It is therefore also very important to keep low warehouse level and thereby low *tied up capital costs.*

4-5 years ago, a company working with flower distribution investigated the possibility to use railway for the transports from the Netherlands to Sweden. The perceived service from the railway sector however left much to be desired. Among others, the company could not access the trailers during late evenings at the receiving intermodal terminal in Sweden. Due to the fact that the business requires transport activities 363-364 days a year and often during night hours, this setup was not considered to be realisable. A general feeling from logistic actors in this business is that inflexibility and old structures is a heavy burden for the railway industry and prevents expansion.

Delivery security

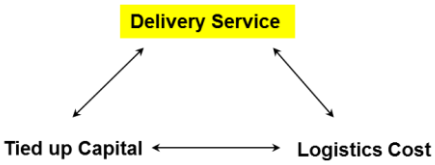

Figure 5, The mix of logistics objectives (Lumsden 1998)

Flowers and plants are in their nature sensitive cargo and require extra consideration. The products are to be transported in thermo equipment which ensures correct temperature during the whole journey. As the truck driver accompanies the goods, he/she can act if for example problems with the aggregates controlling the temperature in the trailer should occur. This type of extra control or delivery security (subgroup to *delivery service*, figure 5) is hard to achieve in other transport modes.

The distribution of flowers is as previously mentioned very time critical and the demand for high delivery precision is vital. A delayed delivery to a flower shop will directly affect the sales. A delivery precision figure above 95% is therefore a realistic target in the business.

Transport flexibility

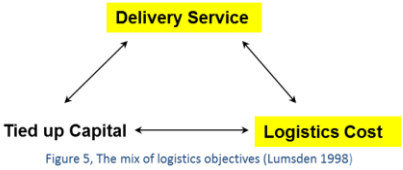

Figure 5, The mix of logistics objectives (Lumsden 1998)

A common scenario for flower distribution within Europe is that an actor in the floral industry purchases flowers at one of the markets in the Netherlands. After that a transport request is sent to a logistics provider specialised in transporting sensitive cargo. The shipment is expected to be at a distribution centre in south Sweden during the morning, 12-15 hours later after loading in the Netherlands. In the afternoon

the products are distributed to a large amount of customers in Sweden and Norway. Many of the deliveries to flower shops are carried out during night time/early morning. In order to carry out the final delivery, the drivers often have access to keys and codes to the flower shops. On the way back from the shops, the driver picks up racks and flower trays for immediate transport back to the distribution centre. All this tasks performed by the driver support logistics parameters like service level and flexibility which is a subgroup to *Delivery Service* (figure 5).

The *logistics cost* (figure 5) is also of great importance within flower distribution. The circumstances in the business with great focus on lead time makes it however hard to affect the logistics cost. A longer delivery time could imply lower logistics cost, but this is hard to achieve since the business is dealing with fresh products with short life time.

Imbalance in the goods flow

The volume of goods for the flower shops have a general tendency to vary during the week. Most of the sales occur during the weekend. Due to these circumstances a majority of the products are required at the end of the week. On top of this, festive seasons and holidays like Christmas and Valentine's Day implies major volume peaks. A flexible transport mode, i.e. road transports is therefore required.

A common issue within transport of flowers is the unbalance of volumes between Europe and Scandinavia. It is hard for logistic providers to find cargo in the direction Scandinavia to the Netherlands and the trailers often go empty. This development seems to have been reinforced during the recent years according to the businesses. The trailers can always carry the empty flower racks but as empty racks compose 1/10 of the original size, there is still plenty of room in the trucks. For a railway setup it would be even more challenging to collect the desired cargo. This due to the fact that the potential search area for goods is limited by the distance to the railway terminal.

Figure 9, Flower racks on trailer (source: http://www.alex-andersen.com)

Proposed intermodal solution for flower distribution

Traditional business values

Fundamental for the work in creating a greener supply chain is that the customers are not negatively affected. The sustainable supply chain should provide the same quality as the supply chain it is supposed to replace. Goals for a traditional supply chain like customer satisfaction and profitability (figure 4) are still to be in focus.

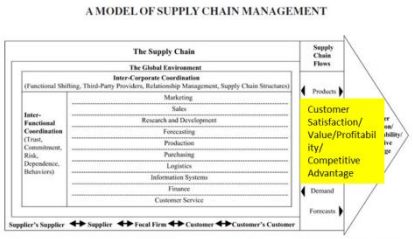

Figure 4, Supply chain management model (Mentzer et al., 2001)

Marketing

Flowers are often associated with natural aspects. Using consumer empowerment can therefore be an interesting way in supporting greener logistics. Hence, promotion of greener transport could be considered as a positive marketing factor (business function in figure 4). If the tulips were transported with an intermodal and thereby a more sustainable transport mode it could be visualised to the end customer in some way. It could for example be a special environment label on the cellophane used to wrap/seal the tulips.

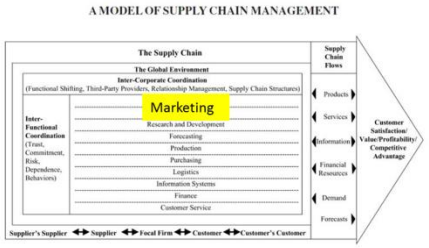

Figure 4, Supply chain management model (Mentzer et al., 2001)

Proposed logistics solution

The general idea behind this setup is to reuse already existing thoughts from the logistics industry and adapt for this example. The containers/racks today used for transporting flowers are well developed to be carried both on railway wagon and semi-trailer. An intermodal concept combining road and rail could therefore be an interesting alternative.

The RRT (Rail Road Terminal) could be located in the surroundings of Amsterdam within reasonable distance from the main flower markets in the Netherlands. The semi-trailers or containers from the flower market are loaded on the train destined to an intermodal terminal close to major distribution centre for flowers in Sweden, like Helsingborg. In Helsingborg the trailers and containers are carried via road direct to bigger customers or via distribution centres to smaller business.

Transport frequency

To build up a dedicated train system with high frequency which supports the *Delivery Service* (figure 5), access to volumes is prerequisites. A full length train should carry around 36 trailers. The floral industry cannot by itself produce such volumes (see appendices). It can however contribute to a significant part and set the volume base for the train. It is therefore advantageously if the train operator has good connections to other industries in order to sell empty slots on the train. For the return transports from Sweden will it due to the structural unbalance be hard to find goods. The train operator needs to be innovative to solve this issue.

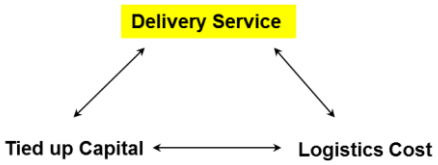

Figure 5, The mix of logistics objectives (Lumsden 1998)

Delivery time and security

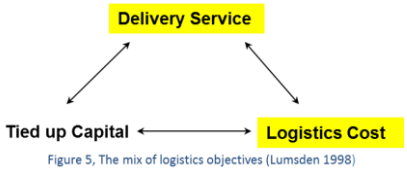

Figure 5, The mix of logistics objectives (Lumsden 1998)

The intermodal transport setup should offer the same delivery time (subgroup to *delivery service*, figure 5) as for the current setup which is completely managed by road transports. This implies that the trailer should be at the distribution centre in Helsingborg around 12-15 hours after loading at the flower market in the Netherlands. This requires fast and efficient handling at the transhipment points in the intermodal terminals. The RRT should have generous opening hours so that the trailers are accessible for an intermodal swap also during late hours. This could affect the *Logistics cost*. Due to the short lead time is a dedicated train i.e. full length train is required. Margin for an extra stop to build a block train should not be an alternative.

High delivery security is of great importance, the intermodal setup should prove delivery precision figures for at least 95%. A delay can also occur for a road transport but then in general only one semi-trailer/container is affected. Disturbance for the train on the other hand affect all 36 loaded units. The train should therefore be given high priority in the railway system and preferably be on the same level as for passenger trains.

It is also vital that the train system is robust enough to carry out its transports. Figure 10 shows planned measures for railroad within GreCOR, which should strengthen the stability of the transport system.

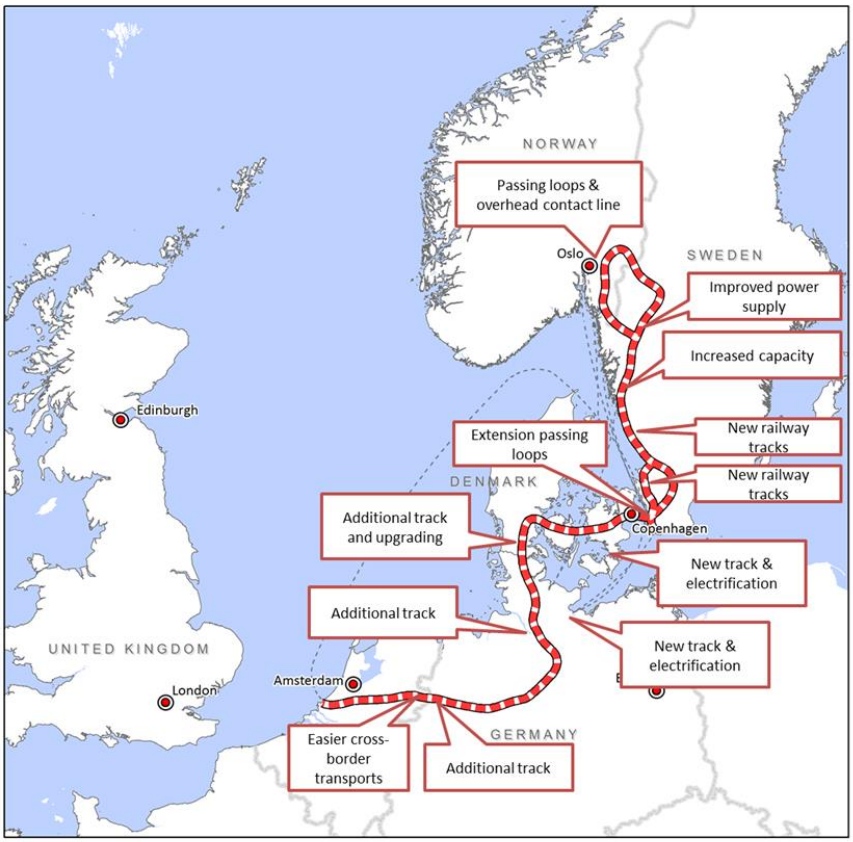

Figure 10. Planned measures on the railway (source: GreCOR WP3 Inventory report)

Recommendations for introducing green logistics in the supply chain

In this report have knowledge from logistics theory combined with experience from case studies been used to describe the challenges required to implement sustainable transport solutions.

Most supply chains are different and complex in their nature. A logistics setup for one chain can be hard to apply on another. As many parties and actors are involved in one way or another, it is important to have in mind that a change in one part of the chain can lead to unforeseen consequences in another part. It is therefore important to have a holistic perspective when introducing changes.

In order to develop the supply chains in a more environmental direction, it is vital that traditional business functions still are in focus. Central parameters within supply chain management like customer satisfaction and profitability shall still be in focus in order to setup a competitive green supply chain.

The green transport solution needs to be as efficient as a conventional logistics setup. The road transport mode is very competitive when it comes to central logistics parameters like flexibility, cost and lead-time. In order to break the dominance from the road sector it is advised to be innovative, seek for new solutions and questioning old structures. Projects on EU level like GreCOR can support and facilitate this operation. For example can GreCOR promote freight corridors with large and concentrated freight volumes. Major goods volumes are often prerequisites to start up sustainable intermodal transport solutions where rail and sea can be an active part.

The ferry shipping route Gothenburg-Ghent is an example of an intermodal solution which has been active for many years. With sufficient volume as a base it has been possible to build up a system which can provide competitive logistics in terms of; lead time, security, frequency, flexibility and cost. The positive environmental impact compared to an alternative dominated by truck transports has been an added value.

Table 2, ideas how to promote sustainable/greener logistics solutions.

IDEA	*DESCRIPTION*
Holistic logistics perspective	Avoid sub optimisation. Changes in one part of the supply chain can have negative effect on another.
Keep focus on traditional supply chain goals	Customer satisfaction, value and profitability still to be prioritised.
Consider green logistics to be a business factor among others	In order to created long-term sustainable setups.
Take advantage of technical transport development	Utilise the concentration of distribution centres and standardisation of load carriers to initiate intermodal solutions
Logistic efficiency remains central	Continue to work and improve logistic objectives like delivery time and delivery security.
Challenge current view of the transport- and logistics setups	Demand the same type of quality and customer service independent of transport mode.
Promote transparency and cooperation	An intermodal setup often requires major volume of goods. Cooperation between companies is often a prerequisite for this.

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Interviewees

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Larsson, Martin, DFDS Seaways (Göteborg)

Lindhe', Karin, Hartmann&Krogh, (Helsingborg)

Löfkvist, Lars, Volvo group logistics services (Göteborg)

Van den Bussche, Mario, Volvo group logistics services (Ghent)

Appendices

Import and export of goods from DK and NL to SE		**Import to Sweden from consignor countries (DK,NL), tonnes**					**Export from Sweden to receiving countries (DK, NL) ,tonnes**				
Source: Statistics Sweden (SCB)											
	Article groupe	**2009**	**2010**	**2011**	**2012**	**2013**	**2009**	**2010**	**2011**	**2012**	**2013**
Denmark (DK)	Lac; natural gums, resins, gum resins, and balsams	6	0	0	0	0	0	0	11	0	0
	Vegetable materials of a kind used primarily for plaiting (e.g., bamboos, rattans, reeds, rushes, osier)	21	48	48	33	5	59	34	47	27	39
	Plants and parts of plants (including seeds and fruits) of a kind used primarily in perfumery, in pharmacy.	64	56	87	93	108	18	17	36	27	19
	Seeds, fruit and spores, n.e.s., of a kind used for sowing	1 471	1 401	1 298	1 068	1 180	915	822	4 454	3 521	2 196
	Bulbs, tubers and rhizomes of flowering or of foliage plants; cuttings, slips, live trees and other plants	*15 242*	*15 193*	*15 141*	*16 407*	*13 957*	*1 625*	*1 111*	*280*	*913*	*1 071*
	Cut flowers and foliage	*1 608*	*1 691*	*2 044*	*2 401*	*3 663*	*916*	*414*	*1 602*	*1 240*	*1 637*
	Materials of vegetable origin, n.e.s.	614	713	540	594	814	21	21	26	43	45
Netherlands (NL)	Lac; natural gums, resins, gum resins, and balsams	0	0	168	0	0	0	1	0	0	2
	Vegetable materials of a kind used primarily for plaiting (e.g., bamboos, rattans, reeds, rushes, osier)	76	12	85	232	158	0	0	0	0	0
	Plants and parts of plants (including seeds and fruits) of a kind used primarily in perfumery, in pharmacy.	17	27	20	10	12	0	0	0	1	1
	Seeds, fruit and spores, n.e.s., of a kind used for sowing	654	941	1 131	783	637	66	133	86	109	37
	Bulbs, tubers and rhizomes of flowering or of foliage plants; cuttings, slips, live trees and other plants	*25 977*	*25 159*	*28 514*	*32 128*	*37 052*	*0*	*26*	*2*	*0*	*20*
	Cut flowers and foliage	*9 155*	*10 238*	*11 772*	*12 082*	*11 895*	*23*	*28*	*1*	*0*	*2*
	Materials of vegetable origin, n.e.s.	40	51	106	407	43	4	0	0	0	0

Contact

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