UNIVERSITY OF GOTHENBURG
SCHOOL OF BUSINESS, ECONOMICS AND LAW

Master Degree Project in Logistics and Transport Management

The Competitiveness of the Port of Gothenburg as an E-Business Distribution Centre in Scandinavia

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ABSTRACT

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The research is focused on the competitiveness of the Port of Gothenburg, as a future destination for online retailers, when investing in a new warehouse; emphasis is dedicated to those warehouses locate in ports area (port-centric logistics).
Several topics are discussed in order to provide some fundamentals for a future e-retailer's investment choice.
The literature discussed focus on *supply chain*, general characteristics, the network planning, logistics strategies, and logistics factors related to the performance.
A background in *warehousing* is provided, to better clarify several elements such as warehouse adoption, and appropriate location. Necessary elements affecting the facility location strategy.
The *maritime* background where the major players are ports and shipping lines. Particular focus is placed on port operations, port efficiency, port services, port-centric activities, and the choice of shipping lines when calling a port.
Certainly, some information about *retailers* and *online retailers* characteristics, represent some basic knowledges to provide. Several parameters are taken into consideration when retailers select e-consumers in the most profitable country.
E-buyers characteristics are considered to identify the Scandinavian potential buyers.
The thesis conclude specifying the country and the port that better satisfy (time-miles) the Scandinavian e-consumers.

Key words
Scandinavia, warehousing, supply chain, maritime, port, port performance, port-centric, e-commerce, e-buyers.

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To My mother Emilia,

my brother Fabrizio,

and my girlfriend Hannah G.

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ABBREVIATIONS

3PL: Third Party Logistics
B/L: Bill of Lading
CMP: Copenhagen-Malmo Port
COG: Centre of Gravity
CUF: Common User Facility
DK: Denmark
DMA : Distribution Management Association
DWT: Dead Weight Tons
DPW: Dubai Port World
ETF: Empty Run Factor
FTL: Full Truck Load
FTZ: Foreign Trade Zone
GSC: Global Supply Chain
GRT: Gross Register Tonnage
LF: Load Factor
LSP: Logistics Service Providers
LSCI: liner shipping line index
LSBC: liner shipping bilateral connectivity index
LTL: Less Than Truck Load
NEP: Northamptonshire Enterprise Partnership
NO: Norway
OOS: Out of Stock
PoG: Port of Gothenburg
QR: Quick Response
RDC: Regional Distribution Centre
ROB: Remaining on Board
SC: Supply Chain
SCM : Supply Chain Management
SCND: Supply Chain Network Design
SE: Sweden
SHEX: Sunday and Holidays Excluded
TEUs: Twenty-Foot Equivalent Unit
TPC: Tons per Centimeters
JIT: Just in Time
J4U: Just for You

DEFINITIONS

Corridor, a sequence of nodes and links supporting modal flows of passengers or freight. They are generally concentrated along a communication axis, have a linear orientation and usually serve a gateway.

***Cross-dock warehouse*,** referred to the meeting place for products to move from inbound trucks to outbound trucks.

D time, 'Demand and delivery time' that the customer experiences between placing the order and getting the goods. See also P time.

Euclidean distance represents the distance as a simple function of a straight line between two locations where distance is expressed in geographical units such as kilometers (or miles). Commonly used to provide an approximation of distance, but rarely has a practical use (Ballou, 1999).

Feeder, a node that is linked to a hub. It organizes the direction of flows along a corridor and can be considered as a consolidation and distribution point.

Flow, the amount of traffic that circulates on a link between two nodes and the amount of traffic going through a node.

Gateway, a node that is connecting two different systems of circulation that are usually separate networks and that acts as compulsory passage for various flows. An intermodal function is performed so that passengers or freight are transferred from one network to the other.

Green Logistics, *"Supply chain management practices and strategies that reduce the environmental and energy footprint of freight distribution. It focuses on material handling, waste management, packaging and transport."* It is characterised by *Reduction of costs; Integrated supply chains (*JIT and DTD); *Increasing system-wide* efficiency of the distribution system through network changes (Hub-and-spoke structure); *Reliable and on-time distribution* of freight and passengers; Increased business opportunities and diversification of the supply chains (Rodrigue, 2016c).

Hub, a node that is handling a substantial amount of traffic and connects elements of the same transport network, or different scales of the network (e.g. regional and international).

Hub Warehouse or Central Warehouse, refers to a warehouse that consolidates products to be shipped to other warehouses in the system before moving on to

customers. The other warehouses in the network are typically called spokes or regional warehouses.

Link, Physical transport infrastructures that enable connection between two nodes.

Liner Shipping Connectivity Index captures how well countries are connected to global shipping networks (UNCTAD) (see appendix “H” for details).

Liner shipping bilateral connectivity index: indicates a country pair's integration level into global liner shipping networks (UNCTAD) (see appendix “H” for details).

Logistical distance includes physical flows, but also a set of activities necessary for the management of these flows. For freight movements, among the most significant tasks are order processing, packing, sorting and inventory management. Geographical distance units are less relevant in this assessment, but the factors of costs and time are very significant (Ballou, 1999).

MHE, Materials handling equipment, e.g. forklift truck

NCFRP, National Cooperative Freight Research Program

NRI, Networked Readiness Index measures, on a scale from 1 (worst) to 7 (best), the performance of 143 economies in leveraging information and communications technologies to boost competitiveness and well-being (World Economic Forum, 2016)

Node, Any location that has access to a transportation network.

Plant Attached Warehouse, it refers to a warehouse that is attached to a manufacturing plant. When the company has a plant-attached warehouse, the standalone warehouse is sometimes called *forward warehouse,* meaning it is placed “forward” or out closer to customers.

P Time, ’Procurement and Production’ time is the real time that it takes to produce a customer order. In general, this is much greater than the D time that the customer experiences. The higher the P:D ratio, the more stock will there be in the system and the more will be the reliance on the forecast.

Scandinavia refers to the following countries: Denmark, Finland, Norway an Sweden. **Nordic Countries** is used to refer to the same geographic area.

Transport Distance is suggested to be used for the existing structure of the transport network. In a simple form involving only one mode, it is a routing exercise

considering the shortest path between two points. In a more complex form, it concerns the set of physical activities related to transportation, such as loading, unloading and transshipment, are considered (Ballou, 1999).

Transportation nodes, they serve as access point to a distribution system or as transshipment/intermediary locations within a transport network.

Transportation networks, the spatial structure and organization of transport infrastructures and terminals.

1. INTRODUCTION

This section starts with a presentation of the background of the study, and it conducts the reader through the general idea of the research. The investigation concerns the analysis of the global supply chain, and in particular from the maritime point of view. Ports, in a modern era, play a key role in transport due to the higher number of TEUs managed and transported by intermodal transport.

1.1 Background

The traditional concept of ports, effectively refers to a border crossing for international carriers. Cargo and ships coming to and crossing the border are assessed charges for their use of port facilities and services. The port logistics chain consists of a variety of nodes through which the ship and cargo move. The chain starts at the entrance to the harbour and usually ends as the cargo passes through the port gate after it is nationalised and claimed by the consignee.

Ports have been playing an increasingly important role in our trading system. Trade liberalization and the development of land infrastructure have abolished national (economic) borders and captive hinterlands, obliging ports to compete fiercely for custom, particularly transshipment cargo transported in containers through marine terminals. Greater carrier choice in routing cargo and parallel advances in logistics and supply chain management have thus changed competition from one between ports to one between supply chains (Cullinane, 2011, p. 363).

The new expectations of ports are today clearly felt by port administrations who realize, often painfully, that the benefits of fine-tuning supply chains can be easily withered away by bottlenecks in inefficient ports (Haralambides et al, 2002). This realization has led to a global restructuring of the port industry.

Ports, in order to be competitive in the global maritime supply chain, have started improving the core business elements and, furthermore, identifying new business opportunities to achieve better economical performances. To deal with these requirements, shipping companies have integrated horizontally through mergers, acquisitions and strategic alliances, and vertically through operating dedicated terminals and by providing integrated logistics and intermodal services (Notteboom, 2004). Additionally, shipping companies have rearranged service networks with the dual aim of global coverage and diversification. The reactions of shipping companies ultimately affect every facet of the maritime industry, especially port operations (Slack et al, 2001).
The main challenges ports face from this structural change is that their main customers, the shipping lines, are becoming more powerful with stronger bargaining power, and that competition between ports is getting more intense both at inter-port and intra-port levels.

Many studies suggest that ports have had to evolve across the range of their activities to cope with the challenges (Notteboom and Winkelmans, 2001; Robinson, 2002; Carbone and De Martino, 2003).

From the external perspective of the performance model “Service”, particular attention is focused on the relationship with customers; Notteboom and Winkelmans (2001) confirm that the seaports likely to succeed in the twenty-first century are those that are customer-led, which understand customer needs, and which can offer best-in-class performance. With this focus on adopting a customer-oriented philosophy, ports are expected to provide a high quality service at the lowest cost possible, satisfying customers’ increasingly complicated requirements (Marlow and Paixao Casaca, 2003).
Offering lower service price is one of the inevitable strategies used to attract lines that are themselves under huge pressure to reduce total shipping costs. In reality, many port authorities and individual terminals attempt to secure footloose transshipment cargo by lowering port charges for container lines using their terminals as load centres. However, sustainable competitive advantage cannot be achieved by becoming the lowest-cost service provider (Notteboom and Winkelmans, 2001). Delivering service quality and customer-oriented practices, such as flexible and responsive service provision, is essential for success and survival in today’s competitive port industry.

Logistical performance models deal with issues of vertical and horizontal integration of ports along supply chain and transport channels. Several researchers demonstrate that ports compete not simply on the basis of operational efficiency or location, but on the basis that they are embedded in chains that offer shippers greater value (Robinson, 2002). Additionally the seamless, door-to-door philosophy has transformed terminal operators into logistics organizations (Notteboom and Winkelmans, 2001). It is also suggested that port networking with overseas and neighbouring ports improves a port’s functioning in the global transport system through the exchange of knowledge and ideas and helps prevent port authorities from wasting scarce resources on inter-port competition.

It has been demonstrated that manufacturing companies have realized the necessity of managing supply chains effectively in response to the globalization of the economy and intensifying competition, and therefore adopted new strategies such as supply chain management (SCM), global sourcing and outsourcing of certain functions, for example logistics (Lambert and Cooper, 2000; Cho and Kang, 2001; Rabinovich et al, 1999). Such new strategies require transportation companies both to cover a wider geographical area and to provide a wider range of services to meet increasingly diversified demand patterns with lower price and higher quality than before (Heaver, 2001; Slack et al, 1996).

The focus of this thesis is the discussion of the role of ports, and the (changing) role of ports in supply chains, a role which can vary from that of simple transshipment hub to important logistics node, and which in turn is heavily dependent upon the supply chain strategies of those who use these ports. A better supply chain integration can be achieved

through greater collaboration and coordination of functions across supply chains. This means partnerships, alliances and networks that are created within and between organizations. This research focuses on e-retailers' use of port infrastructures and the role that warehouse location can play in satisfying customer demand through shorter lead times, with positive consequences for e-consumers.

E-retailers' warehouse location strategy is one of the main focal points of this research. Retailers and online retailers manage a global supply chain, because they are searching for low-cost production, ability to distribute products effectively from far-spread points of production to multiple locations for purchase and then consumption. Retailers now refer to global supply rather than global production and they are aware of the need to manage business globally; in some cases this means repatriating some production to meet the consumer 'speed' challenge. (Fernie and Sparks 2015, p. 28)

1.2 Problem Discussion

The world of e-commerce is booming. China's primary online marketplace, Taobao, sells more today than the top five brick-and-mortar retailers in the country combined.
The marketplace now offers some 800 million different products online. Significant increases in online sales are expected in most parts of the world, but especially in developed countries and emerging countries. The forecast for Europe is an 85 per cent increase in the next few years. Global supply chain will feel the pressure to be part of the value-added solution to the market (Hult, Closs, and Frayer, 2014, p. 41).

Consumers are increasingly demanding the best at a good price. Global SCs are a major part of the solution. Specifically, companies need to have a well-working global supply chain infrastructure available to them to distribute their products to a larger number of potential customers than ever before. Customers want new products with more features and better quality - all costly propositions. Using global supply chains helps offset these costs through potentially larger market coverage involving more customers (Hult, Closs, and Frayer, 2014, p. 48).

Watson (2013, p. 64-65) refers to supply chain service design, where he considers the relevance of *minimising the average transport distance,* and *maximising the percentage of customers within a certain distance.*
The best way to think about network design is that it gives you the opportunity to meet your service promises.

Mallard et al *(*2008, p. 38-39), specify that when analysing the demand for a certain product there are several determinants to take into consideration:
- *the price, availability and quality of substitute products;*
- *the price, availability and quality of complementary products;*

- *income changes; population changes; popularity effects; speed; reliability; bureaucracy* and *security.*

The problem the author is trying to solve is the reduction of lead time for e-buyers in the Scandinavian market, through locating warehouses in the port area (port-centric activities benefits). Several distribution centres across Europe (e.g. Germany and the Netherlands) dispatch products to Sweden, Denmark, Finland and Norway, causing long delivery time. The consequences of DCs being located outside Scandinavia are higher costs, inefficiencies, customer dissatisfaction, higher greenhouse emissions due to transport and congestion, with consequences across the entire supply chain (even in reverse flow).

1.3 Purpose of the Study

The purpose of this study is to analyse the factors influencing e-retailers in their choice of warehouse (or DC) location, potentially within ports, with the ultimate goal of better satisfying demand within a specific geographic area or market.
Locating the warehouse within the port itself has certain benefits, such as influencing lead time and operations of the players involved in the supply chain.

In this study, the author aims to determine the best-possible location of warehouse to satisfy the Scandinavian market, for a specific client. With this in mind, the investigation starts with supply chain characteristics, warehouse location strategies (from the investor's point of view), the maritime sector, e-commerce and e-buyers/population. Container ships will prefer to call at a specific port when it has a certain level of efficiency and competitiveness.

By selecting several research themes that stem from the literature review and are patterns across the data analysis, this study helps us to construct an extensive investigation across multiple topics in order to answer the central research question.

This analysis, conducted independently, pays particular attention to the Scandinavian ports, and specifically to the Port of Gothenburg (PoG), Port of Oslo, Port of Copenhagen-Malmo and Port of Stockholm.

The study the author intends to carry out is the analysis of port-centric logistics (warehouses) in Gothenburg. This investigation concerns the satisfaction, in *primis,* of the final warehouse users (online retailers), and the relative attractiveness of the PoG compared to its competitors.

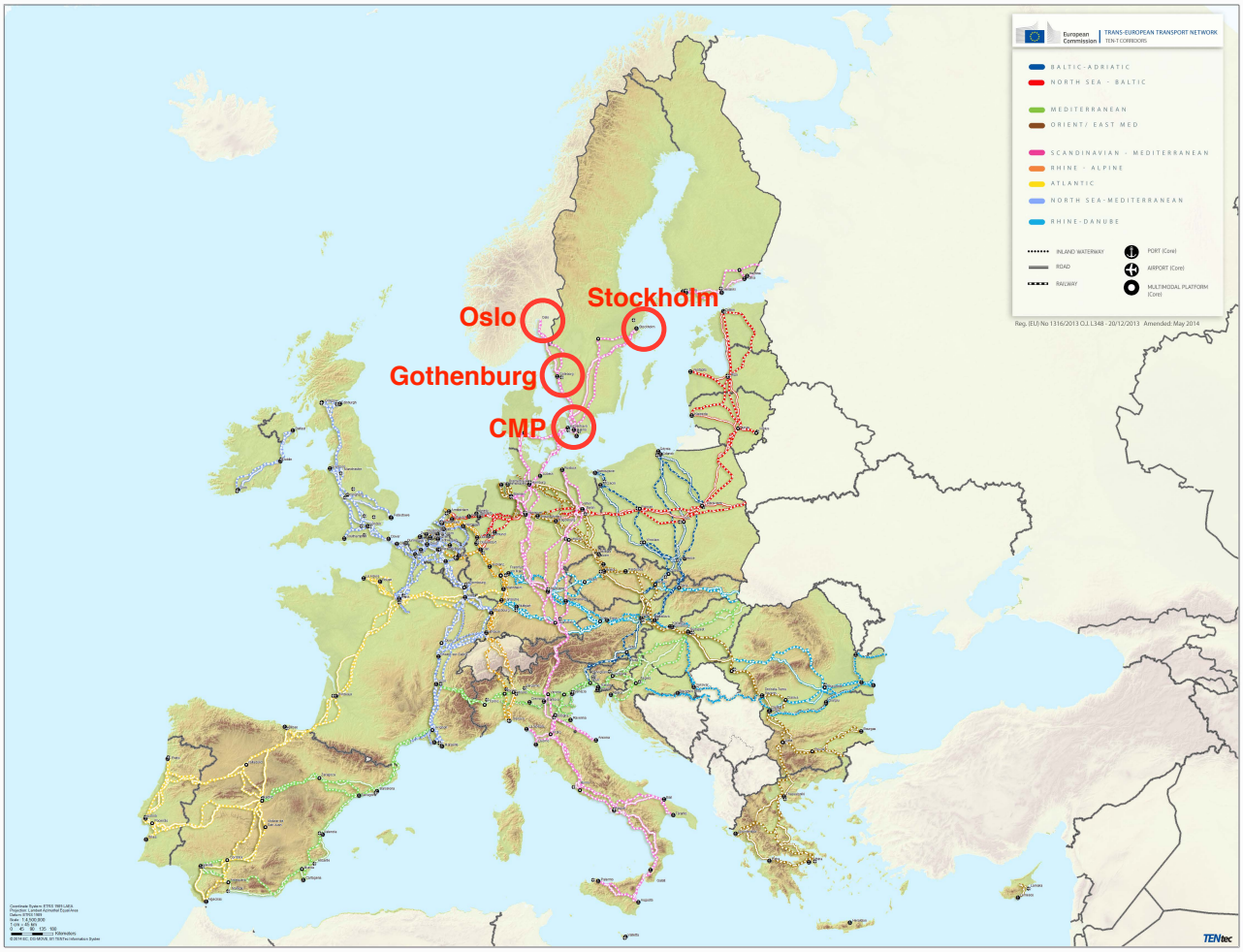
The research question is this: assuming that all four ports included in the research provide warehouses to e-retailers, which location has the most convenient distribution (e.g. short lead time and large e-buyer customer base)? *How can the Port of Gothenburg (PoG)*

contribute to the success of online retailers? Which factors create a competitive advantage for e-retailers? Which factors influence the choice of location for a warehouse/DC?

The project was jointly developed with the PoG, who selected the main ports.

Image 1.2 shows a map of trans-european core ports and corridors, including the key ports in this research.

Image 1.2 European Ports and Corridors



Source: *personal elaboration, based on EU TEN-T corridors.*

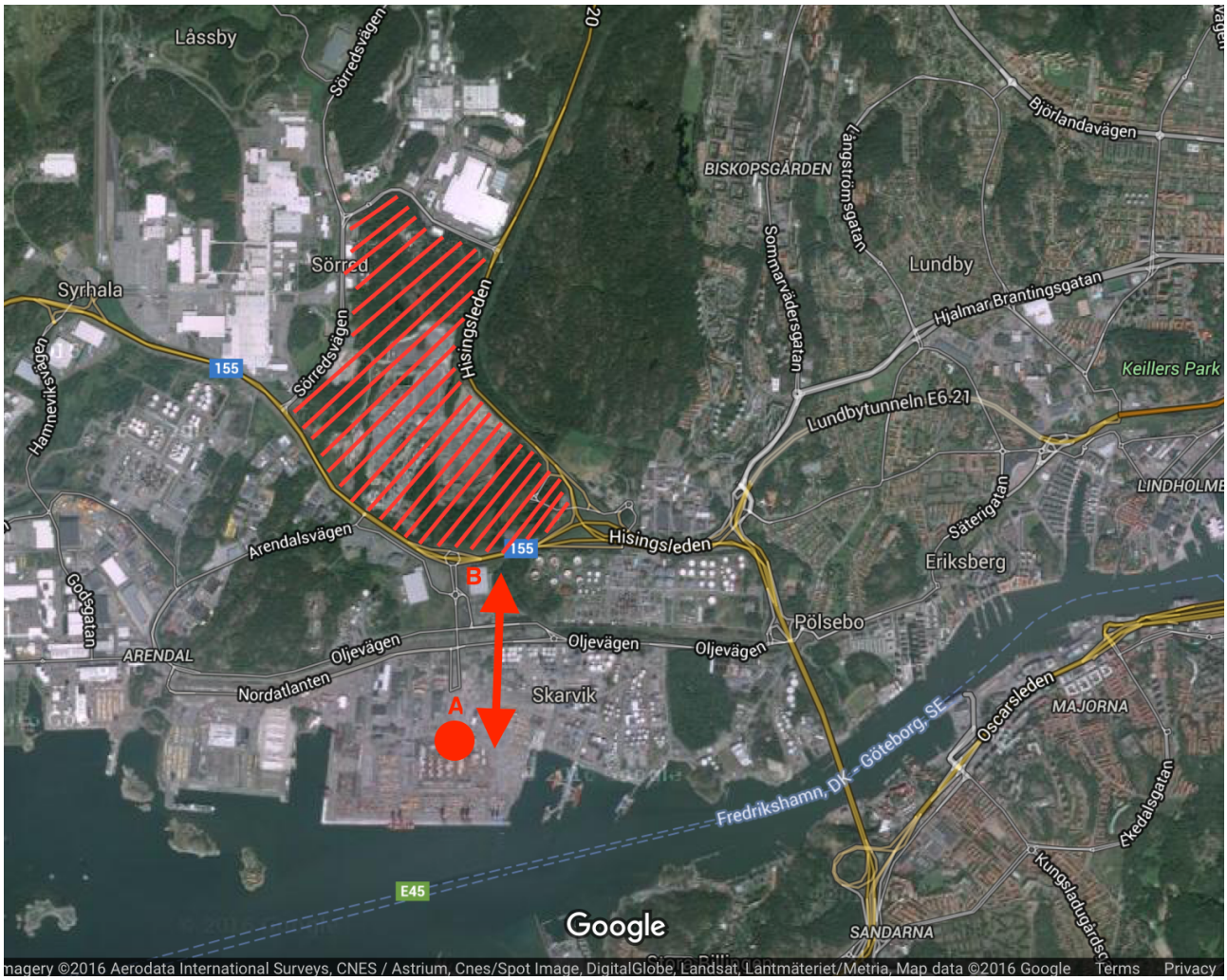
How can the Port of Gothenburg (PoG) contribute to the success of online retailers? This study focuses on the possibility of the PoG satisfying the growing demand for dedicated warehouses and particularly for e-commerce businesses.

The Port of Gothenburg, geographically located in the west of Sweden, represents one of the access points to the Scandinavian market. It is the largest port in the Nordic countries. The port's proximity to the market and its physical conditions contribute to its penetration of Scandinavia and the Baltic Region (with considerable potential for growth); and the rail shuttles and the inland terminals in Sweden and Norway are a major strength. The port has the infrastructure and traffic to move goods quickly and conveniently to and from the

port by rail. Also, there are large areas of space that can be used, both for quays and other terminal operations, to support the port's growth.

The PoG owns approximately 60 hectares of land, strategically located nearby the highway and the railway line (Image 1.3 Warehouses Location, point **B**). The area is 1km (ca.) from the container terminal (Image 1.3, point **A)**. In this case the containers are able to move rapidly and directly to the warehouse/DC with positive consequences across the SC.

Image 1.3: Warehouses Location



Source: *personal elaboration, based on Gothenburg Google Maps.*

The project the PoG intends to realise is the construction of new warehouses (ca. 30 hectare), located nearby the port, with proper connections to the railway network, highway and Scandinavian hinterland. The warehouses have different dimensions (from 15 to 35 metres high), in order to satisfy different customers' demands; several international investors are co-financing the project, already. The total investment in the project to date is SEK 4 billion = $490 million US = 430,1 million Euros, including SEK 1 Billion from PoG). These investors are NCC Property Development, Prologis Nordic, Eklandia Fastighets, and Bockasjo. (Sea-web.com, 2015b)

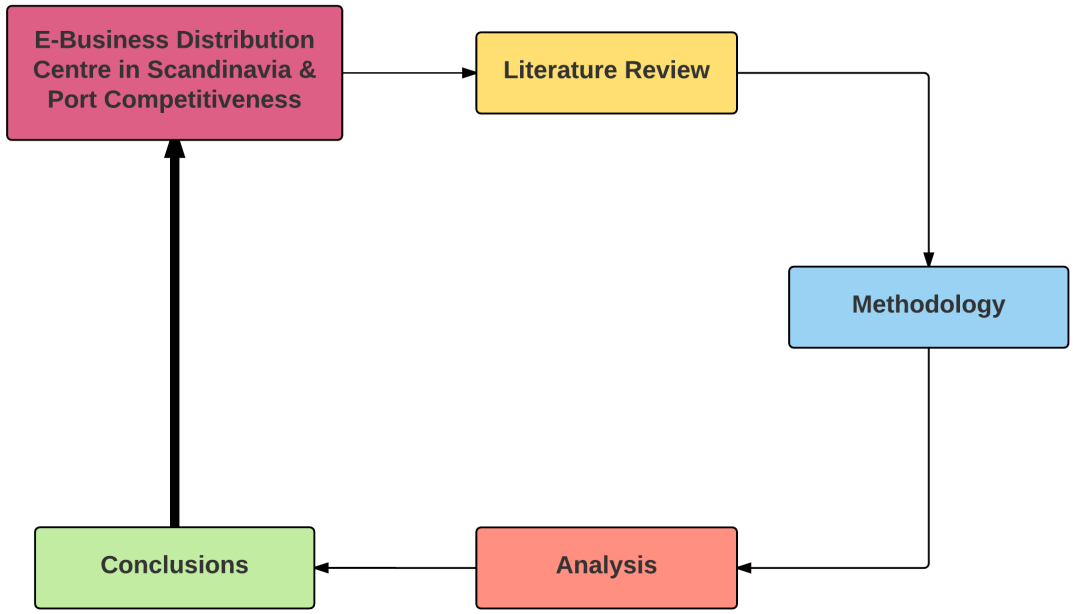
The PoG identified large online retailers as the final users of the warehouses, those with large throughput and adequate market share. Large online retailers that trade in apparel, fashion, electronics, sports equipment, household goods and books (for example), with high value products may be interested in the infrastructure; such retailers as Amazon, Alibaba, Zalando, Decathlon, XXL, Zara, H&M, Intersport and Team Sportia.

Those companies, according to their business strategies, will consider the possibility of investing in a new warehouse or distribution centre (DC) in Gothenburg, in order to penetrate the Scandinavian market, satisfying customer's demands.

1.3.1 Study Steps

Image 1.0 (Research Steps) shows the main steps undertaken in this research. The starting point is *E-business Distribution Centre in Scandinavia & Port Competitiveness*, followed by a review of the relevant *literature* to support the research, the *methodology* applied to the research, an *analysis* in line with the literature review and *conclusions*, where the author's findings in relation to the research questions are summarised.

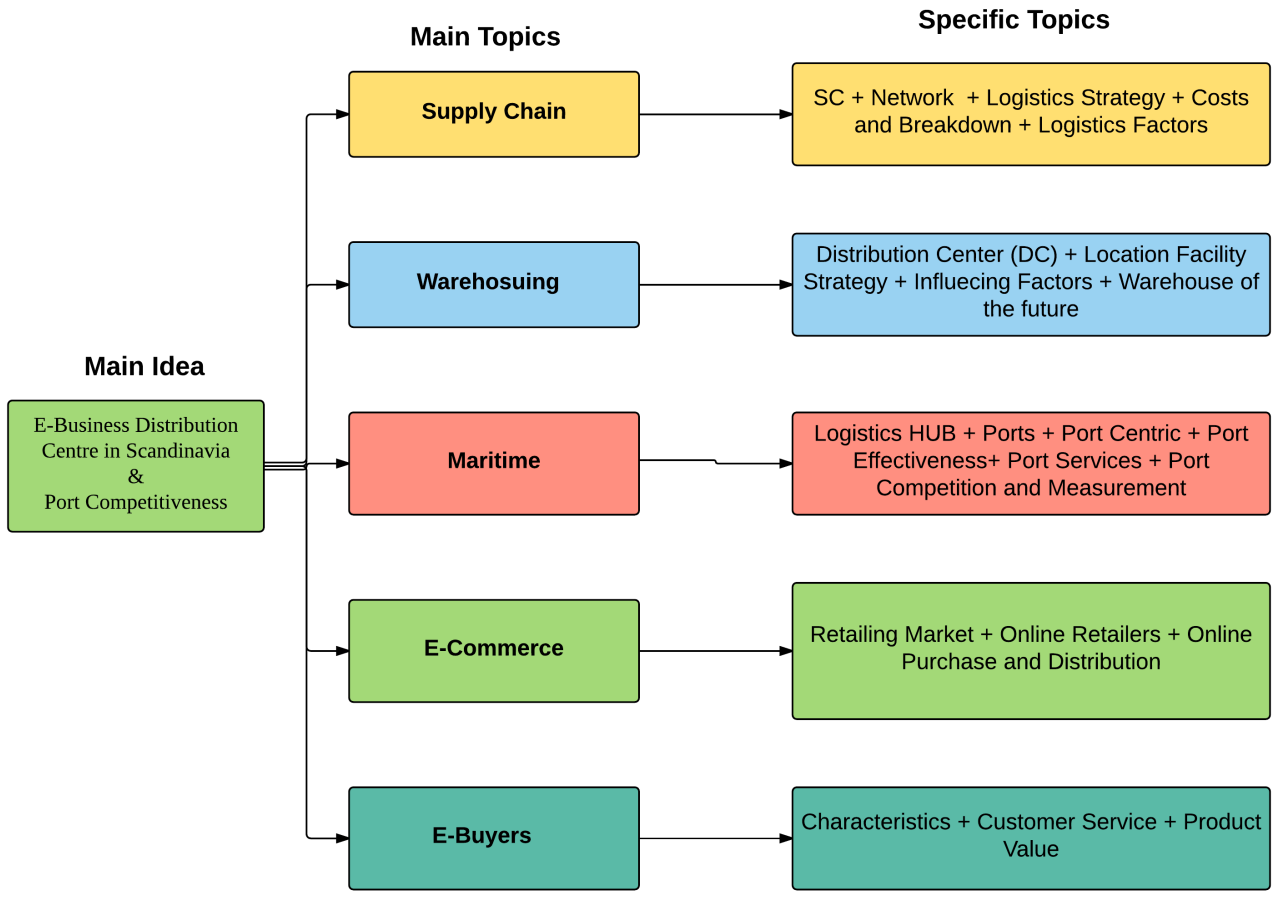
Image 1.0 Research Steps



In order to have an appropriate method of study and research, several sections have been identified and merged in main categories.
The **research topic** is the *E-business distribution centre in Scandinavia & Port competitiveness;* the **literature review** include the section no. 2-3-4-5-6; the **methodology** in section 7; the **analysis** in sections 8-9-10-11; and the **conclusions** and in section 13.

In order for the reader to have an understanding of supply chain and the entire research, some important assumptions must be introduced, to better view the big picture about the warehouses/DC located in a port's logistics park, and the benefits for the entire SC and its network. **Image 1.1** shows the *main idea*, the literature background (*main topics)* considered for this investigation and the key areas (*specific topics)* relating to the *main idea.*

Image 1.1 Topics Covered in this Research



Source: *personal elaboration*

1.4 Comparison of the Port's Competitors

The empirical analysis compares the characteristics of the following Scandinavian ports: Oslo, Gothenburg, Copenhagen-Malmo and Stockholm.
The study includes a shipping cost analysis (from Asia to Europe; voyage, port charges, etc.), port performances, to better identify the more efficient port.
Afterwards a port's warehouse simulation location is conducted to "compare" the Scandinavian distribution system.

The main purpose of the study is to conduct an independent analysis about the attraction of big online retailers in Gothenburg, and using the new warehouses to satisfy online retailing markets in Norway, Sweden, Finland, and Denmark.

1.5 Scope and Limitation - Problems Related to the Research

The author's goal is to guide the reader through the general concepts of supply chain, maritime infrastructure, warehousing, e-retailers and e-buyer characteristics.

The analysis comprises the following areas:
1. The trade flow (for specific products) in the Scandinavian countries
2. The maritime sector
3. Population characteristics (e-buyers)
4. The identification of the warehouse location that better satisfies the Scandinavian market.

The analysis is quite extensive and due to restriction in length (by the University) the author tried to summarise all data in the main section; the supporting analysis is presented in the Appendix.
The most recent data was selected, dating from 2015 where available. Due to data availability, some data is from 2014 and 2013.

Regarding *trade flow,* the following elements are not considered: *the grocery market, fresh food, frozen food, flowers and all products not part of the online retailing business; appendix "A"* identifies the selected categories (categories chosen in accordance with the PoG).

Regarding the *maritime sector*, port characteristics are taken into consideration, as are the ports' locations. It was necessary to combine information from multiple sources to carry out a comprehensive analysis. This thesis will not to take global port operators (GPOs) into consideration.

Regarding *e-buyers* and Scandinavian population characteristics, one limitation was the availability of data across all ports, such as the income by age group, income by educational level and number of children per adult.

Regarding warehouse location analysis, the investigation does not cover the type of infrastructure to build, nor the dimensions or internal facility layout, nor traffic flow from/to the warehouse to the customer; only the location. Centralised and decentralised warehouses are not part of this investigation.

The identification of the retailers and their market shares was not considered.

The study will not take into consideration the reverse flow analysis (reverse logistics); transportation costs are not analysed either.

Considering that there are many aspects to take into consideration, from the most general to the most specific, this research focuses only on what is presented in the previous paragraphs (in Section1) and in the methodology section; all the rest that wasn't mentioned is part of future research (see last section).

1.6 Expected Results

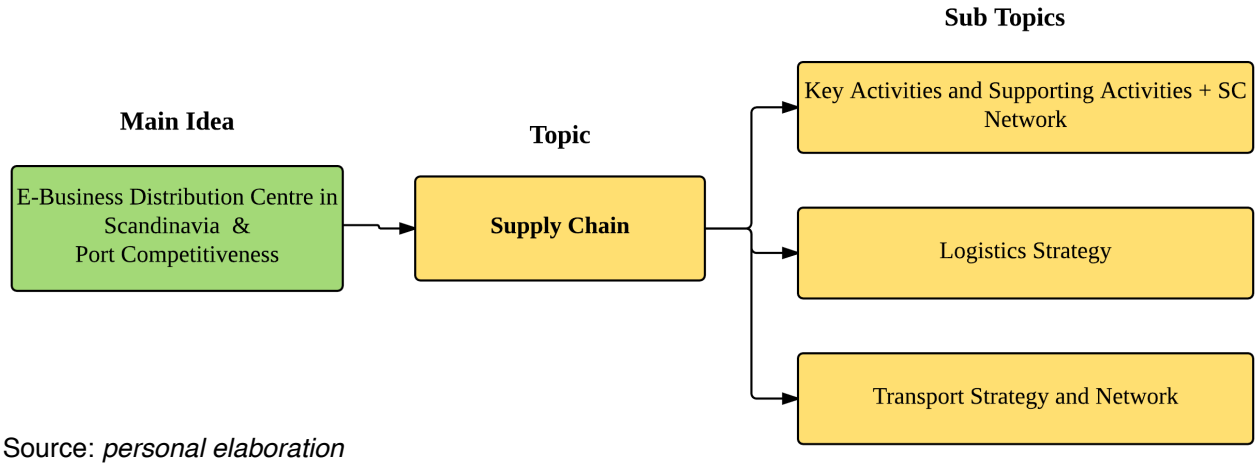
The result of the study is to understand the most appropriate location where set-up a new warehouse for online retailers, when investing in the Scandinavian market, in order to satisfy the higher number of e-customer in the shortest range time/distance. Another expected result is the show the ports and countries' performances (economics, population, income, etc.) and supporting the investment "localisation" in the most appropriate country/ city.

The aim is to set up a ranking, among the ports, for the considered parameters.
Considering the transport system, the positive effects on the environment are also considered, in order to build a more sustainable world and sustainable e-shopping system.
The facility location is influenced by the trade flows and population characteristics (e.g. income), and the final ranking will sum up the results.

2. BACKGROUND - SUPPLY CHAIN

This section presents the supply chain theoretical framework, which begins with describing the general characteristics and the network planning, and different definitions are provided. The section continues with the logistics strategy, and logistics factors related to the performance. Image 2.1 shows the sub topics investigated in this section.

Image 2.1 Supply Chain Literature Investigation



Source: *personal elaboration*

2.1 Supply Chain

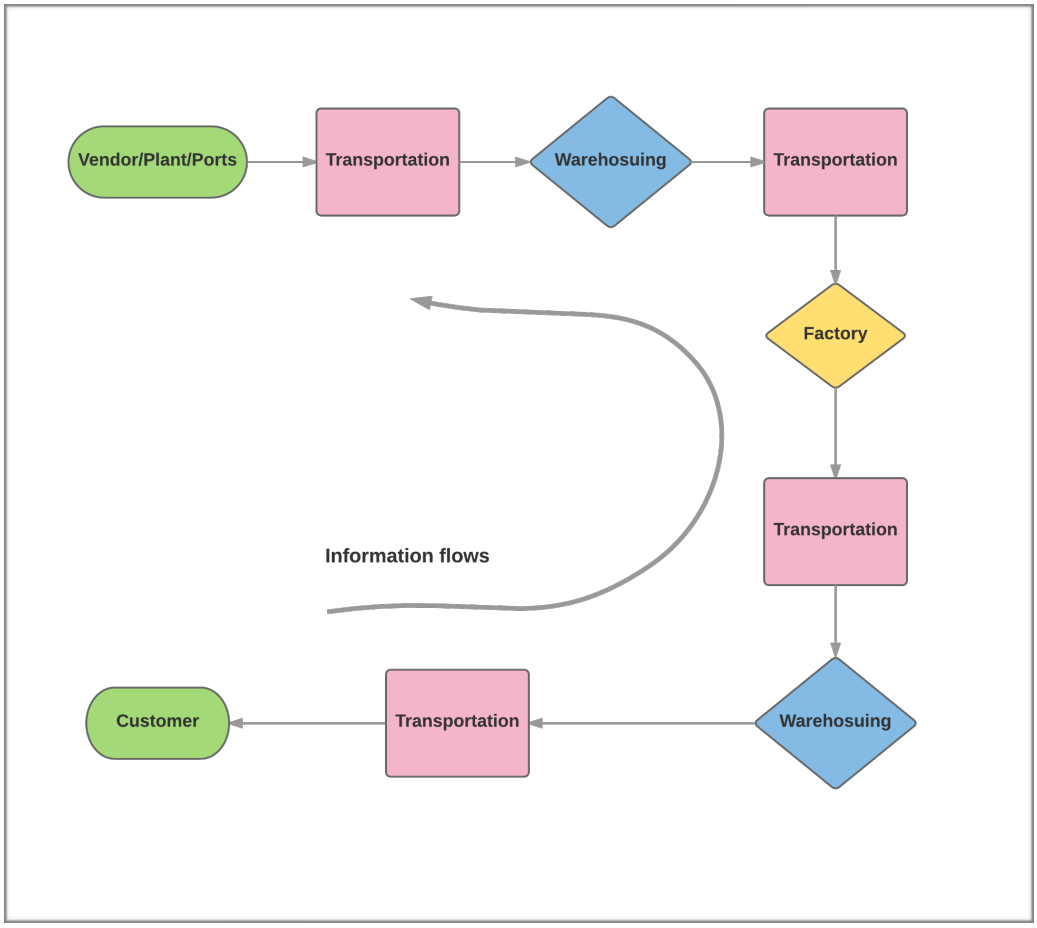
According to Ballou (1999) there are different activities that make up business logistics (SCM). These vary from firm to firm, depending on a firm's particular organisational structure, management's honest differences of opinion about what constitutes logistics, and the importance of individual activities to its operations.

The Council of Logistics Management (CLM) gives this definition:
"Logistics is the process of planning, implementing, and controlling the efficient, cost-effective flow and storage of raw materials, in-process inventory, finished goods and related information from point of origin to point of consumption for the purpose of conforming to customer requirement".

Consider also the following definition provided by "*The Council of Supply Chain Management Professional" (2016): logistics management is part of supply chain management that plans, implements, and controls the efficient, effective forward and reverses flow and storage of goods, services and related information between the point of origin and the point of consumption in order to meet customers' requirements."*

Ballou (1999) suggests the typical steps for a general supply chain of an *Individual Firm* (Image 2.2).

Image 2.2 Immediate SC for an Individual Firm



Note Image 2.2: source Ballou (1999) image 1.1, and adapted)

The same CLM (Oak Brook) states:
"The components of a typical logistics systems are customer service, demand forecasting, distribution, communications, inventory control, material handling, order processing, parts of service support, plant and warehouse site selection (location analysis), purchasing, packaging, return goods handling, salvage and scrap disposal, traffic and transportation, warehousing and storage."

According to Ballou (1999), logistics costs increase in proportion to the level of customer service provided, such that setting the standards for service also affects the logistics costs to support that level of service. Setting very high service requirements can force logistics costs to exceedingly high levels. For instance transportation and inventories are the primary cost-absorbing logistics activities. Experience has shown that each will represent one-half to two-thirds of total logistics costs. It is transportation that adds *place* value to product and services, whereas inventories add *time* value.
Transportation is essential because no modern firm can operate without providing for the movement of its raw materials and/or finished products.

Ballou (1999), mention the importance of logistics and it is about creating *value* - value for customers and suppliers of the firm, and value for the firm's stakeholders. Value in logistics

is expressed in terms of *time* and *place.* Products and services have no value unless they are in the possession of the customers when (time) and where (place) they wish to consume them. Logistics add significant value to customer value; by moving the product toward the customer or making an inventory available in a timely manner value has been created for the customer that was not there previously.

Logistics is important to the company's strategy because most firms invest time in finding new ways to differentiate their products from their competitors, but when management recognise that logistics impacts on a significant portion of a firm's costs and that the result of decisions made about the supply chain yields different levels of customer service, it is in a position to use this effectively to penetrate new markets, to increase market share, and to generate profits. (Ballou, 1999, 13)

According to Fernie and Sparks (2015, p. 2), the stock itself contains value and might not sell or could become obsolete. Warehouses and distribution centres (DCs) are generally expensive to build, operate and maintain. Vehicles to transport goods between warehouses and shops are not cheap, both in terms of capital and, increasingly, running costs. There is thus a cost imperative to make sure that logistics is carried out effectively and efficiently, through the most appropriate allocation of resources along the supply chain.

Retailers are one part of the supply system; they are involved in selling goods and services to the consumer. For this they draw upon manufacturers to provide the necessary products. They may outsource certain functions, e.g. transport, warehousing, to specialist logistics services providers. Retailers therefore have a direct interest in the logistics systems of their suppliers and other intermediaries. (Fernie and Sparks 2015)

Sparks (1998, 2010), refers to the concept of logistics mix as an integrated part in retailer supply chain, because these are the essential elements of logistics management.
Being aware of consumer demands and requirements is vital for all players involved in the system. By contrast, if company "X" is highly focused on consumer demands and the provision of excessively high service levels, this will cause cost problems for retailers. If the system is too responsive at any price, then the operation is likely to be unsustainable. The transformation in retail supply chains is thus about appropriate balances and activities and the right approach to supply and demand.

2.1.1 Supply Chain Network

According to Watson et al (2013) *supply chain network design* should consider the geography and business strategy of the company; several elements influence the SC network planning and require the player to make trade-offs:

- *Transportation costs:* because the company is interested in moving product from its original source to the final destination; by contrast, the location of the facilities

determines access to transport infrastructure such as highways, ports, airports, railheads; and different locations may have different transportation rates.

- *Service Level:* the location of the company infrastructure affects the customer's delivery time
- *Local Labor: Skills, Materials and Utilities:* the location of facilities is influenced by the labor sector, ability to find required skills, cost of local material, and cost of utilities
- *Taxes:* facilities can be taxed directly according to their location and to the operations performed. Taxes have to be considered when shipping a product to and from the company's locations
- *Carbon Emissions:* the location of facilities in certain areas, minimise distance traveled and/or transportation costs, with reduced CO2 emissions; on the other hand if the facility requires a high level of electricity, the appropriate location is near low-emission power plants - with reduction in emissions.

According to Hult, Closs, and Frayer (2014, p. 42), the infrastructure for global supply chain is becoming much better, with numerous options for global and regional channels in most parts of the world. Shipping routes are being reconfigured, leverage points in the world are being reformulated, and value is being added to global supply chains.The forecast is that the infrastructure for global supply chains will improve by 11 per cent in the next five years.

Global firms are experiencing several issues, such as global sourcing, including sourcing from foreign markets. Firms now source globally to achieve the best combination of quality, cost, and ultimately value. (Hult, Closs, and Frayer (2014, p. 41)

2.2 Logistics Strategy

The primary goal of logistics is to "minimize" firms' costs and maximise customer satisfaction by coordinating flow of materials and information in the most efficient way, and by providing a service to customers in a timely fashion and at a reasonable price (Coyle et al, 2009; OLeary-Kelly and Flores, 2002).
Retailing and logistics are concerned with product availability. Many have described this as '*getting the right products to the right place at the right time*'. Unfortunately, however, that description does not do justice to the amount of effort that has to go into a logistics supply system and the multitude of ways that supply systems can go wrong.
Retailers must be concerned with the flows of product and information both within the business and in the wider supply chain. In order to make products available retailers have to manage their logistics in terms of product movement and demand management. They need to know what is selling in (and through) their stores and their websites and both anticipate and react quickly to changes in this demand. At the same time they need to be able to move less demand-volatile products in an efficient and cost-effective manner (Fernie and Sparks 2015, p. 3). The real management 'trick' is in making product availability look easy.

Innovative approaches to logistics strategy can give competitive advantages; It has been suggested that a logistics strategy has three objectives 1) *cost reduction,* 2) *capital reduction* and, 3) *service improvement*.

1. *Cost reduction* is a strategy directed towards minimising the variable costs associated with movement and storage. The best strategy is usually formulated by evaluating alternative courses on auction, such as choosing among different warehouses locations or selecting among alternative transport modes. Certainly a profit maximisation is the primary goal to achieve.
2. *Capital reduction*, is the strategy directed toward minimising the level of investment in the logistics system. *Maximising the return on investment* is the motivation for this strategy. Shipping direct to customers to avoid warehousing, choosing public warehouses over privately owned warehouses, selecting just in time supply approach rather than stocking to inventory, or using third party providers of logistics services are examples.
3. *Service improvement* strategies usually recognise that revenues depend on the level of logistics service provided. Although costs increase rapidly with increased levels of logistics customer service, the increased revenues may more than offset the higher costs. To be effective, the service strategy is developed in contrast with that provided by competition.

A proactive logistics strategy often begins with business goals and customer service requirements. These have been referred to as ”attack strategies” to meet competition (Ballou, 1999).

As mentioned earlier, “time” plays a key role in the entire supply chain, and particularly in efficient distribution. According to Christopher and Peck (2003) there are three dimensions to keep to consider if an organization is interested in being responsive to market changes (time-based competition):

1. *Time to market*: the speed of bringing a business opportunity to market;
2. *Time to serve*: the speed of meeting a customer’s order; and
3. *Time to react*: the speed of adjusting output to volatile responses in demand.

According to Christopher and Peck (2003), the three time-based competition elements are used to develop strategies for lead time management.
Refer to Christopher and Peck (2003) for more information.

Fernie and Sparks (2015, p. 28-29) are concerned with *availability*, *supply chain competition,* and *relationship matters*. *Availability* is meeting the customers’ demand, and retailers are concerned about availability of products in store and online.
S*upply chain compete*: in the past competition was mainly between retailers, at the horizontal level only. In the modern era, competition pass by the supply chains, between production and consumption. The retail store and website are the recipients of both changing demand and supply. Nowadays retailers are competing not only horizontally but

also vertically, in terms of the efficiency and effectiveness of their supply systems; retailers need to expand their customer's penetration, delivering products in customer's hands.
Relationship matter: in order to focus mainly on their core business (companies), they have utilized logistics services providers to carry out many logistics activities (coordination, management and control). The number of direct partners and activities have in many cases been reduced considerably.

2.3 Logistics Costs Breakdown

According to Rodrigue (2016a), total logistic costs reveal much about the locational dynamics of logistics activities, particularly distribution centers, since they indicate the weight of most important factors. *Transportation costs* remain the dominant consideration as they account for about half of the logistic costs (50.3 per cent). *Inventory carrying costs* are also significant with a share of about one fifth of total costs (21.8 per cent). They include the costs of holding goods in inventory (capital costs, warehousing, depreciation, insurance, taxation, and obsolescence) and are commonly expressed as a share of the inventory value. *Labor costs* involve the physical handling of goods, including tasks such as packaging and labeling (9.5 per cent). *Customer service* encompasses receiving and processing orders from customers (7.8 per cent). *Rent location* account for 4.3 per cent (of logistics costs), a*dministration* for 2.7 per cent, and *supplies* represent 2.2 per cent of logistics costs.
Under such circumstances, distributors are **willing to pay higher rents** to take advantage of a logistics site that offers co-location with an intermodal terminal since this strategy enables them to reduce transportation costs, such as drayage, as well to improve their time responsiveness (lead time). Therefore, while transportation costs remains the most important element of logistics costs, non-spatial components such as **inventory carrying** and **labor costs**, are significant components that will influence locational choice **depending on the supply chain**.

2.4 Transport Strategy and Network

Transport decisions can involve mode selection, shipment size, and routing and scheduling. These decisions are influenced by the proximity of warehouses to customers and plants, which, in turn, influence warehouse location. Inventory levels also respond to transport decision through shipment size (Ballou, 1999, p.35).

From a customer service point of view, several elements must be considered in order to offer a proper service such as inventory availability, speed of delivery, and order-filling speed and accuracy. The costs associated with these factors increase as the level of customer service level is raised. Therefore, distribution costs will be quite sensitive to the level of customer service provided, especially if it is already at the high level. *Customer service levels* such as facility location, inventory and transportation are major planning

areas because of the impact that decisions in these areas have profitability, cash flow, and the firm's return on investment, as aforementioned. Each aspect of the decision is interrelated and should not be planned without at least some consideration of the trade-off effect (Ballou, 1999, p.35-37).

Ballou (1999) mentioned that another way to look at the logistics planning problem is to view it in the abstract as a **network** of *links and nodes.* Logistics planning is a design problem. The network is to be constructed as a configuration of warehouses, retail outlets factories, deployed inventories, transportation services, and information processing systems that will achieve an optimum balance between the revenues resulting from the level of customer service established by the network design and the costs associated with the creation and operation of the network.

The term *network* refers to the framework of routes within a system of locations, identified as nodes. A **route** is a single link between two nodes that are part of a larger network. It can refer to tangible routes such as roads and rails, or less tangible routes such as air and sea corridors (Rodrigue, 2016b).
In transport geography, it is common to identify several types of transport structures that are linked with transportation networks with key elements such as nodes, links, flows, hubs or corridors (see "definitions" section). Network structure ranges from *centripetal to centrifugal* in terms of the accessibility they provide to locations (Image 2.3). A centripetal network favors a limited number of locations while a centrifugal network tends not convey any specific locational advantages (Rodrigue, 2016a).

According to Rodrigue (2016b), the recent decades have seen the emergence of transport hubs, a strongly centripetal form, as a privileged network structure for many types of transport services. Evidence underlines that the emergence of hub-and-spoke networks is a transitional form of network development rationalizing limited volumes through a limited number of routes. When traffic becomes sufficient, direct point-to-point services tend to be established as they better reflect the preference of users.

Image 2.3 Centripetal and Centrifugal Structure (Rodrigue, 2016a)

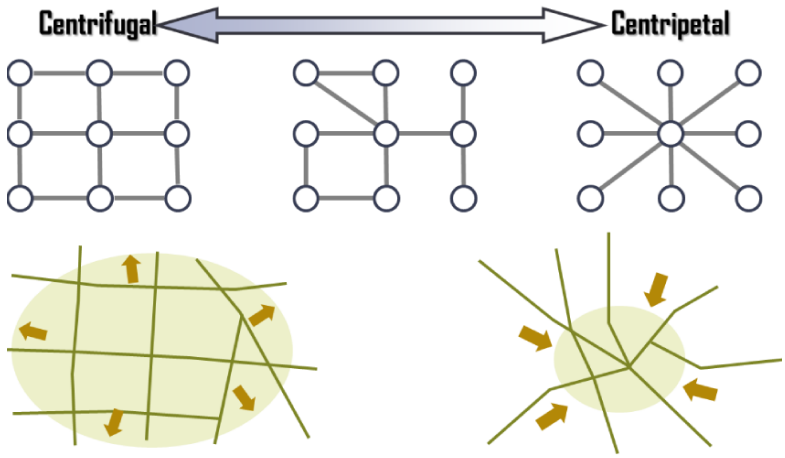
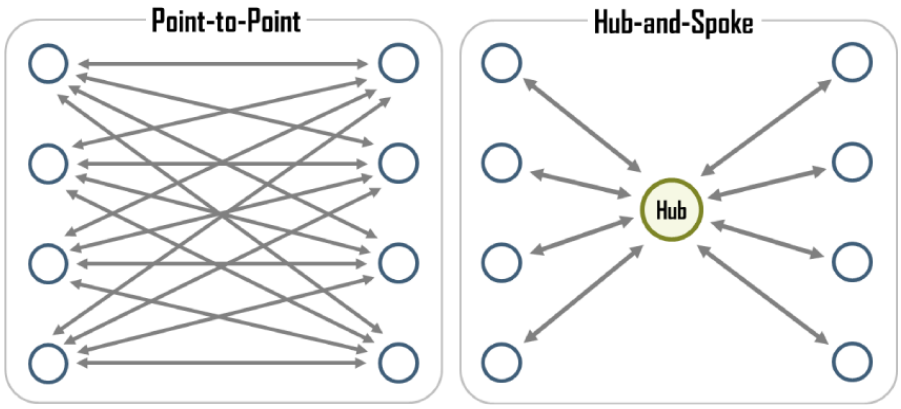


Image 2.4 Point-to-Point Vs Hub-and-Spoke (Rodrigue, 2016b)



Rodrigue (2016c) points out that hubs, as a network structure, allow a greater flexibility within the transport system, through a concentration of flows. For instance, as illustrated in image 2.4, a point-to-point network involves 16 independent connections, each to be serviced by vehicles and infrastructures. By using a hub-and-spoke structure, only 8 connections are required. The main advantages of hubs are:

Economies of scale on connections by offering a high frequency of services. For instance, instead of one service per day between any two pairs in a point-to-point network, four services per day could be possible.

Economies of scale at the hubs, enabling the potential development of an efficient distribution system since the hubs handle larger quantities of traffic.

Economies of scope in the use of shared transshipment facilities. This can take several dimensions such as lower costs for the users as well as higher quality infrastructures.

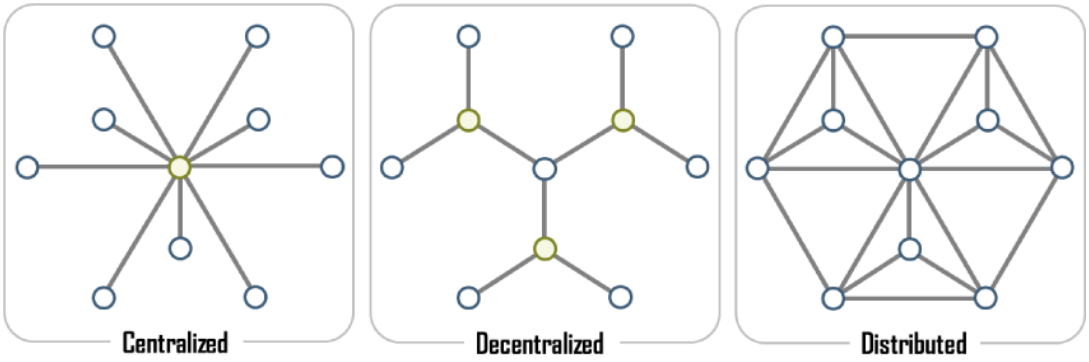
Rodriguez (2016c), (Image 2.5), specifies the difference between *centralized, decentralised* and *distributed* networks, according to their level of service which is related to their structure.

Centralised is referred to one centre has privileged accessibility and thus represents the dominant element of the network and the spatial structure it supports.

Decentralized refers to a network where the centre is still the point of highest accessibility, but the network is structured so that sub-centers also have significant levels of accessibility.

Distributed, No centre has a level of accessibility significantly different from the others.

Image 2.5 Type of Networks (Rodrigue, 2016c)



Christopher et al (2006) suggest that ports can have various different roles in the context of different supply chain strategies and, building upon the work of Fisher (1997) and others, have put forward a taxonomy for selecting global supply chain strategies, where two main elements are considered: predictability of demand for products and replenishment lead times. It also incorporates lean and agile philosophies as appropriate (Mangan, Lalwani, and Fynes, 2008) (table 2.1).

Table 2.1 SC Strategies

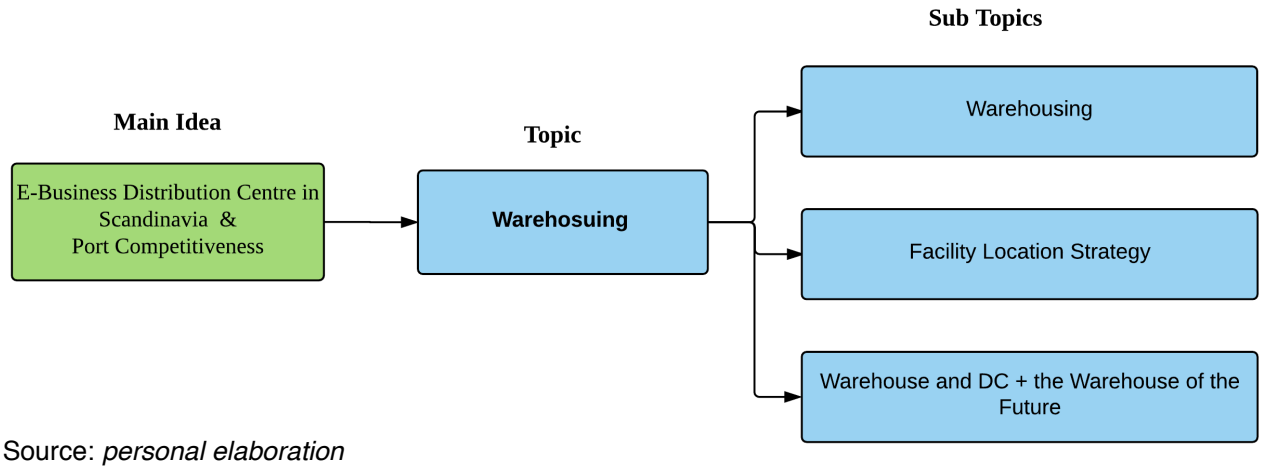
	Predictable Demand	Unpredictable Demand
Long Lead Time	**Lean** (Plan and Execute)	**Leagile** (Postponement)
Short Lead Time	**Lean** (Continuous Replenishment)	**Agile** (Quick Response)

Source: Christopher et al (2006)

3. BACKGROUND - WAREHOUSING

From the author's point of view, a deeper investigation of warehouses is required, to better clarify several elements influencing the choice of this infrastructure adoption, and appropriate location. The reader will understand the elements affecting facility location strategy and elements (or factors) to consider, the difference between a warehouse and DC; another consideration is the flexibility and agility required of modern warehouses, over and above their role as simple storage facilities.

Image 3.1 Warehousing Literature Investigation



Source: *personal elaboration*

Warehousing is an integral part of every logistics system. It plays a vital role in providing the desired level of customer service at the lowest possible total cost. Warehousing activity is the link between the producer and the customer. Warehousing is defined by Lamber and Stock (1993) as that part of a firm's logistics system that stores products (raw materials, parts, goods-in-process, finished goods) between point-of-origin and point-of-consumption, and provides information to management on the status, condition, and disposition of items being stored. The term distribution centre is also used. However, warehouse is the more the generic term. The Transportation-Logistics Dictionary defines a distribution centre as "a warehouse of finished goods; also applied to facility from which wholesale and retailer orders may be filled; a material warehouse would also be distribution centre for the buyers of its stock." (Lamber and Stock, 1993, p.263).

3.1 Warehousing

According to Lamber and Stock (1993), the importance of warehousing is characterised by two basic type of inventories: 1) raw materials, components and parts (physical supply); and 2) finished goods (physical distribution). In general it is necessary to hold inventories for the following reasons: to achieve transportation economies, to achieve production economies, to take advantage of quantity purchase discounts and forward buys, to

maintain a source of supply, to support the firm's customer policies, to meet changing market conditions (e.g. seasonality, demand fluctuations, competition), to overcome the time and space differentials that exist between producers and consumers, to accomplish least total logistics commensurate with a desired level of customer service.

Croucher, Baker, and Rushton (2014), specify the importance of warehouses as an integral part of the supply chains in which companies operate. Recent trends, such as increasing market volatility, product range proliferation and shortening customer lead times, therefore all have an impact on the roles that warehouses are required to perform. Warehouses need to be designed and operated in line with the specific requirements of the supply chain as a whole. They are therefore justified where they are part of the lowest-cost supply chain that can be designed to meet the service levels that need to be provided to the customers.
The nature of warehouses within supply chains may vary tremendously, and there are many different types of classification that can be adopted, for example:

- *by the stage in the supply chain:* materials, work-in-progress, finished goods or returned goods
- *by geographic area:* for example, a global warehouse may serve the whole world, a regional warehouse may serve a number of countries, a national warehouse may serve just one country, or a local warehouse may serve a specific region of a country
- *by function:* for example, inventory holding or sortation (e.g. as a 'hub' of a parcel carrier);
- *by product type, ownership, company usage, area, height,* and *equipment.*

Ballou (1999) specifies that companies use storage spaces for four basic reasons: 1) to *reduce transportation-production costs*, 2) *to coordinate supply and demand*, 3) *to assist in the production process*, and 4) *to assist in the marketing process*

From a marketing perspective, companies are frequently concerned about the availability of products in the marketplace; it means that warehousing is used to put value into a product. Where warehousing is adopted to provide the product as close as possible to customers, delivery time can often be reduced or supply made readily available. This improved customer service through faster delivery can increase sales (Ballou, 1999). Another change is the demand for reduction in lead times, shorter product lives, and increased inventory turnover, which are linked to such management philosophies as Quick Response (QR) and Just in Time (JIT) (Tompkins and Smith 1998, 6-7).

Warehouses are no longer viewed as independent operations but as an important part of a firm's overall logistics strategy, where the goal is to minimise the cost of product delivery while still providing excellent customer service. Because of this heightened emphasis on the importance of warehousing, third parties (3PL) have increased their role in this part of the logistics chain. The 3PL may organise the entire logistics system for a company as well as running its warehouses and DCs (Tompkins and Smith 1998, p. 6-7).

According to Watson et al (2008, p.7), several functions are typical of warehouse such as: *Consolidation of Products*; *Production Lot Sizes*; *Inventory Pre-Build;* and

a) *Buffer Lead Time*, in this case the warehouse holds products at a location closer to the customer in order to provide the next day transport promised each time an order is placed;
b) *Service Levels,* where the product is stored and its proximity to the market where it will be consumed (it is also a measure of the service the company can provide). Overall cost versus service level is a trade-off in SC network design;
c) *Transportation Mode Trade Offs,* economies of scale in transportation; allowing the shipment of products for long distance with an efficient (and lower cost) mode of transportation and then facilitating the changeover to a less efficient (and usually more expensive) mode of transportation for shorter trip to the final destination.

Warehouses can be used to support manufacturing, to mix products from multiple production facilities for shipment to a single customer, to break bulk or subdivide a large shipment of product into many smaller shipments to satisfy the needs of many customers, and to combine or consolidate smaller shipments of products into a higher-volume shipment. (Lamber and Stock, 1993, p. 265).

Ports can add value to supply chains by 1) sharing information with upstream and downstream supply chain partners, 2) undertaking long-term planning with supply chain partners, e.g. shipping lines, inland transportation carrier, and shippers, 3) providing the flexibility to accommodate changes in the needs of port users, e.g., to **launch new tailored services**, and 4) planning and organising activities beyond their boundaries that improve the performance of the supply chain as a whole (Panayides and Song, 2006).

3.2 Warehouse Facility Location Background

As mentioned in the aims of the project, the author is interested in identifying the best location for a warehouse/DC for online retailers. Several models have been identified, with pros and cons. A short summary is presented:

The site selection decision can be approached from a *macro* and *micro* perspectives. The *macro perspective* examines the issue of where to locate warehouses geographically (in a general area) to improve the sourcing of materials and the firm's market offering (improve service and/or reduce cost). The *micro perspective* examines factors that pinpoint specific locations within the larger geographical areas.

In his macro approach, Edgar Hoover identified three types of location strategies:

1) *market positioned*: it locates warehouses nearest to the final customer
2) *production positioned :* it locates warehouses in close proximity to source of supply or production facilities
3) *intermediately positioned*: it locates warehouses at a midpoint between the final customer and the producer.

Weber also developed a model of facility location based on cost minimisation; the optimal site was the location that minimised "total transportation costs - the costs of transferring raw materials to the plant and finished goods to the market" (Weber, 1929).
Other geographers included the factors of demand and profitability in the location decision. Hoover examined both cost and demand elements of location analysis. His approach stressed cost minimisation in determining an optimal location. Additionally, he identified that transportation rates and distance were not linearly related; that is, rates increased with distance but at a decreasing rate.
Greenhut (1956) expanded the work of his predecessors by including factors specific to the company (e.g., environment, security) and profitability elements in the location choice. According to Greenhut, the optimal facility location was the one that maximised profits. (Lambert and Stock, 1993)

Distribution worldwide (1976) magazine published one of the most comprehensive overviews of the warehouse site selection decision. The publication identified three primary considerations that needed to be examined when determining the site of warehouses: *marketing aspects*, *traffic* (transportation economics), and *location or consolidation* objectives. (Lambert and Stock, 1993)

Network models, are similar to planar models, with one important exception: possible locations are constrained in that they must be on or near a transport network. While planar models identify optimal facility locations anywhere in the plane, network models only locate facilities on various transport networks such as roads, shipping lines, rail lines, and air corridors. Therefore, the number of potential sites is more limited, although the sites determined by the model are more realistic (Lambert and Stock, 1993).

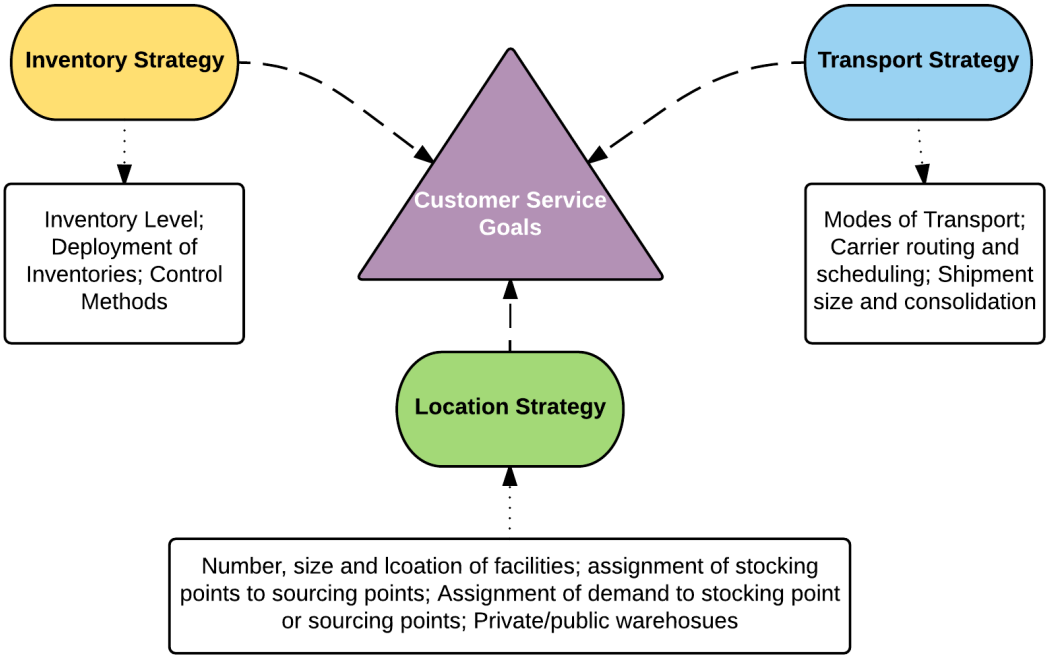
3.3 Facility Location Strategy

Facility location background represents the base for analysing in detail the potential warehouse/DC; several elements will be investigated and analysed.
According to Richards (2014), the selection of a warehouse location requires multiple criteria to be assessed, including both quantitative and qualitative data.
Richards (2014) states that "*Locating a warehouse strategically and in the most cost-effective geographic location is one of the most important decisions a company will make.*"

The geographic placement of the stocking points and their sourcing points create an outline for the logistics plan. Fixing the number, location, and size of the facilities and assigning market demand to them determines the paths through which products are directed to the marketplace. The proper scope for the facility location problem is to include all product movement and associated costs as they take place from plant, vendor, or port location through the intermediate stocking points and on to customer locations. Assigning customer demand to be served direct from plants, vendors, or ports, or directing it through selected stocking points, affects total distribution costs. Finding lowest-cost assignments,

or alternatively the maximum profits assignments is the essence of facility location strategy Ballou (1999, p. 34).

Image 3.2 The Triangle of Decision making



Source: Ballou, 1999, p. 34 and re-elaborated by the author

For example, in a firm's fulfillment centres, because of the nature of deliveries, an important criterion is the need to be located near to the motorway network to delay the latest collection time from the parcel companies and therefore enable companies to introduce a later order cut-off time for next day delivery (Richards, 2014).

For instance, in the case of the Inland Empire, Los Angeles port, the location decision for distribution centres depends on the availability of relatively low-cost land as well as skilled and relatively low-cost labor; easy access to transportation in terms of delivery, so that proximity to the ports is a consideration; *good* means of transportation (roads, railroads, airports) from the DCs to the destinations for delivery; and *proximity* to population centres where large proportions of the goods are to be delivered. (Bonacich and Wilson, 2008, 135).

Mulcahy (1994) specifies that here are three basic types of site selection project:
1) International
2) Macro (national, state region or major city)
3) Micro (within a state, region, or major city)

International applies when an evaluation of the international site is conducted, because the company is looking to determine the best foreign country's new operation.

Five major economic factors are considered when selecting the international site: *transportation*, *labor*, *energy* and *utilities costs*, *taxes* and *incentives.*
On the other hand, the international site selection factors are 1) Value of the U.S. dollar and the host country's currency, 2) Stability of the host (foreign) government, 3) Stability of the host (foreign) currency, 4) Ability to take profits out the host country and availability of barter agreements, 5) Population attitude toward a foreign company, 6) Government attitude toward a foreign company, 7) Import and export regulations, 8) Availability of required materials handling equipment, 9) Free trade or most-favoured-nation status, 10) Culture and customs of the host country.

Macro site
The Macro (national, state, regional, or major city) site selection project reviews the quality of the factors for a region of the country or a particular state or city. The followings are considered: 1) Transportation costs: in a particular state or major city site selection project, identify the various metropolitan cities of interest to the company; 2) Census information; 3) Local government and business development agencies; 4) Professional associations and business in the area; 5) Labor availability and cost; 6) Taxes and Incentives; 7) Availability and costs of energy and utilities; 8) Building and land requirement costs.

Micro Site
Mulcahy (1994) suggests that if a company is in the retail business distribution, it must focus on a site selection process that includes a micro site selection project. In this case the company will identify the site that best serves all retail customers within a small geographic area. Several factors must be considered, such as store delivery transportation cost and time and land costs. Other site selection factors are considered fixed because the potential sites are within the same geographic area. These are labor, taxes, and utility and energy. The site selection project covers a 150-200 miles (241-321km) radius of a major city. Exact land size, building size, and the geographic location for the new operation are considered.

Mulcahy (1994) suggests several micro site selection methods, in order to determine the exact delivery time to all customers: 1) Serve a cluster of customers method, 2) Centre of gravity (demand pull or weighted average) method. Explained briefly the different methods:
- *Serve-a-cluster-of-customer method:* the project team choose a site that is reasonably close to most of the company's customers (delivery) locations. Ideally, the site is chosen is in the centre of the store (customer) cluster. This location rude the delivery trucks traveling time and miles from the distribution centre to various customer locations within the cluster.
- *Centre-of-gravity (demand pull or weighted average) method:* it is a systematic and detailed site selection method. This site location is at the centre of gravity and is ideal for the distribution centre.

According to Watson et al (2013), in order to estimate the distance in miles between any two latitude and longitude points the following equation is considered:

F 3.1) $$Dist(mile)_{ab} = 69 * \sqrt{(Long_a - Long_b)^2 + (Lat_a + Lat_b)^2}$$

Dist(mile)$_{ab}$ is the distance from *point a* to *point b.* Long$_a$, Lat$_a$, Long$_b$, and Lat$_b$ are the longitudes and latitudes expressed as decimal numbers of point *a* and point *b*, respectively. (to calculate in km, simply change 69 to 111) (Watson et al, 2013, p. 26).

Instead the mathematical formula for physics centre of gravity (or the weighted average location) are the followings **F3.2** and **F3.3.**

F3.2) $$Lon_{cap} = \sum_{c \in C} P_c Lon_c \; / \sum_{c \in C} P_c$$

F3.3) $$Lat_{cap} = \sum_{c \in C} P_c Lat_c \; / \sum_{c \in C} P_c$$

Here *Lon* represents a city's longitude, *Lat* represents its latitude, and *P* represents a city's population (Watson et al, 2013, p.27). In the analysis section the population is used as the weighting factor (also suggested by Watson et al, 2013) because in *network problems*, customer demand is the most common. In other cases, the authors suggest that the many different weighting factors can be used.
It is confirmed by Watson et al (2013, p.31) that the alternative centre of gravity (COG) is the point that minimise the average distance traveled, among the selected points. The choice of selecting alternative centres of gravity is due to the fact that the first one might be located in shark-infested waters offshore from a mountainous and desert region (*probably not practical).* (Watson et al, 2013)

Reinforcing the elements mentioned by Mulcahy (1994), Richards (2014) confirms, first of all, that many companies look at the location and size of customers; then the environment will also play a part in the decision-making process. The decision making process about warehouse location is influenced by the following factors:

- goods traffic flows
- travel minimisation
- cost of land, rent and rates

- access to transport networks
- proximity to ports and airports
- availability and cost of utilities
- labor availability, availability of affordable skilled labor
- the potential neighbours (e.g. proximity to oil storage depots can be a negative factor).

A report by DTZ (2013) stated that the global top five least expensive markets for warehousing are dominated by the Chinese Tier II cities of Wuhan, Shenyang and Chengdu, with Atlanta and Marseille completing the top five. Meanwhile, London Heathrow remains the most expensive area globally – at US $313 per square metre per annum, followed by Hong Kong, Zurich, Singapore and **Oslo**.

According to Savills (2013) survey, the top nine requirements for e-retailing operations in terms of location were as follows:
- land/rent/lease costs
- access to affordable labor
- expansion space available
- close proximity to parcel hub
- close to motorway network
- central location
- close proximity to consumers
- government incentive
- close proximity to higher skilled labor.

3.4 Strategic Issues Affecting Warehousing

NCFRP (2013) highlights that *Freight facilities* will only consider locations that fulfill the primary objective of moving goods in the most efficient manner from point of origin to destination.
Companies and carriers rarely base location decisions on personal relationships, government incentives, or regional promotions. These factors are only a consideration after a location meets the required criteria for the business to be successful.
Local officials can make their communities more attractive to freight facilities by providing a hospitable climate through appropriate zoning, compatible land use, transportation infrastructure, and community support.
When companies evaluate sites, some criteria are far more important than others. The ability to access key markets, availability of efficient transportation, sufficient qualified labor, and total costs are considered key criteria.
Proximity and/or access to markets is the most important driving factor that determines the region or community in which a freight facility will locate.
Freight location decisions rarely respond to a “build it and they will come” approach by the public sector, yet it is also true that having the necessary support infrastructure in place can be a great incentive if the location is a good one and other factors are positive.

Companies will first examine their current and future needs internally and then develop a planning framework to determine how best to address these needs externally.
Site selection decisions typically involve at least the following four steps:

- Defining the company's business strategy and the success parameters for the new (or relocated) facility.
- Developing the site selection criteria, usually phased in such a way as to allow a progressive evaluation from broad to specific, region to community.
- Examining the communities and sites directly through on-site visits.
- Involving three to four sites and communities in detailed discussions and negotiations.

As noted above, location planning is methodical and iterative. Factors will vary in importance throughout the process. For example, access to specific markets, costs, and population trends may drive the early stages.
A *secondary screening* may involve examining highway and rail networks to determine areas with service advantages.
The location selection process for any freight facility begins with the *identification* of a need. This need may arise from the desire to serve a new market, to merge facilities acquired from another company, or to respond to a change in market conditions.
Furthermore, proximity and/ or access to markets, especially supply chain networks, is the single most important factor in determining the location of a freight facility. Most of the other site selection factors are used to refine the site selection process to specific, sometimes competing, sites.
Access is expected to accomplish two things: 1) delivery service with speed, predictability, and precision that matches or exceeds the competitive standards in the market and 2) costs that are as low as possible.
Retail companies often establish their distribution networks on a concept of overlapping circles, each with a radius of approximately **500 miles**. Beginning with the factory, this builds a supply chain that allows for a one-day drive to the regional distribution centre, then the local distribution centre, and finally to stores located in major consumption areas.
The ability to service a particular customer within a one-day drive is a common service expectation and location consideration. This requires both physical proximity to the customer and a location within the transportation network, which permits ready movement to the customer's facilities. For a city terminal being operated for pickup and delivery by a truck fleet, customer proximity is substantially shorter and the density of customers in the region greater. These facilities are situated to minimize total miles within a few-hour service radius and require an investment in trucks as well as terminals.

Depending on the facility type and the markets to be served, access to more than one mode of transportation may be required. Communities that successfully attract freight facilities are able to efficiently connect points of production or ports of entry to consumers.
Freight facilities are located near key transportation channels such as:

- Areas or sites on major highways.
- Areas where multiple interstate highways converge.
- Railroad terminals at the edges of their network or at key consumption markets.

- Major sea and airports.

Distribution centres usually need to operate on a **24-hour basis**, yet a community may have regulations that restrict hours of operation or prohibit truck traffic on a strategically located route. Decisions about what mode to use for goods movement are unique to each shipper, receiver, and carrier but generally reflect direct transportation costs, reliability, and travel time. These factors can vary greatly by mode and region depending on transportation infrastructure, available freight carriers, size of the market, and quality of freight service.

Third-Party Shippers
Instead of co-locating or locating near specific freight infrastructure, some freight businesses will rely upon and perhaps locate near third-party shippers or third-party logistics (3PL) companies. For example, large retailers who ship most of their own merchandise through their distribution centers may also rely upon commercial carriers such as FedEx or UPS to ship small packages, such as jewelry, directly from central distribution to their stores.

3.5 Warehouse Vs DC

A classification and explanations of warehouses is due, in order to better understand the type of infrastructure and its utilisation by the most appropriate player in the supply chain.
Watson et al (2013, p.8) identify the classification for “warehouse” infrastructure by different needs:

- *Distribution centre* (DC), typically refer to a warehouse where product is stored and from which customer orders are fulfilled. For instance when a customer order a product, the DC will pick the items from the inventory and ship to the customer. This type of facility is also called *mixing centre* because it “mix” products from many locations, so the customer can place an order form one single location.
- *Cross-dock warehouse*
- *Plant Attached Warehouse*
- *Hub Warehouse or Central Warehouse*

Rodrigue (2016f), specifies the **Distribution Centre** as the facility or a group of facilities that perform consolidation, warehousing, packaging, decomposition and other functions linked with handling freight. The main purpose is to provide value-added services to freight, which is stored for relatively shorts periods of time (days or weeks). DCs are often in proximity to major transport routes or terminals. They can also perform light manufacturing activities such as assembly and labeling. A **warehouse** on the other hand is a facility designed to store goods for longer periods of time. Therefore, a distribution centre tends to focus on demand while a warehouse is more driven by supply.
From a locational standpoint, distribution centers mainly rely on trucking, implying a preference for *suburban locations* with good road accessibility supporting a constant

traffic. They service regional markets with a 48-hour service window (lead time) on average, implying that replenishment orders from their customers are met within that time period. Another trend has been the setting of *freight distribution clusters* where distribution activities agglomerate to take advantage of shared infrastructures and accessibility. This tends to *expand the added-value* performed by logistics.

3.6 The Warehouse of the Future

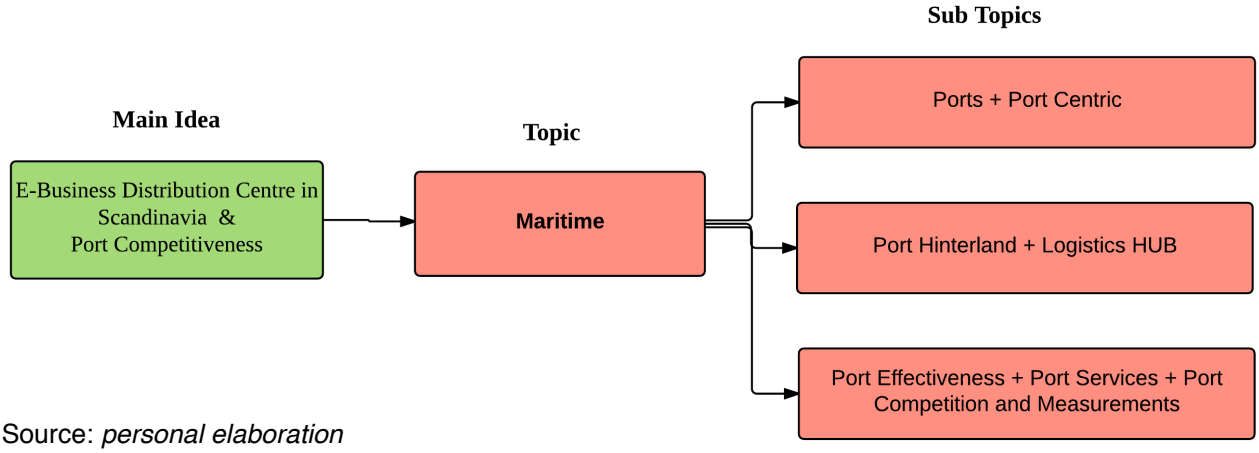
Richards (2014) refers to future warehouses and the forces affecting them as:

- The Global growing and ageing population
- The growing economies of not only the BRICS countries (Brazil, Russia, India, China and South Africa) but also those of the developing world where consumerism and the growth of the internet will put even greater pressure on consumer product manufacturers and their warehouses. Consumer awareness and demand for new products and services will continue to increase
- As economies grow and the population gets older there will be greater competition for staff
- Sustainability will play a significant role in supply chain operations in the future. The green lobby will look to the supply chain for initiatives in terms of alternative energy use, reduction in CO_2 emissions, reduction in waste, reduction in water usage and the use of alternative forms of transport. This will include intermodal transport initiatives as well as fuel-efficient MHE. Consumers and retailers will also be encouraged to source local products, leading to an increase in demand for neighbourhood warehouses
- Fuel and energy costs will continue to rise as fossil fuels continue to decline. Companies will look to warehouse automation and the use of greener vehicles whilst developers and warehouse operators will be encouraged to consider solar panels, wind turbines and the use of waste product for energy production
- The potential introduction of government taxation initiatives to encourage companies to reduce their impact on the environment
- An increasing pressure on companies to collaborate and share resources
- Technology will continue to improve, evolve and become more affordable
- With the growth in e-retailing there will be more fulfillment and returns centres as opposed to warehouses
- The current trend seems to be towards greater centralization of warehousing, with retailers building bigger sheds with more automation, replacing smaller regional centres.

4. BACKGROUND - MARITIME

This section focuses on the maritime sector, where the major players are Ports and shipping lines. Particular focus is placed on port operations, port efficiency, port effectiveness, port hinterland, port services, port-centric logistics, and the choice of shipping lines to select the most appropriate port according to several conditions.

Image 4.1 Maritime Literature Investigation



Source: *personal elaboration*

4.1 Ports as a Valuable Step in the Logistics Chain

Ports have become the most important logistics link in the production, distribution and consumption chains of economies worldwide (Sanchez, 2006) and parts of intermodal networks, with competition increasingly taking place between complete logistics chains instead of between ports (De Lange and Chouly, 2004). The competitiveness of ports within logistics chain is thus a much higher priority than it was before.

The developments in the logistics and port environment have created the need for ports to be part of wider logistics networks and to provide value-added services (Verhoeven, 2010). In an era of economic globalisation ports are evolving rapidly from being traditional land-sea interfaces to providers of complete logistics network (UNESCAP and KMI, 2005), a value-added logistics services (Bichou and Gray, 2004) and their pre-eminent role in international distribution is unlikely to be challenged in the foreseeable future (Notteboom and Winkelmans, 2001).

Seaports can evolve from a pure import/export and transshipment centre to a complex of trade and industrial functions within a logistics system (IAPH, 1996; UNESCAP and KMI, 2005). They are the value-adding transfer points (Notteboom, 1998) and central links in complex supply and logistics (Banister et al, 1995) and transport chains, providing seamless transport facilities (Branch, 1986) with a strong interface with other modes of transport services (Branch, 2007; Song, and Panayides, 2012). According to de Langen

(2004) seaports should be regarded as logistics centres, industrial zones and centres of trade. Branch (2007) and Nottemboom and Rodrigue (2005) state that the **free trade zone**, the inland **clearance depot**, the **freight village**, **container freight stations** and "**distriparks**" are the components of ports as trading and industrial centre with an increasing role in global supply chain management and logistics network structures (UNESCAP and KMI, 2005). Woo and Pettit (2009, p. 3) redefine port-supply chain integration as "a strategy undertaken by a seaport terminal to integrate various functions and organization in a supply chain to become an integral part of the supply chain.

Panayides (2006) for example notes that: [. . .] *the demand for maritime transport nowadays cannot be solely considered to be a derived demand emanating from the need for products, but rather as an integrated demand emanating from the need to minimise costs, improve reliability, add value, and a series of other dimensions and characteristics pertaining to the transportation of goods from the point of production to the point of consumption*.
Bichou and Gray (2004), propose a channel approach and conceptualise the role of ports from three perspectives: **logistics channel** perspective, where the port serves as an intermodal transport intersection and operates as a logistics centre; **trade channel** perspective, where the port acts as a key location where channel control and ownership can be identified and trading take place; and **supply channel** perspective, where the port not only links outside flows and process but also creates patterns and process of its own (Song, and Panayides, 2012, p. 237).

Botha and Ittmann (2008) describe the role of seaports as major components in determining the competitiveness of a nation's economy, and there is a close relationship between development and expansion of seaports and economic growth. Ports constitute a critical link in the supply chain, with their level of efficiency and performance influencing a country's competitiveness (Cullinane and Song, 2002). Tongzon (2007) provides nine key determinants to be a successful port (and also logistics hub): *port operations efficiency level*, *cargo handling charges*, *reliability*, *port selection preferences of carriers and shippers*, *the depth of the navigation channel*, *adaptability to the changing market environment*, *landslide accessibility*, *product differentiation*, and *government role* (including government support, and law/regulation). Compared to the past, today's port authorities are focusing on **efficiency** rather than **effectiveness**.
In order to develop maritime transport as an integrated part of the logistics and supply chain management system, ports have to simultaneously work in several directions simultaneously, by taking into account the requirements of the sender and receiver of goods (such as physical accessibility from land and systematic organisation of the information flow, which affect the choice of seaport) as they become their business partners in addition to the traditional ones (such as shipping companies, terminal operators, and forwarding companies) (Song, and Panayides, 2012, p. 201).

There are cases worldwide where some ports have plenty of idle land-side space available which in the absence of other uses can be used for container storage; others ports, rather, with limited space and good land-side transport linkages may choose to maximise the available space for warehousing, distribution and light manufacturing.

Ports have evolved from being simple transshipment points and can provide a range of services and activities to support the wider supply chain. This can benefit supply chains by making them both more efficient and effective, while allowing ports to become more profitable (Mangan, Lalwani, and Fynes, 2008).

Cullinane (2011, p. 323-324) clarifies that choice of port corresponds to the choice of alternative logistic chains or routings. The level of decision-making can be distinguished:

1. The level of locations (trade generation) concerns:
    a. location of industries, number of goods produced
    b. total of imported and exported goods per firm or region
2. The level of relations (trade distribution) concerns:
    a. the choice of trade partners
    b. the assessment of trade relations between regions
3. The level of operations concerns:
    a. the choice of transport mode, scheduled versus non-scheduled, choice of transport route and vehicles size.

Chen (2001) also points out that modern ports depend upon the availability of efficient infrastructure and inland connections, as a part of global transport system. Chen (2001) highlights the ability of logistics and transport operators to contribute to value creation and moreover to accomplish the qualitative attributes of customer demand (such as reliability, frequency, availability of information, security, etc.) (Song and Panayides, 2012, p. 201).

4.2 Port as a Logistics Centre

Johnson and Wood (1996) view a logistics centre as a cost reduction centre, defined as a facility where commodities move constantly to the end of circulation and the warehousing other relevant costs are reduced as much as possible (Song, and Panayides, 2012: 196). An UNESCAP report (2002) states that a logistics centre should be equipped with all the public facilities necessary to carrying out all logistics-related activities. Logistics centres serve a variety of purposes including cargo transshipment, production synchronisation and facilitating business and trade, and others aiming to strengthen the logistics capability for transforming a region into a more attractive or competitive market. However, fundamental requirements for a logistics centre include being on a nodal point of the transport network, common infrastructures, inter-modality, and logistics and transport services (Bhutta et al, 2003). Over time there have been changes to how things are stored, produced and moved, which have been significant for the development. The logistics facilities concept could, however, be derived from three different perspectives such as a *traditional logistic*

and supply chain perspective (distribution centre or warehousing), a *freight transport* perspective (load centre, freight village and transport node point), and a *foreign direct investment* perspective (international logistics zone and international free trade zone) (Song, and Panayides, 2012, p. 196).

Different definitions of a *distribution centre* are provided by Bowersox (1968), and by Reynaud and Gouvernal (1987). Firstly, Bowersox define it as *a physical facility used to complete the process of product line adjustment in the exchange channel, and its primary function is placed upon product flown contrast to storage.* Reynaud and Gouvernal, by contrast, expand its simple warehousing function into transportation that is defined as a *place where the consignments from different origins are grouped or split, and is above all transportation organisation centre, located at a nodal point in the logistics system.* Riming and Grundey (2007) define the ***freight village*** as *the defined area within which all activities relating to transport, logistics and distribution of goods, both for national and international transit, are carried out by various operators.*
It is claimed that there are four requirements for a freight village: it must allow access to all companies involved in the logistics activities in order to comply with free competition rules; it must be equipped with public facilities including staff and equipment; it should be preferably be served by a multiplicity of transport modes (e.g. intermodal transportation); and it is imperative that a freight village be run by a single body, either public or private (Europlaform, 2004).

4.3 Port-centric Logistics

Referring to the latter part of the previous paragraph, Robinson (2002) introduces the concept of value chains in the port environment and discusses the notion that competition takes place along the value chain (logistics chains) and not between individual ports.
Song, and Panayides, (2012, p. 240) argue that ports contribute to the supply chain through the creation of competitive advantage and value-added delivery.
Mangan et al (2008) define port-centric logistics as 'the provision of distribution and other value-adding logistics services at a port' (p. 36); they specify that higher profit margins can be made by the provision of non-core port activities in **port-centric logistics services.** Ports are increasingly recognising that higher profit margins can be made on some non-core port activities and this is driving them to engage in activities beyond simply providing berths for ships and other core port services (Falkner, 2006; Wall, 2007; Analytiqa, 2007). Carbone and De Martino (2003, p. 306) define value added service as "an activity along the chain that adds value to the product or service and which the final customer is willing to pay"; these services vary from simple processes such as packaging, labelling and bar-coding to more complicated processes such as inventory management and quality control (UNESCAP, 2002). By offering value-added logistics services, ports aim to attract a large portion of the value-added creation within product and logistics chain (Notteboom and Winkelmans, 2001; Paixao and Marlow, 2003).

Mangan, Lalwani, and Fynes, (2008), refer "[…] ports can be quite heterogeneous in terms of their traffic mix and the potential for port-centric logistics activities is likely to vary significantly among ports; […] the potential for port-centric logistics activities is not just limited to container terminals at ports located close to end customers."

It is now generally accepted that supply chains, and not individual firms or products, are the basis of much marketplace competition (Christopher, 1992). Transport services (links in supply chains) and transport infrastructure (nodes in supply chains) are key elements in efficient logistics systems. Maritime transport (comprising ports as nodes and shipping services as links) is the dominant mode for international freight movements and is thus crucial to international trade and a vital component of many supply chains (Marshall, 2005).

Notteboom and Rodrigue (2005) argue that current patterns of (inland) distribution centre location ignore the fact that most of the freight that passes through these distribution centres first passes through a port. Therefore, they argue that it is logical (and often times easier in terms of land cost, lack of congestion, etc.) to locate such distribution centres at ports. The approach in-port distribution centres is not in conflict with the regionalisation approach (connections to inland distribution centres) advocated by Notteboom and Rodrigue (2005). It has also been recognised that the gateway position of major seaports offers opportunities for the development of value-added logistics and other activities proximate to ports. *Port clusters* (de Langen, 2002) have thus evolved which Haezendonck (2001) defines as: [. . .] *the set of interdependent firms engaged in port related activities, located within the same port region and possibly with similar strategies leading to competitive advantage and characterised by a joint competitive position vis-a`-vis the environment external to the cluster*.

Pettit and Beresford (2009) refer to the potential benefits of port-centric operations in order to earn extra revenue from activities carried out on port's land; and, moreover, and element in considering the port's attractiveness is how much land is available and the quality of hinterland connections.
Port-centric strategy users highlight the opportunity to cut supply chain costs, reduce carbon footprints and improve customer service. (NEP, 2012)

Browne (2010), specifies that port-centric logistics eliminate the costs of double handling; and the recent recession, has forced companies to rethink their freight-handling and transport strategies, simplifying the complex supply chain, adopting a port-centric logistics approach.
According to Paul Barker, PD Ports development director "Port-centric logistics works on the principle that it is faster, more cost-effective and certainly more environmentally friendly to set up a distribution centre at the port(s) and distribute directly to the local region from there." (Brown, 2010); the positive effects of port-centric activities, eliminate the fuel and labor costs of double-handling - carrying goods from port to distribution centre and from

distribution centre to end user (ibid).

Monios (2011) states “Now that the majority of products come through ports, it may not be efficient to haul containers to a central location and then send the contents outward again.” Certainly, the port might incur in conflicting strategies, as affirmed by Monios (2011), between inland intermodal terminals and port-centric logistics, because when an inland intermodal terminal is used, containers are transloaded from rail to truck then taken to RDCs for stripping, then trucked empty back to the depot at the inland terminal (or maybe another depot); by contrast, if the customer is located within warehousing/logistics areas adjacent to the terminal, the container can be stripped and the empty container can return immediately to the onsite depot, as a consequence of these activities, stock can then be picked and put on trailers direct to stores rather than via a diversion to a central DC.
One advantage of establishing a distribution centre at a port is that it cuts down on the number of empty (return) containers on roads by “stripping” (e.g. emptying) imported containers at the port. This also allows faster repositioning of containers to another port where they are required.

In the article Port-centric logistics (2009), port-centric logistics was referred as the “new” industry standard, challenging much of the conventional wisdom of inland cargo movement and creating a broader approach to hinterland distribution. This approach evolved into a series of mature relationships with importers and cargo owners, together with third-party operators and ensures that the very best supply chain solutions are specified and consistently delivered.
For instance Hutchison's UK ports have established themselves as leaders in the field of global logistics, acquiring a unique position, because they tailored a package of logistics services to meet and perhaps exceed the needs of cargo owners.
Ports are not a static element or player in the entire supply chain, as stated in the aforementioned article, ports continue to work closely with both shippers and consignees in challenging the traditional model of logistics. The positive consequences of this challenge, has been the reduction of expensive and wasteful practices, early visibility, fast-tracking, elimination of demurrage and the reduction of inventory levels.

According to NEP (2012), the positive consequences of port-centric logistics will only be found if people consider the entire logistics chain. Players only look at the distribution from DC to the retail store; that is where all the sophisticated figures are and the costs calculated. But people don’t take into account the empty containers going back to the port. Someone has to pay for that. It adds to the cost and when you overlay with the carbon footprint issue, that is when the business case gets stronger, when people look at the total picture rather than one or two legs of the chain.

4.3.1 Examples from the United Kingdom

The United Kingdom is recognised as being well-organised in terms of port-centric activities. Most of the ports across the country reorganised logistics and efficient distribution systems in order to satisfy customer demand.

Several actors in the UK confirm the benefits coming through of the port-centric idea, one of those is Perry Glading, Chief Operating Officer, Forth Ports, who believes that port-centric ideas can be applied to a much broader range of cargoes and supply chains: "*When people talk about port-centric, they get carried away with it only being for imports of containers. We believe it is about how you use the port as a centre for both import and export. It is about broadening the role of the port. We talk about 360° port-centric logistics: the port sits in the middle. Too many people have a vision of going in one direction, but it isn't, and exports from the UK are growing. It is how you use your port to add value. You either don't touch the cargo and it goes straight through, or you add value in and out*." (NEP, 2012)

Many medium-sized ports in the UK are pursuing port-centric logistics as a way of competing with larger ports. Indeed, even large ports like **Felixstowe** are using this strategy where possible and the new development at London Gateway is designed as a port-centric operation (Monios, 2011); at Felixstowe there are 70,000m2 of warehousing located within the HM Revenue and Customs wharf-approved area. (Port-centric logistics, 2009)

For instance Bapgroup (2016) and PD Ports (2016) offer a wide range of services from the port-centric perspective, such as in the north-east, PD Ports has been a leading advocate of port-centric logistics, making use of its very significant land bank at **Teesport**; the port counts more than 3.5 million ft^2 of warehousing (equivalent to 325,000m2 or 32,52 hectare) on the port estate or close to the port, occupied by shippers using the port for import/ export activities; at the same port, retailers such as ASDA and Tesco have positive effects on their logistics activities. (NEP, 2012). Stephen Taylor, Director of Port Centric Logistics Partners, says: "Land has always been a key issue for port-centric logistics"; so, land is a positive influence on the success and competition of the port. As a consequence, the proactive development of port-centric logistics at English ports such as Teesport will exert a strong influence on the future directions of logistics in Scotland.

Forth Ports is investing heavily in the rebranded London Container Terminal at the **Port of Tilbury**, which handles deep-sea, short-sea and feeder services. At the same time, work has started on Tilbury's new London Distribution Park, north of the existing port estate. This will add another one million ft^2 (92,900m2 or 9.29 hectare) of warehousing to the port's already substantial supply of five million ft^2 (464,500m2 or 46.45 hectare) on the port estate. (NEP, 2012)

An example of port-centric logistics onshore is the warehousing developments at the **port of Grangemouth,** which has received government funding, indicating government support for a strategy of port-centric logistics whereby the port authority is aiming to develop retail business at the site (Monios and Wilmsmeier, 2012).

The **Port of Tyne** has focused on the port-centric concept, which it has historically promoted as a one-stop shop approach, incorporating quayside handling and elements such as warehousing, stock control, picking and packing, distribution and haulage (NEP, 2012).

London Gateway Logistics Park

According to Stephen Taylor (NEP, 2012) and Londongatway.com (2016), the impact of DP World's (DPW) London Gateway investment will be a big factor in the logistics network. The new deep-sea container port on the Thames, comes with the benefits of a 10 million ft2 (929,000m2 or 92.9 hectare) logistics park being developed alongside. Several retailers invested in the logistics park such as Marks & Spencer, announcing plans for a £200 million warehouse development. In the opposite site, DPW announced that the park will include a purpose-built common user facility (CUF). This will ensure that all shippers, whether leading retailers or SMEs, can take advantage of the port-centric opportunities.

Peter Ward, Supply Chain Commercial Manager says: "The potential supply chain cost savings in terms of primary and secondary distribution for occupiers of the logistics park are compelling". Stephen Taylor, regarding CUF says: 'Building a CUF for port-centric is a great move for SMEs engaged in international trade; as Tesco and ASDA already did […].

According to Importservices.co.uk (2016), the port-centric model is optimum for the new world of retail logistics, confirming that port-centric retail logistics with import services, is the answer to certain business activities. For instance, in Southampton the distribution centres allow stock to be held, free of duty and VAT, until sold to market in the EU or transhipped, to external markets still under bond; at last some help to ease company's cash flow.

It is mentioned that if the company is located in Southampton and the order is B2C, 3PL will move with agility and speed for next day delivery, straight from the container port facilities, to the customer's home. Port-centric with Import Services means that the carton delivery is processed with thousands of other orders on the day. All orders moving from the port warehouses, in full trailer loads, directly to the parcel hub for sortation and onward delivery via integrated parcel carriers.

Retailers are particularly keen on Port-centric logistics, which helps rationalise deliveries into their DC's, cutting supply chain carbon emissions and allowing a significant tick in the environmentally friendly box, for all concerned (ibid).

4.4 Port Hinterland

Port Hinterlands have been described as captive and contestable (de Langen and Pallis, 2005). A captive port hinterland is a region, where a single port has a competitive advantage (e.g. lower prices for freight trips) over other ports in handling the region's cargo. A contestable hinterland is a region where no single port has a clear competitive advantage over competing ports. Port terminal operators have greater (less) bargaining power versus port users when their ports have captive (contestable) hinterlands; operators are more likely to charge relatively high (low) port prices when port hinterlands are captive (contestable), e.g. high (low) rent extraction. The bargaining position of port service providers versus shippers is generally stronger than that of port service providers versus shipping lines. The rationale for the latter is that shipping lines have larger volumes of cargo (from consolidating different origin-destination cargoes) that strengthens their bargaining position in the bargaining process. Port hinterlands have also been described as captive and overlapping (shared by more than one port) hinterlands.
Ports with overlapping hinterlands compete for the overlapping hinterland market. However, a port with a large hinterland can also compete and be more competitive in computing for the overlapping market (Zhang, 2008). Specifically, a port with a large captive hinterland will 1) allow for more frequent services by shipping lines, 2) facilitate the growth of third-party logistics providers and freight forwarders, 3) allow shipping lines to use larger ships, deriving cost economies of ship size at sea, 4) yield higher ship utilisation, and 5) allow more value-added clusters to be developed. The higher traffic density at the port will in turn, among other things, lower shipping rates to and from the port, thereby making it more competitive in competing for the overlapping market (Talley, 2009, p. 143).

Zhang (2008) states that a larger port hinterland allows for a larger size of ships being attracted, thus realising economies of ship size (Jansson and Shneerson, 1987), higher frequencies of service realising **Mohring effects**, stronger roles as load centres, better availability, of third party logistics service providers and more value-added clusters (de Langen, 2004).

4.5 Logistics HUB

Song, and Panayides (2012, p. 203) give this definition: "*A maritime logistics hub is 1) a nodal point of cargo transit or transshipment assuring flawless door-to-door cargo movements, 2) a principal distribution centre functioning as a temporary storage and sorting, and 3) a place creating and facilitating value added services on a regional and/or international scale*."

Europlatform (2004) provides a precise definition of logistics centre: *the hub for a specific area where all the activities relating to transport, logistics, and good distribution, both for*

national and international transit, are carried out, on a commercial basis, by various operators.

This pattern drives companies to consolidate shipments on a large scale at major terminals (e.g. hubs) and to redistribute smaller shipments to their respective destinations via radial links (e.g. spoke). This concept has been introduced in the supply chain section.

The development of international trade and industrial distribution patterns has impacted on the development of logistics facilities as they have been recognised as main strategic contributor to achieving competitiveness and attractiveness (Cullinane and Song, 1998).
In the 1990s, the hub concept became the primary distribution model employed by logistics integrators as DHL, TNT, UPS, FedEx and leading international carriers. Shipment coming from several origins are consolidated at major terminals (e.g. hub) and redirected to their respective destinations through radial links (e.g. spoke) (Cavinato, 1989). In the field of logistics and supply chains, however, the hub concept has often been introduced under various terms according to its functionality of storage and transportation: *logistics centre, logistics zone*, *freight terminal*, *distribution centre*, *warehouse*, *intermodal terminal*, *international transport terminal*, and so on (Song and Panayides, 2012, p. 195-196).

4.6 Port Services

According to Worldbank (2001) port services definition, there are two types of activities carried out by ports: core (traditional port) and value-added (non-traditional port) services. **Core services** consist of *marine* (e.g. pilotage, towage, and vessel traffic management services), *terminal* (e.g. vessel tie-up, container storage and container stuffing and stripping), and *repair services (*i.e dry dock ship repair, container repairs). **Nontraditional port services** “create value for shippers by expanding the scope of markets that they can economically access, by reducing the delivered cost of products they sell, or by reducing the cost to complete buy/sell transactions” (Worldbank, 2001, p. 10). Non-traditional port services (e.g. information, office and equipment rental, equipment maintenance services, and freeport zone) typically add value to the logistics activities, e.g. inventory management and warehousing, of shippers (Talley, 2009, p. 44).

Customers now tend to look at value-added logistics services as an integral part of their supply chain. As a result, ports must attempt to satisfy these needs by offering differentiated services (Song and Panayides, 2012, p. 201). The importance of a number of logistics value-added services (such as consolidation, packaging, labelling, assembly, economic processing, contingency protection, and operation efficiency) is assessed by various different authors (Song and Panayides, 2012).

4.7 Port Choice and Shipping Lines

Several factors influence the shipping lines routes, or port choice; one such factor is port consignment size, the greater the likelihood that a shipping line will have its ships call at a given port (Talley, 2009, p. 65).
A shipping line's liner (scheduled service) pricing policy will also affect whether a port is included in a ship's transportation network. Equalisation liner pricing is a port-to-portlier pricing scheme whereby the freight rate (or price) for cargo is the same from any main port in a port range (on one end of a ship's round-trip route) to any main port in a port range on the other end. If the shipper is responsible for inland transportation costs to and from ports, the shipper would minimise total transportation costs (ocean and inland) by having the cargo shipped to the port that is nearest to the shipper's location.

The most prominent explanatory variables for port choice are ocean transport costs, inland transport costs, port costs and variables capturing quality of service aspects, such as **Mohring effects** (as mentioned earlier)**.** The demand elasticity of a port can be measured by applying logs models based on revealed or stated preferences. The demand elasticity is measured as the change of demand as consequence of an increase in port call cost consisting of port dues, marine charges and terminal handling charges associated with the shipment of one twenty-foot equivalent unit (TEU) in a port (Cullinane, 2011, p. 323).

Ports that can accommodate larger ships while maintaining fast ship turnaround times (e.g. time differences between ships entering and leaving a port) will likely see an increase in the number of calls by larger ships. Ports with relatively shallow water depths will likely experience a decline in ship calls over time as ships increase in size, conversely for ports with deep water. If a port in a port range charges significantly lower port prices to shipping lines than another port in this port range, the shipping line will prefer the less expensive port in this port range. Also, if one port has superior inland transportation connections, existing port relationships (or a service history), with a given shipping line, and closes access to trade lanes, the given shipping line is more likely to choose this port over another port in a port range. If one port in a range of ports is subject to less port government regulation (e.g. economic, safety, and environment regulation) than another port, the former will more likely be chosen as the port of call in this rage than the latter, all else held constant (Talley, 2009, p. 66).

4.8 Port Competition and Measurements

Port competition may be inter- or intraport competition. *Interport* competition is competition between different ports whereas *intraport* competition is competition among marine terminals. *Intraport competition will not be analysed in this research* because the main analysis concern the competition among the main ports located in Scandinavia as: Oslo, Copenhagen-Malmo and Stockholm.

4.8.1 Interport Competition

Notteboom and Winkelmans (2001) noted that inter-port competition has intensified, even among more distant ports, and point out that for example the competition between European ports situated in different port ranges has increased considerably in recent years.
Fleming and Baird (1999) pointed out that the real future competition will not be between ports and individual transport carriers per se, but between a handful of "total logistics chains". Indeed, Goss (1990), drawing upon Verhoeff (1981), discussed five different forms of competition which ports are subject to, namely – c*ompetition between whole ranges of ports or coastlines*; *competition between ports in different countries*; *competition between individual ports in the same country*; *competition between the operators or providers of facilities within the same port*; and *competition between different modes of transport*.

Fleming and Baird (1999), identify the characteristics influencing interport competition as the following:

1) *Port performance improvements*, with improvements in quality of service, the port time prices of port users are expected to be lower. By reducing its costs, the port is then able to lower its port prices.
2) *Port accessibility* by having superior sea and land accessibilities, a port's competitiveness relative to other ports is enhanced. A ship's transit time and costs such as pilotage and towage costs are less when a port is near the open sea. By having direct connections to highways, rail and inland navigation systems, a port's land transportation transit times for its cargoes will be less all else held constant. The competitiveness of ports is also enhanced if they are located near centres of consumption and production.
3) *Port tradition*: ports located in cities with a long tradition of supporting port expansion projects give rise to a culture of support for port improvement projects, especially when a competing port appears to be gaining an interport competitive edge
4) *Government assistance*: the greater the government assistance to a port, the greater the port's competitiveness relative to other ports. That is to say, the port will be in the position to reduce its port prices after receiving government operating assistance. The latter may include, for example, tax reduction, low costs loans, guaranteed loans, provisions of port infrastructure, and the fallout from government-funded research and development programs that benefit the port.
5) *Port Users Preference* by congregating larger volumes of cargo at fewer ports, the shipping lines (due to the larger cargo volumes at these ports) are able to obtain lower negotiated rates often not proportional to distance) from inland carriers an thus charge lower door-to-door rates (Talley, 2009, p. 140-141).

Major ports in China such as Shanghai and Shenzhen, are are feeling the effects of competition with the neighbouring ports as Hong Kong, Singapore and Busan (South Korea) (Sang-Hun, 2006; Wright, 2007). However as more capacity comes on stream,

ports are looking to attract other traffic, especially transshipment traffic, which passes through ports in neighbouring countries. These ports outside of China are pursuing a variety of strategies, such as developing tax free zones and developing facilities for value-adding activities within the port area, in order to retain their traffic from the onslaught of competition from ports in China.

Increasingly, ports are recognised as key components in determining the overall competitiveness of national economies. Cullinane and Song (2002) point out that ports constitute a critical link in the supply chain and that their level of efficiency and performance influences, to a large extent, a country's competitiveness. Similarly, Sanchez et al (2003) in the context of a number of Latin American countries, showed that port efficiency is a relevant determinant of a country's competitiveness and interestingly they add that, unlike most other relevant variables, port efficiency can be influenced by public policies.

4.8.2 Port Competitiveness

A port's competitive position (or its competitiveness) may be evaluated in terms of the growth, market share, and diversification of its traffic volume (Talley, 2009). An analytical tool that has been used to evaluate the competitiveness of a port (in a port range) that considers these factors is *strategic position analysis* (SPA). SPA includes: *Product portfolio analysis (PPA)*: Four levels of PPA have been used to evaluate the competitive position of ports in a port range (Haezendonck et al*,* 2006)

a. The overall market shares and total growth rates of the traffic volumes of ports in the port range are presented (external positioning analysis/portfolio of ports)
b. The market share and the growth rates of various traffic categories in a port's total traffic volume in the port range are described (internal positioning analysis/portfolio of traffic categories)
c. The port's market shares and growth rate at each commodity group in their total commodity groups in their traffic volumes in the port range are described (portfolio commodity groups)
d. Differs from the third level in that the shares and growth rates are within a port rather than within the port range

4.8.3 Indicator Port Performance

Port operate in different economic, social, and fiscal environments. For example, even if ports have the same economic objective of maximising annual throughput subject to a profit constraint, the profit constraint is likely to differ among ports. Also, one port may have a negative profit (or deficit) constraint that is to be subsidised, while another port may have a positive or break-even profit constraint. Ports may also have different economic objectives (Suykens, 1986). Thus, in a multi performance evaluation approach, where the performance of one port is compared to that of another, similar ports should be used

(Talley, 2009: 139). Port management and strategies are both directly and indirectly influenced by prevailing logistics trends, since the demand for port services is a double derived demand (Marlow and Paixao-Casaca, 2003). From the port industry's perspective, the shipping industry would be the party which has the most direct impact on it (Cullinane, 2011, p. 445).
According to Cullinane (2011, p. 439), the role and function of ports has evolved rapidly and has changed in the context of supply chains and logistics chains. Ports now operate in a new logistics environment focused on supply chain management, global sourcing and logistics outsourcing. Port operators and port authorities are adopting new strategies for improving service quality, such as strategic integration along the supply chain, customer-oriented practices and value-added activities, as well as improving operational efficiency, so that they can adapt to a more challenging logistics environment.

Talley (1994) identifies the criteria specification methodology for selecting port performance indicators:

1) *Conciseness* requires that the redundancy and overlap among selected indicators be limited;
2) *Consistency with objectives*: requires that the indicators be consistent with the port's operating objectives, e.g. they affect these objectives when their values change.
3) D*ata availability;*
4) Da*ta-collection time and cost*: the time and cost to be incurred in the collection of the indicator data should be considered in the selection of port performance indicators;
5) *Measurability*: requires that the selected indicators must be measurable, e.g. having a continuous as opposed to a discrete unit of measurement;
6) M*inimisation of uncontrollable factors* requires that the values of the port's selected indicators be under the control of port management;
7) *Robustness* requires: that the selected indicators allow for the port to be evaluated under various scenarios.

4.8.4 Port Efficiency

Port literature has focused on measuring efficiency while other transport modes such as air, road and rail put a greater emphasis on external perspectives such as customer orientation, reliability and service (Brooks, 2007).

It appears that a reduction of the average waiting time of vessels by one hour corresponds with a cost decrease of 46.4 Euro per TEU Handled. A reduction of the average hinterland transport transit time by one hour corresponds to a reduction in costs of 4.88 euro per TEU, which is nearly a tenth (Cullinane, 2011, p. 336).
In order to improve port efficiency, lower cargo handling costs and integrating port services with other components of the global distribution network, is the correct path according to Bryan et al (2006).

Port costs, for example, represent about 8–12 percent of total transport costs from product origin to destination. Shippers make shipping decisions in part based on those costs. Clark et al (2001) declare that port efficiency can affect transportation costs and that an inefficient port has the effect of increasing the distance to a shipper's export market by 60 percent. In a study of Asia-Pacific Economic Cooperation (APEC) countries, Wilson et al (2003) explore the importance of port efficiency relative to other factors that enhance or constrain trade, such as customs performance, the regulatory environment, and **e-business**.
Calculating indicators for each factor, Wilson et al (2003) found that improvement in port efficiencies yields the largest increases in trade flows; specifically, an improvement of just 0.55 percent in the port efficiency indicator has the same impact as 5.5 and 3.3 percent improvements in customs performance and e-business indicators, respectively. Improving those procedures can lower total transaction costs and thereby improve the competitiveness of a country's trade, and recent research suggests that better procedures can lower costs substantially.

4.9 Freeport Zone

An overview of FTZ is due because the PoG is interested in developing this area, in order to attract new companies.

Rodriguez (2016h), defines the Foreign Trade Zone (FTZ) is an area that is considered outside the customs jurisdiction of a country where cargo can be placed in a duty and tax free environment until ready to enter the country.
FTZ is a prominent value-added service. A freeport zone is a designated area (within or outside a port), where imported goods are stored and/or processed and exported - free of all customs duties (Firoz, 2003).

The main advantages of FTZ are thus regulatory and financial, which enables rather unique and flexible supply chain management practices Rodrigue (2016h):

1. **Custom clearance:** Done inland instead of at the gateway port (merchandises go directly to the FTZ); Simpler and faster; Consignment can stay for an unlimited amount of time in the FTZ; Consignee gets further advance notice that shipment is ready; Quotas can be managed through postponement.
2. **Duties and Fees:** Duties and merchandise processing fee not paid until the consignment is released and moved out of the FTZ (storage); Not paid if goods are exported or re-exported; Deferred if goods moved to another FTZ; Not paid for damaged, defective or obsolete goods; Lower insurance premiums since no duties.
3. **Settlement:** Vendors often not paid until consignments leave the facility for delivery (Delay settlement); Remove damaged or defective products from the settlement.
4. **Security:** Higher security level since under jurisdiction of national customs; Lower insurance premiums.

5. **Transformations and manufacturing:** Product remarked or labeled to meet national requirements; If transformation is performed in the FTZ, the duty class may change (Select the taxation regime); Added value activities performed in a FTZ not subject to custom duties.

A variety of activities can be undertaken in a freeport zone, e.g., packaging, assembling, cleaning, repackaging, sorting, testing, labelling, and combining imported goods with domestic goods or other foreign goods. Freeport zones boost the local port economy by employing labor and other resources and attracting foreign investment for the provision of freeport zone services. The goal of freeport zones is to maximise the value of transshipment cargoes (Feng and Hsieh, 2008).

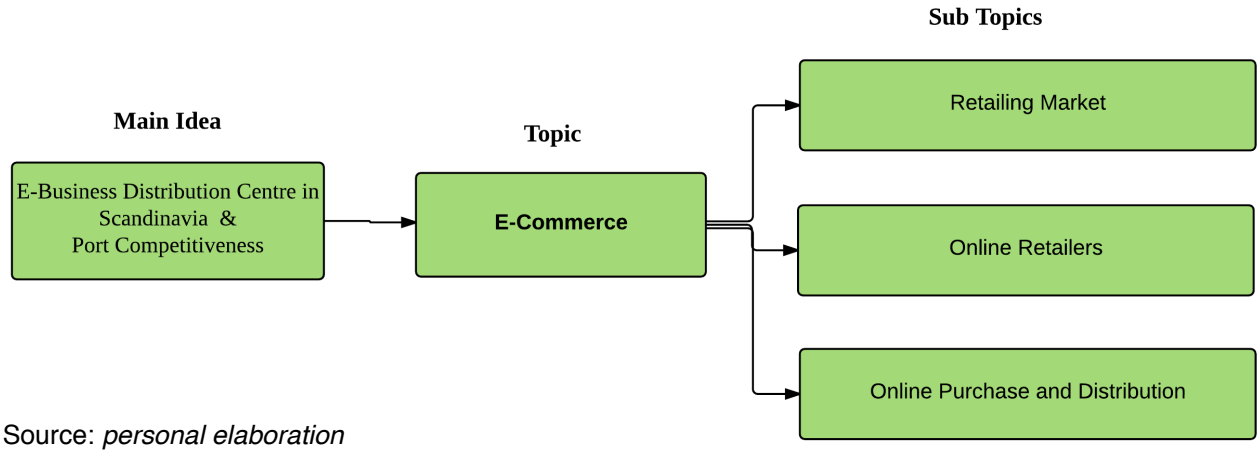
Several FTZ examples can be found in emerging countries:
- Shanghai (China): Airport bonded area, Yangshan (deep water area), logistic park area;
- Dubai (UAE) JAFZA (Jabel Ali Freezone Authority), where the following benefits are included: 100% foreign ownership, 0% corporate tax for 50 years (a concession that is renewable), No restriction on capital repatriation, 0% import or re-export duties, 0% personal income tax, No currency restrictions, No restriction on foreign talent or employees, Ability to mortgage your premises to a bank or financing company, Onsite Customs.

The NVO (non vessel operating common carriers), also known as OTIs (ocean transport intermediaries), in other words, the commoners that are handling the freight of a customer - can split out the cargo here and then have it cleared by customs. This is what is meant by cargo (or container) freight station bonding. The facility also provides bonded warehousing; for example, an importer of liquor can leave it indefinitely here and only pay duty on it when they move it out.
The site was also a foreign trade zone, or FTZ. As an example: *this mean that the goods have not yet entered the commerce of the Country. The FTZ enables firms to manipulate cargo.* (Bonacich and Wilson, 2008, 132)

5. BACKGROUND E-COMMERCE

This section provides an overview of retailers and online retailers characteristics, strategies, location and distribution centres in order to better perform activities that can satisfy customer demand in a short lead time; and some e-commerce definitions. Several parameters are taken into consideration when retailers select the e-consumers segment, the most appropriate country in which to focus their business activities.

Image 5.1 E-commerce Literature Investigation



Source: *personal elaboration*

5.1 E-Commerce Overview

Fernie and Sparks (2015, p. 205) define e-commerce as "[…] is the sale and distribution of goods and services via electronic means, has developed rapidly over the last couple of decades. There are a variety of e-commerce sectors including: business-to-business (B2B); business-to-consumer (B2C); business-to-government (B2G); consumer-to-consumer (C2C) and government-to-business (G2B)."

The e-commerce phenomenon will continue to grow both for business-to-business (B2B) and business-to-consumer (B2C) sectors. From a convenience point of view and under greater environmental pressure, grocery home shopping and delivery will also grow significantly (Richards, 2014, p. 21).

The author is primarily concerned with B2C e-commerce in order to support the location of online retailers' warehouses in the port area, port-centric warehouses for online retailers, contributing to a better distribution system across the country and internationally.
The increase in port-centric logistics has resulted in companies building large warehouses as close to ports of entry as possible. As mentioned, Tesco's 1.2 million square foot warehouse at Teesport UK is a typical example (Richards, 2014, p. 21).

According to the IMRG report (2011), the growth of e-commerce was closely linked to the development of internet usage. In 2000 there were just over 350 million internet users in the world, a figure that grew to over 2 billion in the next 10 years and is forecast to grow to 5 billion by 2015. By contrast, the Global Internet Report (2015) specifies that globally there are 3 billion internet users as at May 2015; the mobile penetration is forecast to reach 71 per cent by 2019; there are 192 countries with active 3G mobile networks, which cover almost 50% of the global population; Smartphone sales are the majority of mobile handsets sold worldwide; and tablet sales will soon exceed total PC sales. Considering the dedicated geographical area of this investigation - Western Europe (Sweden, Finland, Denmark and Norway included), internet users are 79 per cent of the population, the mobile internet penetration is about 64 per cent, and the 3G population coverage is 97 per cent.

According to Forrester (2013) online retail sales in the United States in 2013 reached $262 billion – a rise of 13 per cent over 2012's $231 billion; this represents 8 per cent of the total retail market and will reach $370 billion by 2017. In the United Kingdom online retail sales accounts for approximately 10 per cent of overall sales and is likely to grow between 10 and 15 per cent over the next few years. The growth in countries such as China is closer to 75 per cent (Richards, 2014). Instead, in the old continent, in Europe, 2014 e-commerce sales counted for 372.84 $M, in 2015 counted for 418.05 $M, and 458.98 $M (2016 forecast) (Statista, 2016).

Internetlivestats.com (2016) with data elaborated by International Telecommunication Union (ITU), United Nations Population Division, Internet & Mobile Association of India (IAMAI) and World Bank, statistics for the countries featured in this study are:

- Sweden: there are 9,169,705 internet users (93.1 per cent of population penetration)
- Denmark, with 5,479,054 internet users (96.3 per cent of population penetration)
- Norway, with 5,167,573 internet users (98 per cent of population penetration)
- Finland, with 5,107,402 internet users (92.5 per cent of population penetration)

This information supports the growth trend in e-commerce business, but a deeper investigation about the online sector continues in the analysis section.
The growth of broadband allowed faster download speeds and facilitated the growth of successful e-tail websites, as mentioned by Fernie and Sparks (2015).

Fernie and Sparks (2015, p. 207) pay particular attention to the problem with the B2C model compared with C2C and B2B models, because it entails trade goods that are tangible and need to be stored and transported to the final consumer. The two authors specify that market presence and brand identity are necessary ingredients to wean customers away from their traditional methods of buying.

Yet despite these apparent drawbacks, the ‘hype’ associated with this new form of trading led many analysts to discuss the notion of disintermediation in B2C markets.

5.2 E-Retailers Market Evolution

The fourth “P” of the marketing mix, *Place*, was traditionally centred on the wholesale and retail trade and how suppliers would channel their products to market (Fernie and Sparks, 2014, p. 36).
Despite all of the hype about international retailing, little has been written about the supply chain implications of the internationalization process. Sparks (1995) acknowledges that there are three main threads to understanding retail internationalization: *international sourcing*; *international retail operations*; and *internationalization of management ideas*.

Fernie and Sparks (2015, p. 24) highlight that retailers need to create market demand before investing in costly infrastructure.
One of the large changes in recent years has been the expansion of ‘reserve and collect’ and ‘click and collect’ type operations. It had been thought that internet shopping would be based around home delivery, but consumers have shown that they also value the ability to decide where and when they receive products. In *reserve and collect* type systems consumers seem to be using the internet to check local inventory before going to the store. In *click and collect* operations they are opting to have the order assembled at store and then collect it at a time of their choosing and convenience. For retailers such developments remove some of the issues of organizing home delivery, but emphasize the importance of having accurate and real-time stock and inventories as well as changing work practices. Similarly, the strong development of mobile and tablet computing and shopping has encouraged retailers to shorten their advertised delivery periods and in some urban areas to offer same-day or even two hour-delivery options. This poses real challenges for many retailers.
The same authors highlighted that times have changed and retail logistics has also changed. Retailers are the channel captains and set the pace in logistics. Having extended their channel control and focused on efficiency and effectiveness, retailers are now attempting to engender a more cooperative and collaborative stance in many aspects of logistics.

In 1996, Alan McKinnon reviewed and summarized the key components required for this retail logistics transformation. He identified six closely related and mutually reinforcing trends: Increased control over secondary distribution, Restructured logistical systems, Adoption of ‘Quick Response’ (QR), Rationalization of primary distribution (e.g. factory to warehouse), Increased return of packaged material and handling equipment for recycling/ re-use, Introduction of Supply Chain Management (SCM) and Efficient Consumer Response (ECR).

The dedicated order picking model utilizes e-fulfillment centres to pick and deliver orders to customers. The advantage of this system is that it is dedicated purely to e-commerce customers so OOS should be low and delivery frequencies should be higher. These picking centres, however, have less of a product range and they need to be working at

capacity to justify investment costs. In non-food there are some highly successful operators of this model (e.g. asos.com) (Fernie and Sparks, 2015, p. 23).

5.3 Online Retailers

Eisenmann, Hallowell, and Tripsas, (2002, p. 301) mention that catalog and web business are similar in two important ways: 1) goods cannot be inspected prior the purchase and, 2) consumers do not have access to the goods after the purchase.

What are online retailers exactly? Online retailers are companies that 1) use a web site to merchandise newly manufactured physical goods for which they take title, and then 2) rely on third party service providers (e.g. UPS, Fedex, DHL, etc.) to deliver those goods from remote warehouses.

According to Eisenmann et al (2002, p. 303), compared to the traditional shopping format, online shopping offers several advantages such as 1) online retailers can offer "24/7" service (e.g. consumers can shop 24 hours a day, 7 days a week; 2) online retailers can reach consumers who might live far away to shop at their brick-and-mortar stores.

Web retailers own different attributes:

- *Information-Rich Products*: where graphics and detailed information help consumer to understand the product's features and benefits
- *Large Selection*: internet retailers can offer a big variety of product selection
- *Little Need for Hands-on Service or Product Trial*: certain products such as apparel are often sold after a product trial and through examination.
- *High Value-to-Weight ratio*: Internet retailers ask consumers to bear shipping costs or absorb such costs themselves through "free shipping" promotions;
- *Easily customisable products*: complete, multi-featured products that lend themselves to customisation are well suited to the web (Dell Case)
- *Rapid changes in Stock availability, Demand, and/or Price*: consumers can use websites to check the availability of hard-to-find items, information that can be frustrating and time-consuming to obtain by phoning or visiting brick-and-mortar retailers.
- *Replenishment Driven*: internet technology can be employed to automate the frequent reordering of groceries, pet supplies, ad similar items. Internet retailers who can lock customers into a "sticky" replenishment cycle then have an opportunity to cross-sell additional products and services to these consumers.
- *Unpleasant Brick-and-Mortar Retailing Environments:* Most consumers dislike grocery shopping, finding it time-consuming and repetitive. Parents often dislike shopping for toys with their children because in a toy store children tend to become very excitable. The internet helps consumers avoid these unpleasant brick-and-mortar retailing environments.

Eisernmann (2002) continues with the categorisation of e-retailers in two ways:

1) **Merchandise emphasis**
   a. *Horizontal focused,* when they sell many product categories such as amazon.com, because it sells a broad range of products
   b. *Vertical oriented***,** when retailers sell in one distinct area (single category of merchandise); examples are garden.com, eToys, and Pets.com
2) **Pricing format**
   a. *Fixed pricing* (format valid in the offline market)
   b. *Auction*, such as egghead.com who sells computer hardware and software products.
   c. *Group buying* (demand aggregation) sites as mercata.com and MobShop.com
   d. *Deep discount model*, such as buy.com who sold, once, products at cost price, in order to create a customers' database and then selling it manufacturer (for advertising and marketing programs); but the model had poor results

In the offline market, companies like Wal-Mart and Macy's are considered Horizontal retailers, while Toys and Home Depot can be considered vertical oriented.

Eisenmann et al (2002, p. 304), mention first of all that online prices are lower between 6-10 percent comparing to their brick-and-mortar competitors due to different transport costs; instead several barriers influence the shopping online such as 1) sending the credit card information over the web; (but turned out on *development of electronic wallet)*; 2) Consumer's lack of familiarity with the brands of some pure-play companies (e.g. companies that were "born on the web" and lack a brick-and-mortar or print catalogue heritage) can compound consumers' concerns about credit card theft; and building consumers' trust is an important task for young websites; 3) waiting for home delivery, because 70 percent of the population is not home during the day; for this reason amazon.com organised the delivery in 1 hour, or selecting the appropriate window time for the delivery, in order to reduce thefts when packages are left in front the door.

Fernie and Sparks (2015, p. 218) specify that retailers need the trust of the consumer before investing in the necessary infrastructure.

5.4 Online Purchase and Distribution

According to Rodrigue (2016i), E-commerce offers advantages for the whole commodity chain, from consumers being exposed to a wider range of products to manufacturers and distributors being able to adapt quickly to changes in demand. E-commerce generates significant number of home deliveries parcel movements that are carried by conventional postal services as well as specialized parcel carriers. In the United States, about 70% of home deliveries are made by the United States Postal Services, while the remaining 30% is carried by private parcel companies. Fulfillment (warehousing, packaging) costs account for 10 to 12% of the revenue of e-commerce, while shipping and delivery costs added up another 10%. E-commerce is also inciting shifts in retail freight distribution (Image 5.2) with

the setting of new fulfillment and sortation centers. As retail sales get partially replaced by online sales the need for conventional retail space declines while the footprint occupied by distribution centre increases.

Image 5.2: Evolution of retail freight distribution

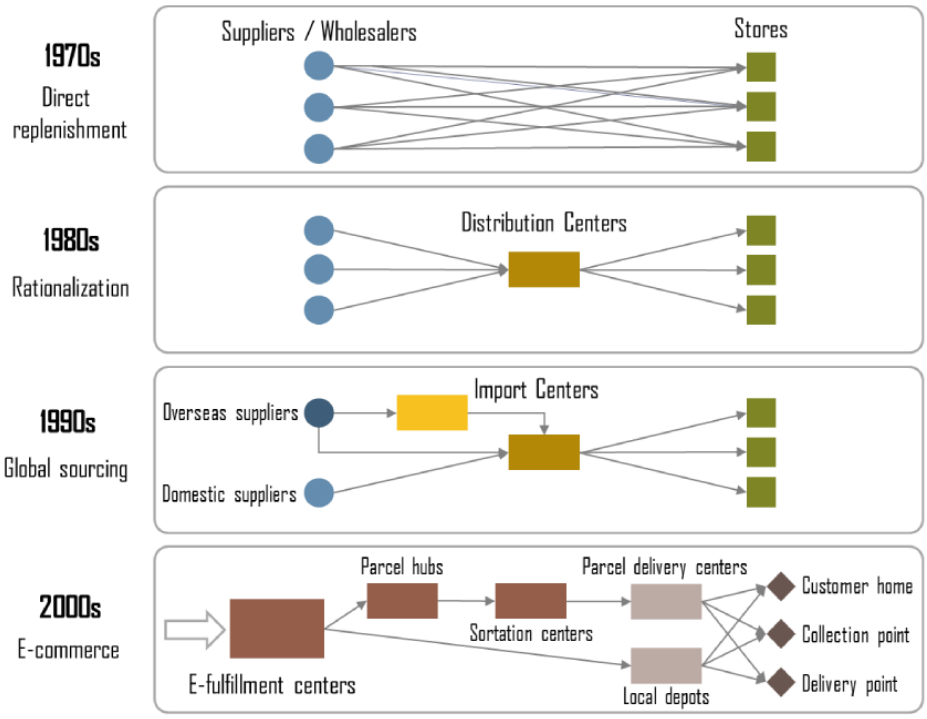


Table 5.1: Logistics Facilities Supporting E-commerce

Facility Type	Facility Attributes	Locational Attributes
E-Fulfillment Centre	Large-sized facility (half a million to one million square foot). Cross-docking configuration common. High racks storage. Push towards automation.	Low land costs. Proximity to highway. Access to a major parcel hub.
Parcel Hub / Sortation Centre	Large-sized facility (half a million square foot). Cross-docking configuration for handling trucks. Automated and semi-automated sortation.	Low land costs. Accessibility to regional distribution.
Parcel Delivery Centre / Urban Logistics Depot	Medium-sized facility. Cross-docking configuration for loading vans.	Periphery of metropolitan areas.
Freight Station / Pickup Location	Small or micro-sized facility. Store-like facility (pickup location). Locker banks (freight station).	High density neighborhood locations.

In standard e-commerce distribution chains, e-fulfillment facilities are usually owned by the online retailer while parcel hubs, sortation centers and parcel delivery centers are usually owned by third party logistics providers. However, consolidation trends are emerging as large online retailers are opening their own sortation centers. Some are also getting involved in the transportation segment of their distribution with urban delivery vehicles and trailers to move cargo between e-fulfillment and sortation centers Rodrigue (2016m).

According to Richards (2014, p. 22-24), there are three types of fulfillment centre:

- integrated fulfillment, where internet sales are carried out alongside existing retail operations;
- dedicated fulfillment, carried out in a purpose-built facility; and
- store fulfillment, which involves picking online orders from existing retail shelves for separate delivery ex store. A same-day courier service provided by Shuttle boasts a record delivery time of 13 minutes 57 seconds for an online order using this channel!

The third option has been favoured in the past for launching the service and establishment of e-fulfillment but is least favoured for a substantive operation.

With regard to warehousing, pure internet traders have had an advantage in developing purpose-built facilities according to a recent TI report for Savills (2013) whereas existing retailers and manufacturers who are selling online need to adapt existing logistics systems and facilities to meet these new demands or create new ones to accommodate the move to multichannel retailing.
The report suggests that the tipping point for dedicated e-commerce fulfillment centres is approximately 200,000 orders and that warehouses are in the region of 20–60,000 square feet (Richards, 2014, p.22).

Online shopping is, nevertheless, imposing new logistical requirements. First, it is substantially increasing the volume of goods that must be handled, creating the need for new DCs and larger vehicle fleets. Second, many online retailers are serving customers from different socio-economic backgrounds from the traditional mail order shopper. As they live in different neighbourhoods, the geographical pattern of home delivery is changing. Third, online shoppers typically have high logistical expectations, demanding rapid and reliable delivery at convenient times (Xing and Grant, 2006).

According to Fernie and Sparks (2015, p. 223), the distribution of online purchases normally exhibits the following characteristics:

1. Products are generally supplied directly to the home from the point of production or a central DC. Each order comprises a small number of items (often just one) and the order picking is centralized at a national or regional level. A large proportion of the orders are channelled through the ‘hub-and-spoke’ networks of large parcel carriers or mail order companies.
2. Within these J4U delivery networks, each order must be individually packaged at the central distribution point. This not only increases the volume of packaging in the supply

chain: it also takes up more space on vehicles in both the forward and reverse channels.

3. Within home shopping systems, whether catalogue- or internet-based, there is a large rate of returned product. Typically, around 30 per cent of non-food products delivered to the home are returned to e-tailers (in contrast to 6–10 per cent for 'bricks and mortar' retailers) (Nairn, 2003). This requires a major reverse logistics operation comprising the retrieval, checking, repackaging and redistribution of returned merchandise.

The home delivery channel terminates at the home or a nearby customer collection point. It is less clear where it begins. For the purposes of this review, the start of the home delivery channel will be defined as the 'order penetration point' (Oldhager, 2003). This physical process usually begins with the picking of goods within a stock-holding point. Only when picked are the goods designated for a particular home shopper. Distribution downstream from this point is sometimes labelled J4U, 'just for you' (Fernie and Sparks (2015, p. 222-223).

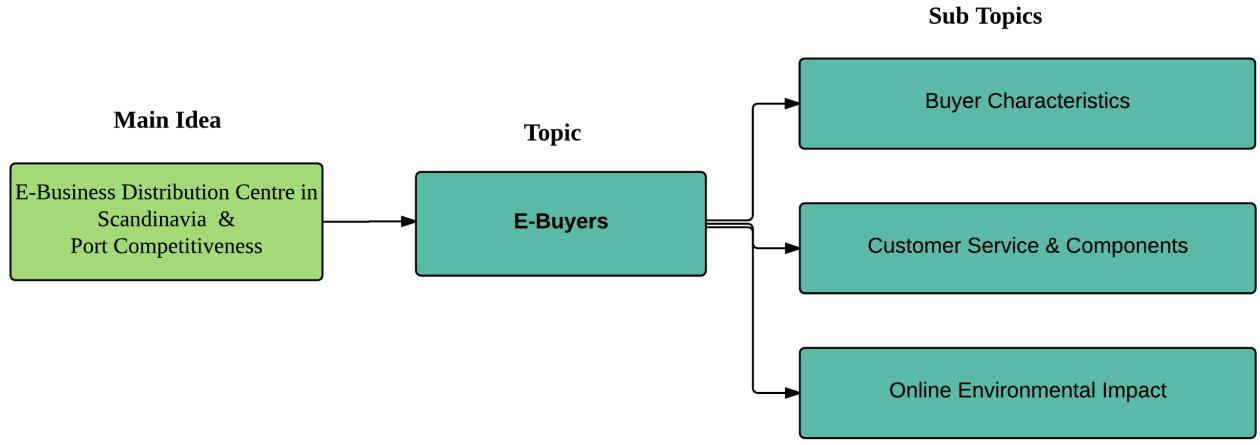
This links to innovation in the ordering process discussed earlier leading to the 'any time, any place' mentality and retailers have responded through offering a plethora of delivery (and returns) options for customers. This means that retailers offer tighter time windows for delivery, provide click and collect choices (the customer incurs the transport costs!) and a range of collection/return points (mainly convenience stores) (Fernie and Sparks, 2015, p. 221).

6. BACKGROUND - E-BUYERS

In order to have a better overview about this research, the author investigated e-buyer characteristics. From the e-buyer characteristics point of view, e-retailers have better knowledge about the specific customer. In this case the actors above mentioned will focus their activities and logistics services based on location, and customer characteristics.

> *A company's primary responsibility is to serve its customers. Profit is not the primary goal, but rather an essential condition for the company's continued existence.*
> *(DRUCKER, 1954)*

Image 6.1 E-Buyers' Literature Investigation



Source: *personal elaboration*

6.1 E-Buyer Evolution

According to Kewill (2013) Generation **Z/**the post-90s generation have entered the market, as both consumers and employees. Having grown up using e-mail, social networking and communications technology such as mobile/smart phones, MP3 players, laptops/tablets and games consoles, they have never known a world without them. Adept at switching between multiple platforms, formats and devices, they expect to utilize the technology they are familiar with in the work environment, accelerating the prevalence of Bring Your Own Device (BYOD) in industries heavily reliant on the timely transfer of data, such as logistics.

Croucher, Baker and Ruston (2014) refer about the rapid growth in online selling companies, such as Amazon, and the fact that all major grocery companies have wholly embraced the concept means that home shopping is now very common, with all the implications for logistics that home delivery brings.
It is important to differentiate between home shopping and home delivery (e-fulfillment). 'Home shopping' refers to the different ways of shopping for and ordering products from

home. ‘Home delivery’, or e-fulfillment, refers to the physical delivery of the product to the home (strictly speaking, e-fulfillment is the delivering of orders made via the internet but the terms are used interchangeably).

The growth of home delivery has led to the need for some fundamental changes in logistics operations that wish to serve the home market. The very nature of the final delivery operation to the home is dramatically different from a standard delivery operation, and home delivery requirements also affect other elements in the supply chain (Croucher, Baker and Ruston, 2014); typical implications are:

- shops become showrooms where stock replenishment is no longer an issue
- there has been a major increase in direct home deliveries, where restricted delivery time windows, often during the evening, have an impact on delivery vehicle utilization
- new distribution systems have been established (small deliveries on small vehicles into residential areas, community depots, etc)
- existing delivery systems have been provided with new opportunities (postal service, parcels delivery operations)
- customer ordering systems can be linked directly to manufacturers’ reordering systems;
- there is a high rate of returns – reverse logistics. Outside the grocery sector, returns levels are quite high and can vary between 30 and 50 per cent.

6.2 E-buyer Characteristics

In only a decade or so, internet connectivity changed from an English-speaking, developed country phenomenon to a global one. This conceals the different stages of development for different country markets and the geo-demographic profile of internet consumers. Furthermore, the increasing cosmopolitan tastes of a new generation of consumers has led to the creation of buying centres throughout the world by the ‘mega groups’ (Fernie and Sparks, 2014).

Eisenmann et al (2002, p. 305) mention that a website must often tailor its pricing, merchandising approaches, and customer service to the needs of distinct customer segments. Online shopper can be classified into the following groups:

1) *E-bivalent Newbies*: newest to the internet, this population is somewhat older, and spends the least amount of time online;
2) *Time sensitive Materialists*: group of consumers interested in saving time and maximising convenience and is less likely to read product reviews, compare prices, or use coupons;
3) *Click and Mortar*: this segment prefer to shop online but prefer to buy offline, are more likely female homemakers, have privacy and security concerns about buying online, and visit brick-and-mortar shopping malls most frequently;
4) *Hooked, Online, and Single:* this is a young single male segment, with high income, have been on the internet the longest play games, download software, investments, and shop online the most often;

5) *Hunter-Gatherers*: this segment is typically age 30 to 49, married, with two children, and most often goes to sites that provide analysis and comparisons of products and prices;
6) Brand Loyalists: this segment of people go directly to the website of a merchant they know, are the most satisfied with shopping online, and spend the most online.

This conceals the different stages of development for different country markets and the geo-demographic profile of internet consumers.

In terms of demographic variables, key variables on online behaviour include income, education, race, age and gender, with life-style, culture and social factors also of importance. However, research has found that as the online market has matured, the general demographic profile of online shoppers has become more similar to those of traditional shoppers (Fernie and Sparks, 2014). Internet shoppers, according to a major international study, tend to be more impulsive, value convenience, tend to be wealthier and are heavier users of internet and e-mail. They also have favourable attitudes to advertising and direct marketing (Doherty and Ellis-Chadwick, 2010).

The profile of an online shopper is not just linked to demographic and psychographic/ behaviour variables that favour online shopping, or to geography, technology and confidence in the online market, but to the merchandise being bought. For example: the age profile for online grocery shoppers tends to be younger, in the 18–40 year old range. Grocery shoppers also tended to be in the higher social categories. Older shoppers (65 plus) were less likely to shop online for groceries (IGD, 2011).

It is interesting to note that early research into M-commerce customers indicates some similarities to customers in the early years of the uptake of e-commerce, for example, most shoppers (62 per cent in 2005) were young (14–24) males. They tended to be confident internet users and experienced internet shoppers (Bigne et al, 2005). The demographic and gender profile is likely to rebalance as the technology becomes widely familiar and the market develops. Internet use was not found to influence mobile shopping, but previous experience of internet purchase meant consumers were more predisposed to buy on mobile devices.
All of this research shows that e-tailing has been most successful to date where a multi-channel *'click and bricks*' approach is adopted. The companies best equipped to adopt such a strategy were traditional department stores and clothing specialists in that they had considerable experience of dealing with the non-store shopper through their catalogues and 'low tech' selling techniques, especially as these companies were well equipped to deal with home deliveries and a returns policy.
According to Harrison, Hoek and Skipworth (2014, p. 287), if the delivery service does not meet customer expectations, sales can be lost. Marks & Spencer (M&S), a household retail brand in the UK, was faced with online shoppers expecting next-day or even same-

day delivery of their orders, but its antiquated technology and delivery systems were not up to the job, Butler (2013) reports.

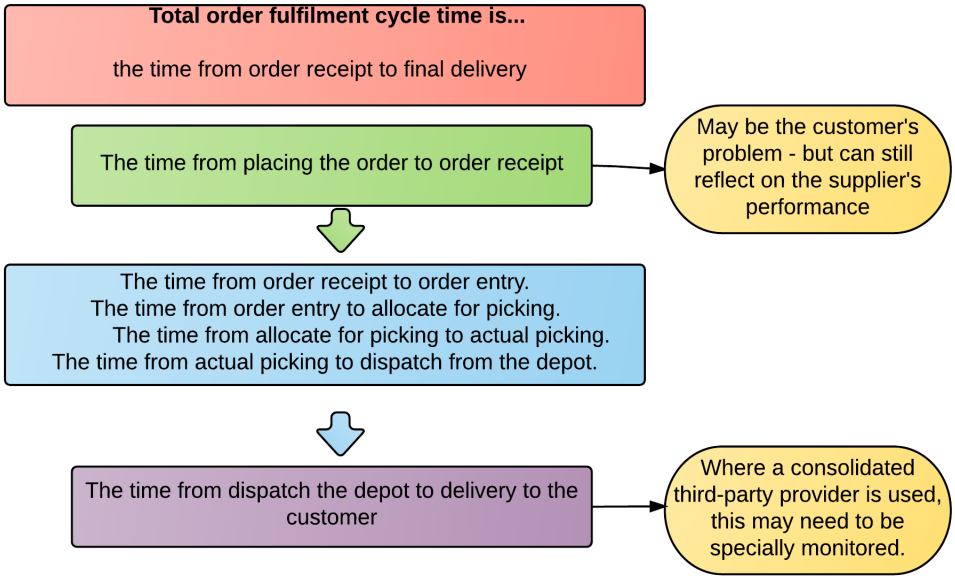
6.3 The Components of Customer Service

Croucher, Baker and Rushton, (2014, ch.3) refer to the logistics components of customer service and their classification in different ways.
Logistics customer service elements can thus be divided into three categories that reflect the nature and timing of the particular service requirements (before, during and after delivery of the product):
1) *Pre-transaction elements:* these are customer service factors that arise prior to the actual transaction taking place. They include: *written customer service policy; accessibility of order personnel; single order contact point; organizational structure; method of ordering; order size constraints; system flexibility; transaction elements*.
2) *Transaction elements:* these are the elements directly related to the physical transaction and are those that are most commonly concerned with distribution and logistics. The following are included: *delivery time; delivery reliability; delivery of complete order.*
3) *Post-transaction elements:* these involve those elements that occur after the delivery has taken place, such as: availability of spares; call-out time; invoicing procedures; invoicing accuracy; product tracing/warranty; returns policy; customer complaints and procedures; claims procedures.

Logistics customer service elements can also be classified by *multifunctional dimensions*. The four main multifunctional dimensions are:
- *time*: usually order fulfillment cycle time;
- *dependability*: such as guaranteed fixed delivery times of accurate, undamaged orders;
- *communications*: such as the ease of order taking or effective queries response;
- *flexibility*: the ability to recognize and respond to a customer's changing needs.

Each of these can be broken down into further detailed elements (Croucher, Baker and Ruston, 2014, ch.3). One example of this is shown in Image 6.2, which describes the different time-related components.
The total order fulfillment cycle time has been split into the five main time-related components from order receipt to final delivery. In addition, there is a preliminary step from order placement to order receipt, although this is not considered by some companies because it is deemed to be part of their customers' ordering process. When identifying and measuring order fulfillment cycle time it is important to be able to break it down to all of the key components. Thus, if there is a customer service problem it can be measured and traced quickly and easily and the actual detailed problem can be identified and remedied.

Image 6.2 The Constituent Parts of Total Order Fulfilment Cycle Time

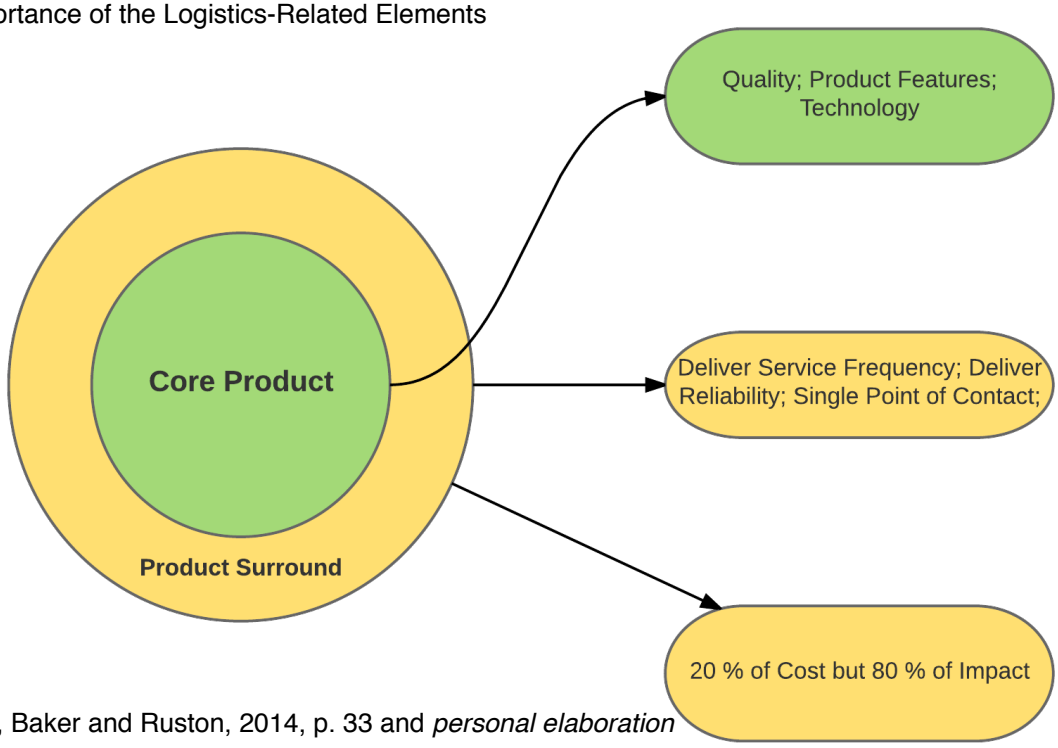


Source: Croucher, Baker and Ruston, 2014, ch.3 and *personal elaboration*

6.4 The Importance of Customer Service

According to Croucher, Baker and Ruston (2014, p. 33), the core product concerns the item itself: the technical content, the product features, the ease of use, the style and the quality. The service elements, which can be called the 'product surround', represent the availability of the product, the ease of ordering, the speed of delivery, and after-sales support.

Image 6.3 Core Product Versus Product 'Surround':
illustrating the importance of the Logistics-Related Elements

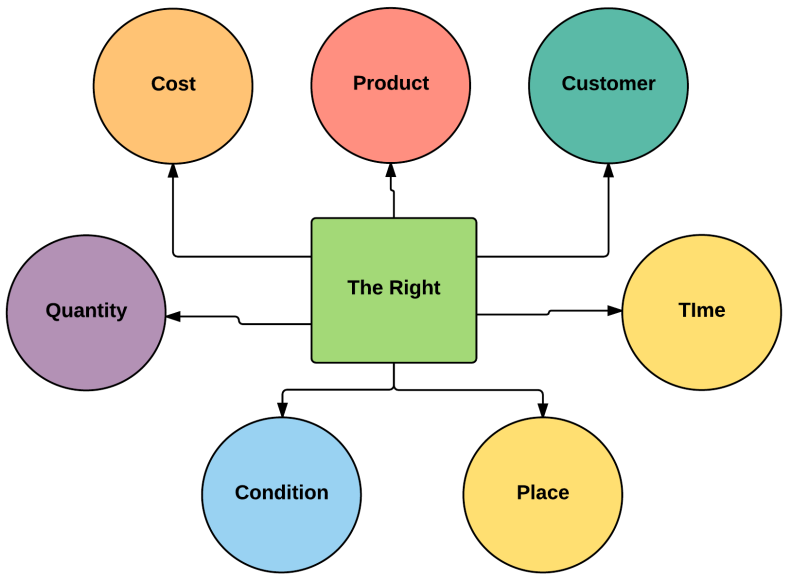


Source: Croucher, Baker and Ruston, 2014, p. 33 and *personal elaboration*

The marketing departments of many companies recognize that the product surround elements are very important in determining the final demand for a product. In addition, these aspects often represent only a small percentage of the cost of a product. Thus, true to the Pareto 80/20 rule, it is estimated that product surround or logistics elements represent about 80 per cent of the impact of the product but only represent 20 per cent of the cost. It is essential that the customer service elements are satisfactory, and logistics plays a crucial role in providing good customer service (Croucher, Baker and Ruston, 2014, p. 33).

One of the definitions of logistics that was provided in the previous sections, referred to 'the positioning of resource at the right time, in the right place, at the right cost, of the right quality'.
This definition can be expanded into what might be considered as the seven 'rights' of customer service. These are the right *quantity, cost, product, customer, time, place and condition* (Image 6.4).
All of these different aspects can be key requisites of a good customer service offering – indeed, each of them may be essential to ensure that a product achieves its expected sales in the various markets where it is made available. It is notable that all of these elements are affected by the standard and quality of the logistics operations that are essential to getting a product to market (Croucher, Baker and Ruston, 2014, p. 33).

Image 6.4 The "Right" Service



Source: Croucher, Baker and Ruston, 2014, p. 33 and *personal elaboration*

The key topic of customer service continues to increase in importance and to have a major impact on logistics, such that the logistics function has become the key element in customer service strategy. This includes:

- the development of 'customer-facing' organizations and operations
- a move towards service policies based on market segmentation
- JIT and quick-response systems requiring markedly more frequent and reliable delivery
- 'brand image' becoming less strong – the dominant differentiator being availability.

One very recent example of the increasing importance of customer service has been the move to develop an alternative approach to the supply chain by creating what is called demand chain management (DCM). Here the intention is to move the emphasis away from the supply of products and towards the demand for products – to reflect the importance of what the customer requires rather that what the supplier wants to provide. Ultimately this is linking the two concepts of supply chain management (SCM) with customer relationship management (CRM), or linking logistics directly with marketing (Croucher, Baker and Ruston, 2014).

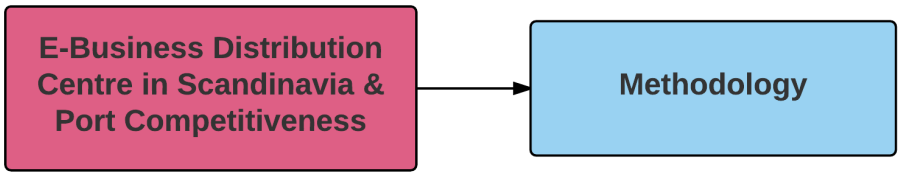
6.5 Online Environmental Impact

Concerns have been expressed that online retailing is likely to generate more transport and impose a heavier burden on the environment than store-based retailing (Hesse, 2002). Some e-tailers, on the other hand, advertise their service as being good for the environment. Matthews et al (2001) compared the externalities associated with the distribution of books through a conventional retail channel and from an online bookseller and came to the conclusion that the latter was less environmentally damaging. According to their calculations, which included 'trucking, air freight, production, packaging and passenger trips', energy consumption, air pollution, greenhouse gas emissions and the quantity of hazardous waste were respectively, 16 per cent, 36 per cent, 9 per cent and 23 per cent lower in the case of online retailing. (Fernie and Sparks, 2015, p. 231)

7. METHODOLOGY

The current section presents the methods and methodology that have been used to conduct this research.
In order to better define the type of research conducted, the classification of the study is provided; it gives an overview of how this research can be classified according to the purpose, process, outcome and logic of the research.
This is followed by an explanation of the study's paradigm and how the data and literature were collected.
This section continues with an overview of several models used in the analysis.

Image 7.1 Study process - Methodology



7.1 Classifying Research

According to Collis & Hussey (2014), research can be classified according to the purpose, process, outcome and logic of the research. To clarify how this study has been conducted, the different classifications will be described in this section.

The purpose of the study is to investigate how the location of a warehouse/DCs at a Scandinavian port would influence online retailers, with particular reference to the ports of Gothenburg, Oslo, Copenhagen-Malmo and Stockholm.

According to Collis & Hussey (2014), this purpose classifies the current research project as predictive research. Predictive research looks into answering the questions of 'how', 'why' and 'where' and the answers or solutions generated from this analysis will be used to generalize in similar studies where applicable.
The process of a study refers to the kind of data that is collected during that study in order to answer the research question(s) (Collis & Hussey 2014).

The research question is this: assuming that all four ports included in the research provide warehouses to e-retailers, which location has the most convenient distribution (e.g. short lead time and large e-buyer customer base)? *How can the Port of Gothenburg (PoG) contribute to the success of online retailers? Which factors create a competitive advantage for e-retailers? Which factors influence the choice of location for a warehouse/DC?*

In order to answer these questions, both qualitative and quantitative data needs to be collected.
The qualitative data refers to the panel session organised with the Port of Gothenburg director and top managers, in order to get experts within the field to share their knowledge of the current situation and receive some inputs. The research sessions contributed to the improvement of this paper (on going) based also on online retailers' perceptions and services requested.

The study relies on a quantitative analysis of data obtained mainly from scientific and official resources. The quantitative data refers to the numerical data that has been used to map the different locations, customers, costs, routes, port's performances, country economy, and different performances within the specific areas that are part of the study.

The data consists of coordinates of the port's location as well as data that is used to calculate the time, costs, capacity and the geographical distance between the distribution centres and customers, which were necessary to be able to identify the best Scandinavian port (among those identified) for online retailers interested in the Scandinavian market.

As described above, the purpose of the research is to investigate the port best able to satisfy the demand for online retailers, shipping lines, offering a well connected hinterland, and penetrating e-buyers spread across the North of Europe (Finland, Sweden, Norway, Denmark). If the Port is aware of what is important to the actors involved in the e-business, the port itself will deliver high services to its customers, and all actors involved work, as a consequence, for "next customer" satisfaction. The outcome of the research can be said to be applied research, as described by Collis & Hussey (2014). Applied research refers to a study where the goal is to solve a problem. Since the Port of Gothenburg faces challenges regarding port activities, lead time, costs and customer satisfaction, these can be related to the problem that this research aims to solve.

A theoretical structure was created, with the purpose of being tested later in the process of the research. This structure of the process indicates that this study was made under a deductive approach. A deductive approach refers to empirical observations that are tested against an already-developed theoretical structure and to a method that goes from general to the particular, something that can also be related to in this study. (Collis & Hussey 2014)

7.2 Paradigm

This section presents an explanation of the study's paradigm and how the data and literature were collected.

A research process is guided by a paradigm, that is to say, a framework that is based on assumptions about the nature of knowledge and the world but also based on individuals' philosophies. There are two main paradigms that exist, which are *interpretivism* and

positivism. Interpretivism refers to the idea that social reality is subjective, since social reality shapes people's perception. This paradigm focuses on exploring the complexity of social phenomena, while a positivist paradigm is more about measuring social phenomena (Collis & Hussey 2014). A positivist paradigm focuses on different theories that can be explained by the social phenomena that exist. Since this study is about building warehouses/DCs in the PoG, with an investment of 490million USD (ca.) and the introduction of new services for e-retailers, LSP, e-buyers, and port, including the development of a new network by using theories about network-hub-port-centric activities, this study is conducted under a positivistic paradigm.

There are different philosophical assumptions that underpin the paradigm and since this study is done under a positivistic paradigm, the philosophy that is used in this study is methodological assumption since a particular aspect was studied in this research and also because the association between the variables was analysed. To add to this, as the sample size studied here was large, it was therefore this assumption that suited the study best. (Collis & Hussey 2014)

7.3 Literature Collection

Considering the extensive literature on the research topic, some previous theories and studies had to be collected. The literature that has been searched for and collected can be referred to as secondary data, as the data already existed before the study began.
To find relevant literature, as published in articles and journals, the first step is to identify the scope of the research.

The scope of the research was to investigate 1) The supply chain from an independent point of view, in order to have a solid background; 2) The warehouse/DCs characteristics, focusing on e-retailers and LSP; 3) The maritime section, as a relevant part of the SC, was analysed taking into consideration the port perspective, shipping line preferences related to port efficiency and hinterland/logistics infrastructure, focusing on port-centric activities; 4) Online retailers as part of the SC were analysed considering their preferences to better respond to customer demand; 5) Logistics service providers, as actors in the SC who receive the non-core activities by e-retailers; 6) E-consumers, as the final users of online retailers' products, were investigated considering their characteristics and locations.
This investigation as a whole identifies properly the role of the port in E-commerce business, identifying the most appropriate port in which to establish a DC for e-retailers.

By having the scope defined, it is possible to identify some limitations, which improve the literature review. (Collis & Hussey 2014)
After the scope was defined, the literature review began. By using different databases provided by Gothenburg University (GU) and Chalmers' library, together with keywords, relevant literature could be found. The specification of the two universities was applied because the first university (GU) has limited access to some online literature, and the

second one provides an extensive database of e-books, relevant material, scanned magazine-articles and online newspapers. The author investigated leading international logistics and maritime transport journals, marketing and management journals, recent books about SC, warehousing, distribution, transport modelling and transport geography. Relevant literature about facility location by different authors was analysed from different perspectives.
Moreover, the author searched for relevant articles in other international journals and news sources by using electronic databases, such as ProQuest (ABI), Spinger link, IHS, Sea-web.com, Eurostat, UN Comtrade, IMF, search words by section.
Dividing the literature background into different sections contributed to identifying several key words, and observations have been classified. The different sections include the following key words:

- *Supply Chain:* supply chain management, transport strategy, supply chain network, logistics factors, supply chain performance; SC key activities, SC network, logistics strategy, transportation network, transport strategy, route, transport structure, hub and spoke, type of networks, transport geography, transport distance, green logistics;
- *Warehouses* (W.): w. location, w. strategic location, w. distance from the inbound logistics access point and distribution area, type of warehouses, warehouses classification, facility location strategy, public warehouse, private warehouses;
- *Maritime Logistics:* Port efficiency and characteristics, port services, port hinterland, port strategic positioning, sea port productivity, port infrastructure in logistics, port competitiveness, port performance, port-centric, port-centric activities, port inefficiency, port choice and shipping lines, models to analyse the port performance, shipping voyage estimation cost, Free Trade Zone (FTZ);
- *Online Retailers*: DCs localisation, facility location, where online retailers decide to locate a warehouse for the online and store distribution; factors online retailers consider when investing in a DC, infrastructure and logistics services required;
- *Logistics Service Providers*: LSP classification, party logistics services, LSP green attitude, LSP localisation preferences;
- *E-Consumers:* e-consumer characteristics, e-buyer segment, e-buyer geo-demographic characteristics.

By studying the gathered literature, the opportunity to find other relevant sources and original sources was given, something that was important to providing the study with high validity.

In line with the theories, the competitors analysis must be conducted through the Port of Oslo, Copenhagen-Malmo, Stockholm and Gothenburg.
Several considerations have been identified in order to have clear guidelines for the research:
Is the competitiveness of the Port of Gothenburg related to the expansion of the port land? and/or is it related to the presence of logistics infrastructure? and/or is it related to port efficiency - performance? and/or is related to the lead time? and/or is related to shipping

line routing? and/or is it related to the investment of large online retailers? and finally, is the competitiveness of the Port of Gothenburg positively related to the identification of Gothenburg as a HUB?

7.4 Data Collection

Data is collected independently and according to the literature background. Each section has a dedicated model or set of data to be investigated. The final result is to combine all data together and present a ranking of the most efficient and competitive port (geographic location) in which to locate a warehouse.

Considering that the strategic value of a company relates to many aspects of the business, non-quantitative aspects must also be considered.

In order to formulate a logical supply chain network model, the following elements must be considered:

- The *Objective* is the goal of the optimisation and the criteria to be used to compare different solutions. If the object is to minimise the distribution time, it is possible to compare two different solutions and judge which is the better based on time;
- The *Constraints* defines the rules of a legitimate solution.
- The *Decision* defines what the company allows the optimisation to chose from. In the optimisation of the physical supply chain, the main decisions include how much product moves from one location to another, how many sites are picked, where those sites are, but of course the decision cannot be separated from the constraints;
- *Data* refers to the factors the company wants consider in the decision-making process. In cases where no supporting data is available, a company will figure out how to make good decisions by creating multiple scenarios.

7.5 Modeling

According to Watson (2013, p.12-13), considering the complexity of the supply chain, mathematical optimisation technology is the best way to sort through the various options balance trade-offs, determine the best location for facilities, and support better decision making. Mathematical optimisation relies on linear and integer programming.
Optimisation is a complementary, not competitive, technology that allows a company actually to determine the best locations for the facilities. The decision maker can let optimisation do the have number crunching to determine the details of the alternatives (where to locate, what is made where, how product flows, which customer is served by which warehouse, for instance); and the positive consequences of optimisation, if set up correctly, are that it will uncover ideas that the decision maker never thought about.

Regarding the population (e-buyers), different sources have been analysed in order to understand the geographical location of potential buyers; each country's economic performance has been considered in terms of, for example, the main economical indicator, trade flow (import/export), trade value, trade throughput.

In the maritime section, several indicators are considered such as the number of TEUs, containers (inward/outward), number of vessels (and GT), port characteristics, berth length and depth, the services offered by the port, the working hours, port charges, location, maritime transport by country, and future/actual investment planned. The port's location is compared with the COG, evaluating the network efficiency. A relevant factor is the shipping route from Asia to Europe (especially to the four ports); a shipping voyage calculation is provided in order to highlight which port that is more convenient for the shipping line (costs, timing, and SECA nautical miles). The four ports are in SECA area and are required to use a different type of fuel with a lower percentage of sulphur (this fuel has a different price to the open sea used fuel).

For logistics, a centre of gravity (COG) problem is usually defined as selecting the location of a facility so that the weighted-average distance to all the demand points is minimised. A COG solution suggests that facilities are located at the centre (the "centre of gravity) of a collection of demand points (or in some instances, for firms with many suppliers, at the centre of the supply points). Centre of gravity models, by definition, are clear cut and not ambiguous.
Problem formulations do not require a skilled professional to determine the cleanest approximation or modelling formula, but rather, merely require a correct and accurate specification. Centre of gravity studies are useful both for building the intuition of the professional analyst and for validating the accuracy of his or her more comprehensive results. The location of the warehouse was also considered from the perspective of time range. In order to serve the higher number of customers in the shortest leat time, the distances to the potential e-customers were analysed from the port (as a departure point) and from the COG, and then compared (both road and rail). They study also focuses on sustainable routing, and in this case Eco-transIT carbon emission calculator was used.

8. Analysis - Trade

According to the literature introduced previously, in this section the author goes on to investigate international trade by country - Denmark, Finland, Norway, and Sweden. The analysis focuses on the selected HS codes, Import-Export value by selected countries, top Import-Export trade partners, and trade value among the Scandinavian countries.

Image 8.1 Study Process - Trade Analysis

International trade - Import & Export - is a picture of the country, and a local population's consumption habits show willingness to spend in products or services.
International trade, *sourcing from foreign markets, products directed to different marketplaces, market/industry trends and goods traffic flows* are important elements to consider for supply chain, maritime transport and warehouse location.

According to the Port of Gothenburg's request, in order to analyse in detail the e-commerce sector, several products with high value have been identified such as *apparel, electronics (computers), sports equipment, household, books, handicraft material and jewellery;* and *related products.*

To perform this investigation was analysed in detail each single HS code by country. In appendix A the selected HS codes are reported, with the proper classification.
After that the HS codes results have been merged to summarise the results (Appendix B).
In appendixes C-D-E-F the results are reported by country and single HS code.

In our analysis the HS codes have been classified as below, first by range (HS from/to) and by dedicated category:

1. HS from 28 to 38: Chemicals & Allied Industries, categories included no. 30-33-34-37
2. HS from 41 to 43: Raw Hides, Skins, Leather, & Furs, category included no. 42

3. HS from 44 to 49: Wood & Wood Products, categories included no. 48-49
4. HS from 50 to 63: Textiles, categories included no. 57-60-61-62-63
5. HS from 64 to 67: Footwear / Headgear, categories included no. 64-65-66
6. HS from 68 to 71: Stone / Glass, category included no. 69
7. HS from 72 to 83: Metals, category included no. 71
8. HS from 84 to 85: Machinery / Electrical, category 84 but only subcategories no. 8467-8468-8469-8470 ; and category 85
9. HS from 90 to 97: Miscellaneous, categories included no 90-91-92-94-95-96.

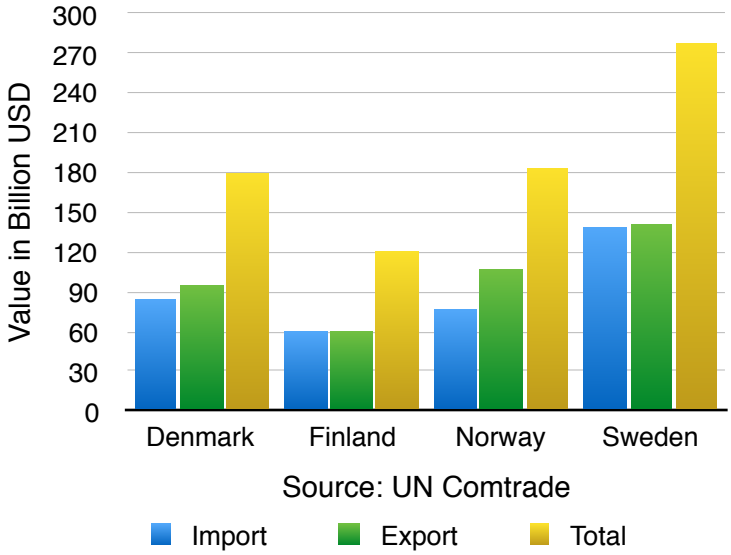
8.1 Total Import-Export by the Selected Countries

Figure 8.1 shows import/export data by country for the year 2015 (in relation to the rest of the world) (Appendix B, table B.1).

Sweden is the first importer and exporters of goods, with a total of 278 billion USD, respectively 137,8 billion USD in import, and 140,1 billion USD in export.

Norway is in second position with the total value of 183,23 billion USD, respectively 76,79 billion USD (import) and 106 billion USD (export).

Figure 8.1 Import-Export Value Selected Countries 2015



Denmark ranks third, with a total value of 179,70 billion USD, with the import value of 85,27 billion USD, and export value equal to 94 billion USD.

Finland comes in fourth position, with a total trade value equal to 119,85 billion USD, the import value reached 60,17 billion USD and the export value is equal to 59,68 billion USD.

Figure 8.2, *export by selected HS category,* highlights export value by country (to the rest of the world) (see Appendix B, table B.2, for data).

In order to better understand the value trade, the *average* have been calculated, equal to 3,25 billion USD.

Sweden in 2015 had an overall better performance in export compared to the three neighbours' countries.

Sweden's total export value for the selected HS codes is equal to 44,9 billion USD; second better performance in exports is Denmark with 32,5 billion USD; third is Finland with 18,9 billion USD; and last is Norway with 7,6 billion USD.

Figure 8.2 Export - Selected HS Category by Country 2015

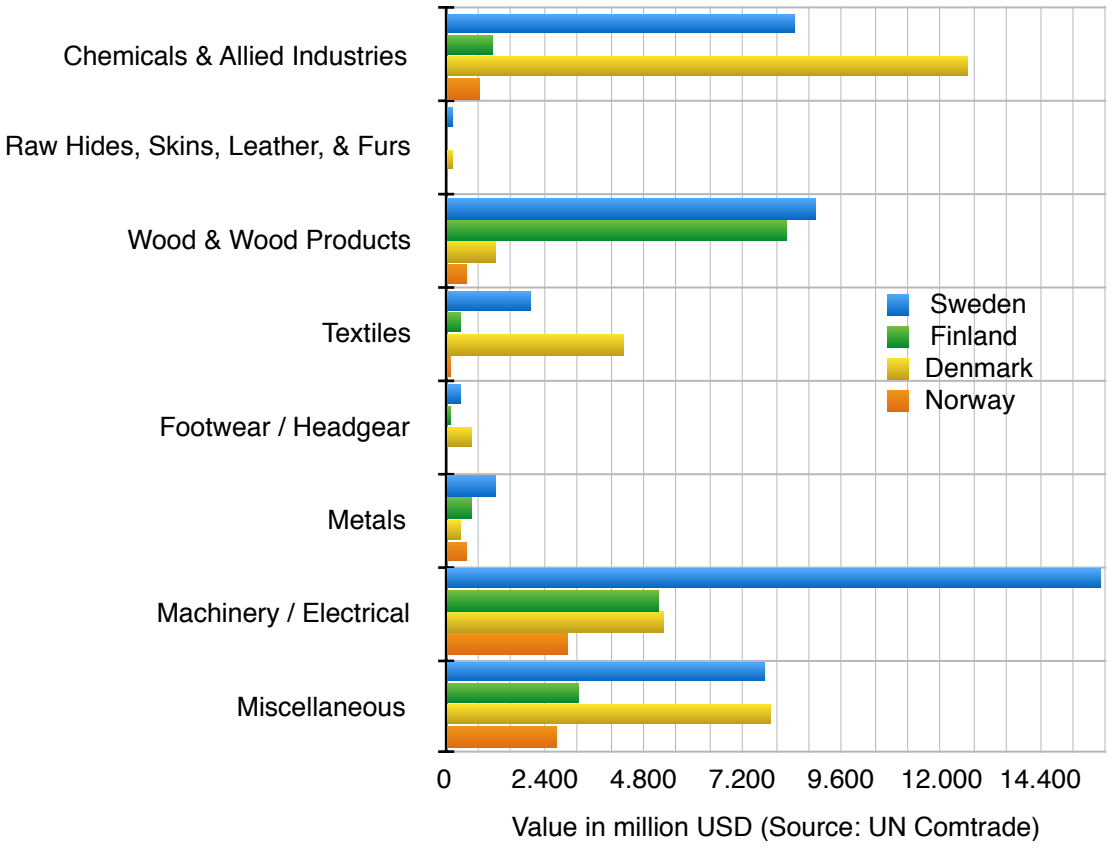
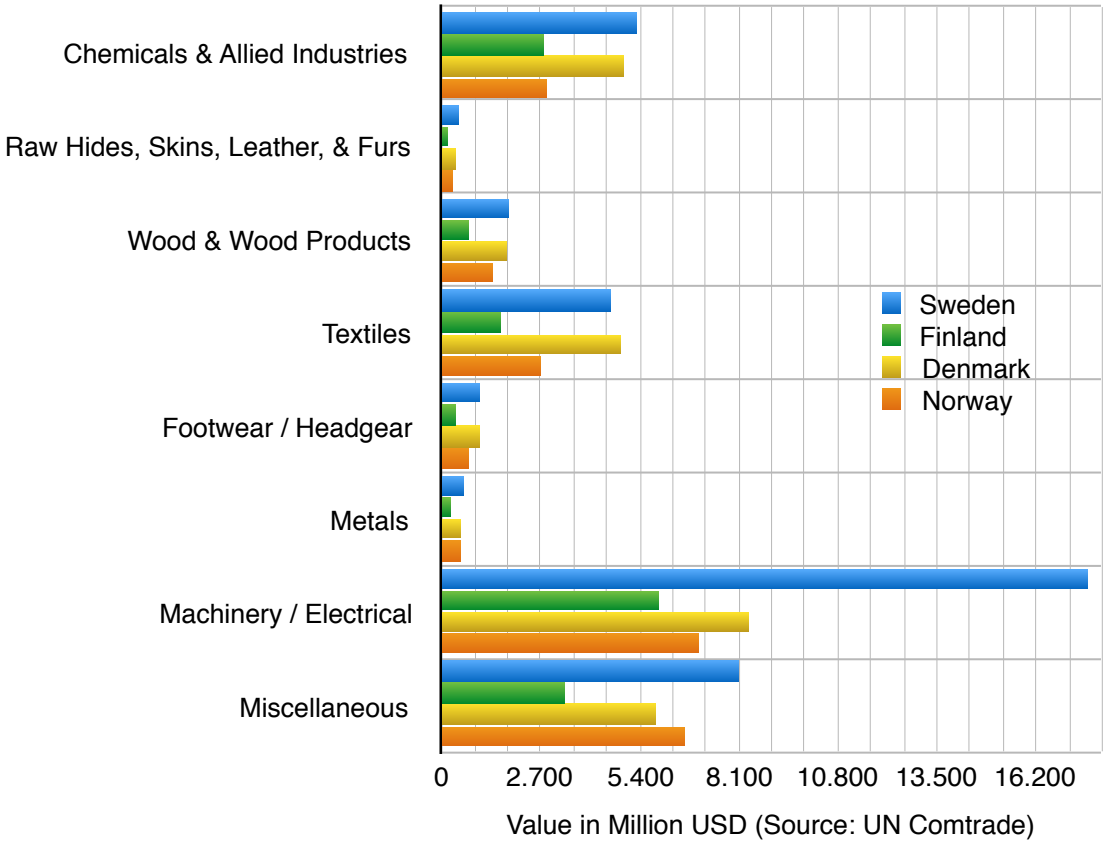


Figure 8.3 shows import value in million USD by selected HS codes, for the selected countries (the import is considered from the rest of the world). The average import value, among the considered countries, is 3,27 billion USD.
The “picture” of the import level changed slightly from the previous figure (8.2).
According to the selected HS category, Sweden remains the major importer among the Scandinavian countries, with the total value of 39,5 billion USD; in second position is Denmark with a total of 27,69 billion USD; third is Norway with 22,16 billion USD; and last is Finland with the import value equal to 15,2 billion USD (see Appendix B, table B.3, for data).

In order to better understand the trade value for each single country, a deeper investigation was conducted. In the next paragraphs the reader will have a detailed picture about the country’s top import/export partners, and the import/export value among the Scandinavian countries; details about trade flow are reported in the dedicated appendix. For a deeper investigation about HS codes (Import-Export) by country, refer to the appendix C-D-E-F.

Figure 8.3 Import - Selected HS Category by Country 2015



8.2 Denmark Trade

Figure 8.4 shows Denmark's top 5 import countries. The first country from which Denmark imports products and services is Germany, with a value of 17,4 billion USDs (39 per cent).
Denmark imports for 10,5 billion USD products and services from Sweden (23 per cent).
The Netherlands ranks third with a value of 6,81 billion USD (15 per cent). Denmark imports "just" 6,37 billion USD (14 per cent); and last one is United Kingdom with total value of 3,83 billion USD (9 per cent) (see appendix C, table C.2, for data). The percentage considered is based on the value of top 5 import countries and not based on total import .

Figure 8.4 Denmark - Top 5 Import Countries (UN Comtrade, 2015)

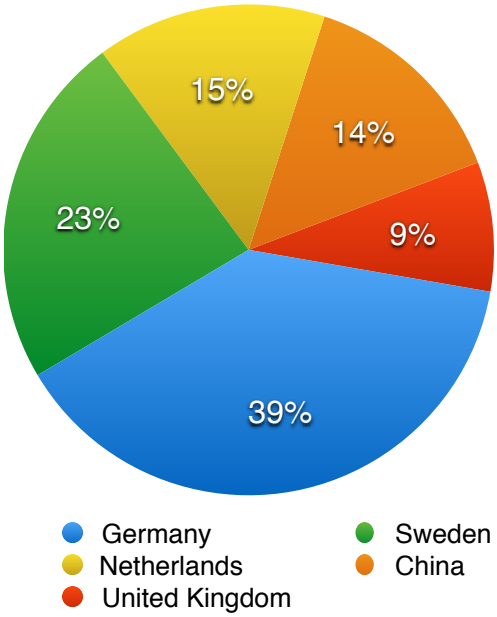
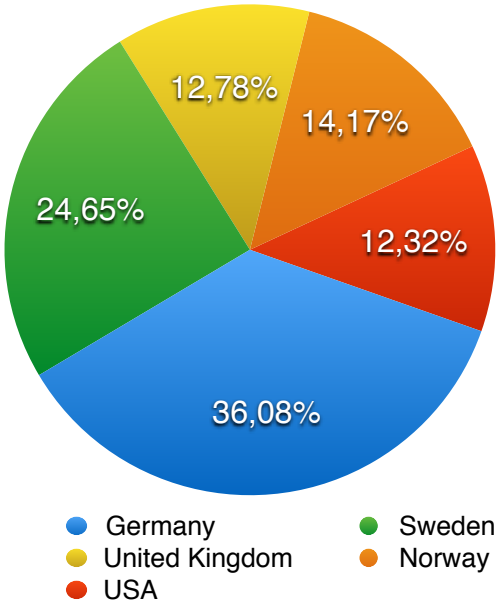


Figure 8.5 highlights Denmark's top 5 export countries.
Germany represents the major market for Denmark where the products are exported; the total value of this trade is 15,29 billion USD (36 per cent of top 5 export value). Sweden is ranked second with 10,45 billion USD (24,65 per cent); Norway rank third, with the total value equal to 6 billion USD (14,17 per cent).
United Kingdom in fourth position, receive goods and services from Denmark with the total value of 5,41 billion USD (12,78 billion USD). The last country receiving Danish export is USA with the value equal to 5,21 billion USD (12,32 per cent) (see appendix C, table C.3, for data). The percentage was calculated on the total top 5 export value.

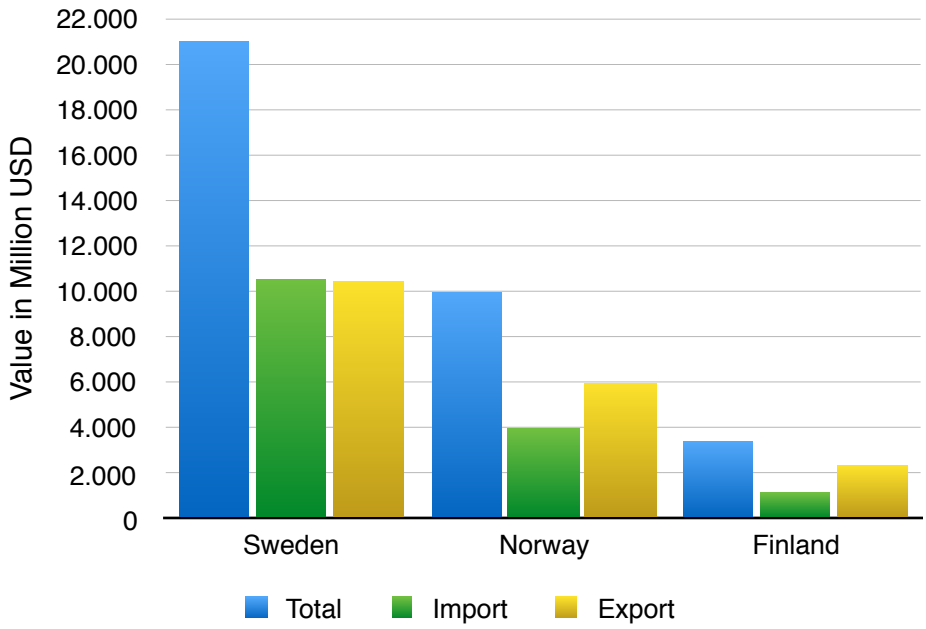
Figure 8.5 Denmark - Top 5 Export Countries (UN Comtrade, 2015)



Analysing the details of the import and export trade between Denmark and Scandinavian countries is clear to highlight the major country partner - Sweden (Figure 8.6).
Figure 8.6 shows the import/export trade value between Denmark and Sweden-Finland-Norway. The total trade with Sweden count for 20,94 billion USD, with import value equal to 10,49 billion USD, and total export equal to 10,44 billion USD.
Norway, is ranked second, among the nordic countries with the total import/export value with 10 billion USD (3,9 billion USD import; 6 billion USD export) (see appendix C, table C. 4, for data).

Finland total trade with Denmark counts for 3,43 billion USD. Denmark import from Finland 1,10 billion USD, and export 2,32 billion USD.
The average value calculated for Denmark, it is equal to 7,63 billion USD. This data is used at the end to compare the trade value among the countries.

Figure 8.6 Denmark, Import/Export 2015 Neighbours Countries (UN Comtrade)



8.3 Finland Trade

According to UN Comtrade (2015), Finland's major import partners are Germany, Sweden, Russian Federation, China and the Netherlands (Figure 8.7).
Germany export value for 8,99 billion USD (30,11 per cent), Sweden count for 6,74 billion USD (22,59 per cent), Russian Federation trade value for 6,58 billion USD (22,06 per cent), China trade value is 4,36 billion USD (14,63 per cent), and last is the Netherlands with 3,16 billion USD (10,61 per cent) (see appendix D, table D.2). The percentage was calculated on the total top 5 import value.

Figure 8.7 Finland Top 5 Import Countries 2015 (UN Comtrade)

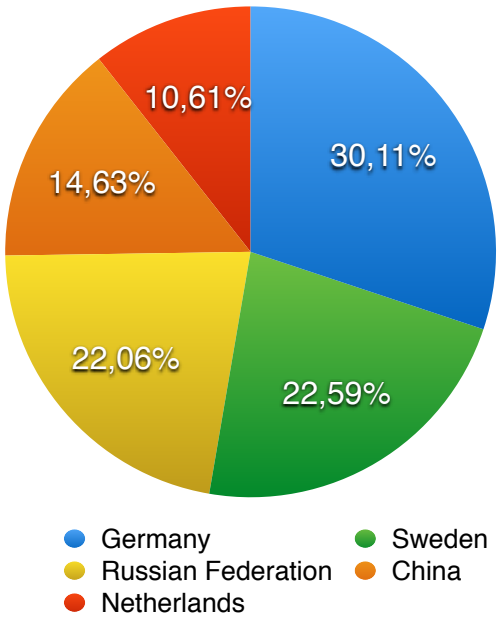
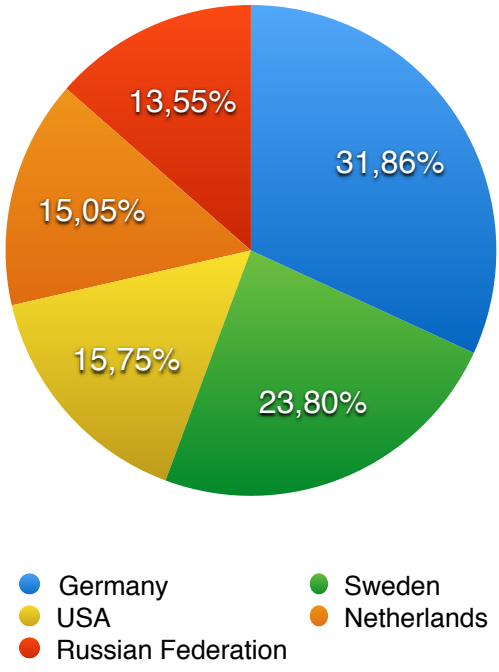


Figure 8.8 shows Finland's top 5 export countries: Germany, Sweden, USA, the Netherlands, and Russian Federation.
In 2015, Germany imported goods with the total value of 8,1 billion USD (31,86 per cent), Sweden imported goods for 6,05 billion USD (23,80 per cent), USA imported goods from Finland with the value of almost 4 billion USD (15,75 per cent). In fourth position the Netherlands imported goods with 3,82 billion USD (15,05 per cent); and last is the Russian Federation who imported goods for 3,44 billion USD (13,55 per cent) (see appendix D, table D.3 for data).
The percentage was calculated on the total top 5 export value.

Figure 8.8 Finland Top 5 Export Countries 2015 (UN Comtrade)



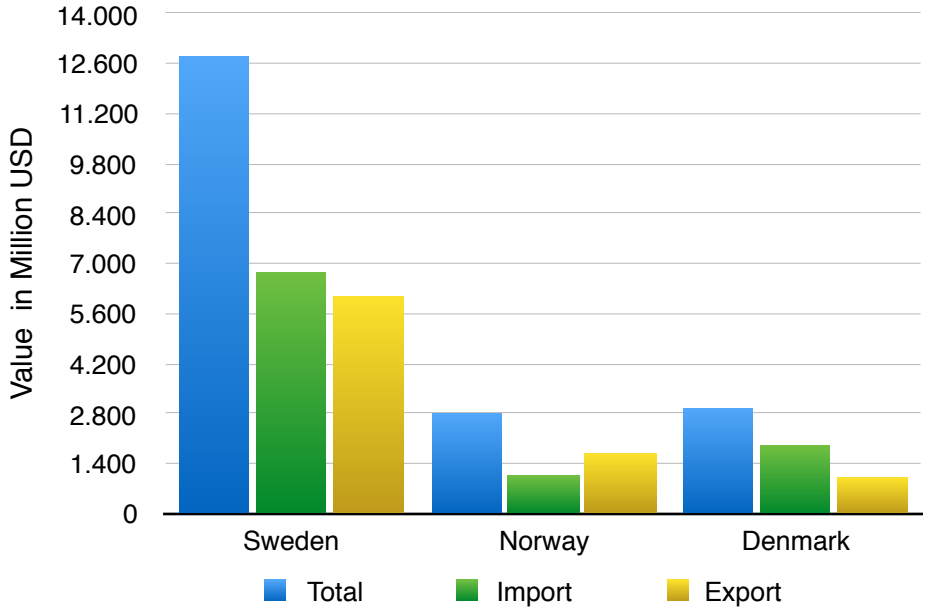
Analysing the details of the import and export trade, Germany results being the first partner's trade, but Sweden result the first country among the Nordic ones.

Figure 8.9 shows the import/export trade value between Finland and Sweden-Denmark-Norway.
The total trade with Sweden accounts for 12,79 billion USD, with import value equal to 6,74 billion USD, and total export equal to 6 billion USD.
Norway, is ranked second, among the nordic countries with the total import/export value of 2,79 billion USD (1,08 billion USD import; 1,71 billion USD export).

Denmark's total trade with Finland counts for 2,92 billion USD. Finland import from Denmark is 1,91 billion USD, and export 1 billion USD (see appendix D, table D.4, for data).

The average import/export value from the Nordic countries is equal to for 4,11 billion USD.

Figure 8.9 Finland Import/Export 2015 Neighbours Countries (UN Comtrade)



8.4 Norway Trade

Figure 8.10 shows Norway top 5 import countries in 2015 (UN Comtrade, 2015). The first country from where Norway import products and services is Sweden with a value of 8,86 billion USD (25,1 per cent). Norway import for 8,71 billion USD products and services from Germany (24,6 per cent).
China rank third with a value of 8,02 billion USD (22,7 per cent). United Kingdom export to Norway 4,94 billion USD (14,0 per cent); and last one is USA with total value of 4,84 billion USD (13,7 per cent) (see appendix E, table E.2, for data). The percentage considered is based on the value of top 5 import countries and not based on total import.

Figure 8.10 Norway - Top 5 Import Countries 2015 (UN Comtrade)

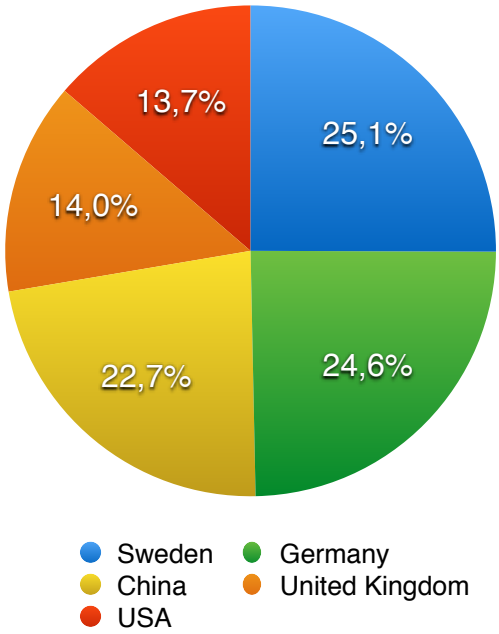
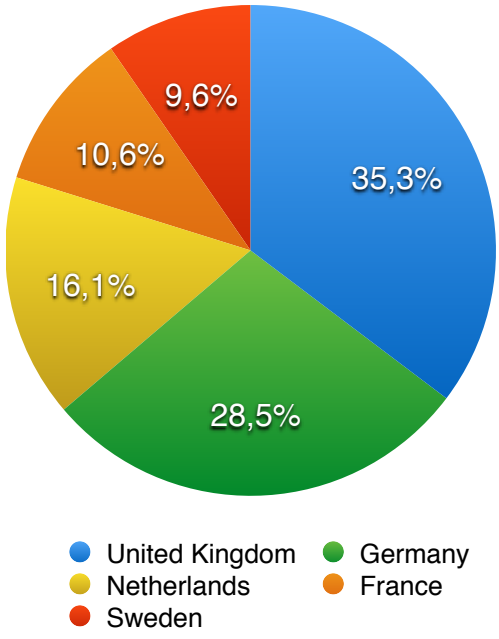


Figure 8.11 highlights Norway top 5 export countries in 2015.
United Kingdom represents the major market for Norway where the products are exported; the total value of this trade is 23,15 billion USD (35,3 per cent of top 5 export value).
Germany is ranked second with 18,68 billion USD (28,5 per cent); the Netherlands rank third, with the total value equal to 10,5 billion USD (16,1 per cent).
France in fourth position, receive goods and services from Norway with the total value of 6,92 billion USD (10,6 billion USD). The last country receiving Norwegian export is Sweden with the value equal to 6,32 billion USD (9,6 per cent) (see appendix E, table E.3, for data).
The percentage considered is based on the value of top 5 export countries and not base don total value.

Figure 8.11 Norway - Top 5 Export Countries 2015 (UN Comtrade)



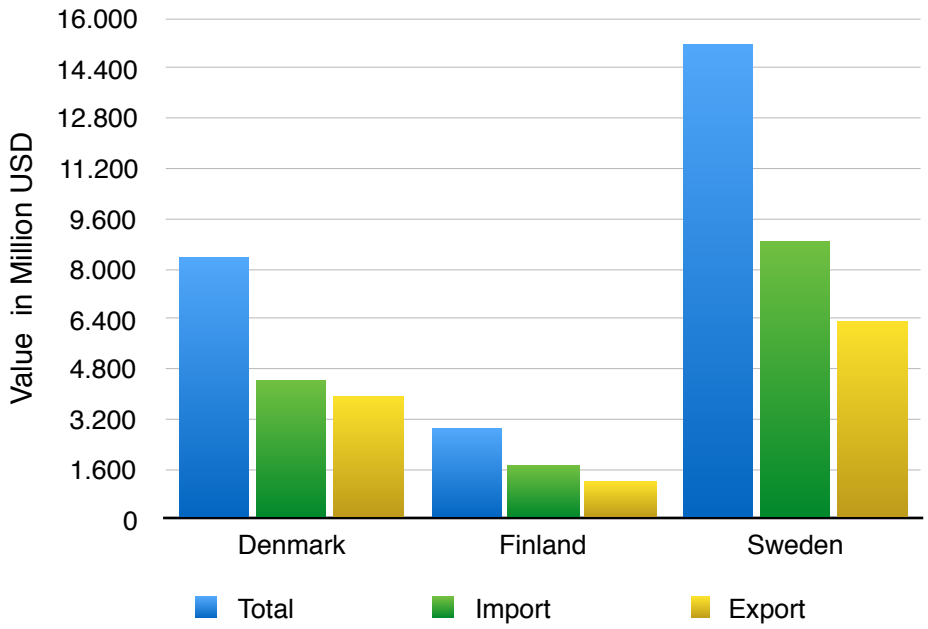
Analysing the details of the import and export trade between Norway and Nordic countries is clear to highlight the major country partner - Sweden.

Figure 8.12 shows the import/export trade value between Norway and Sweden-Denmark-Finland. The total trade with Sweden count for 15,18 billion USD, with import value equal to 8,86 billion USD, and total export equal to 6,32 billion USD. Denmark total trade with Norway counts for 8,31 billion USD. Norway import from Denmark is 4,41 billion USD, and export 3,89 billion USD.

Finland, is ranked third, among the nordic countries (trade with Norway) with the total import/export value with 2,87 billion USD (1,73 billion USD import; 1,14 billion USD export) (details in appendix E, table E.4).

The average import/export value from the Nordic countries is equal to for 5,86 billion USD.

Figure 8.12 Norway Import/Export 2015 Neighbours Countries (UN Comtrade , 2015)



8.5 Sweden Trade

Figure 8.13 shows Sweden top 5 import countries in 2015. The first country from where Sweden import products and services is Germany with a value of 24,77 billion USD (37,7 per cent).
Sweden import for 11,42 billion USD products and services from the Netherlands (17,37 per cent).
Norway rank third with a value of 11,32 billion USD (17,22 per cent). Denmark export to Sweden 10,61 billion USD (16,5 per cent); and last one is United Kingdom with total value of 7,61 billion USD (11,58 per cent) (see appendix F, table F.2, for details). The percentage considered is based on the value of top 5 import countries and not based on total import.

Figure 8.13 Sweden - Top 5 Import Countries 2015 (UN Comtrade)

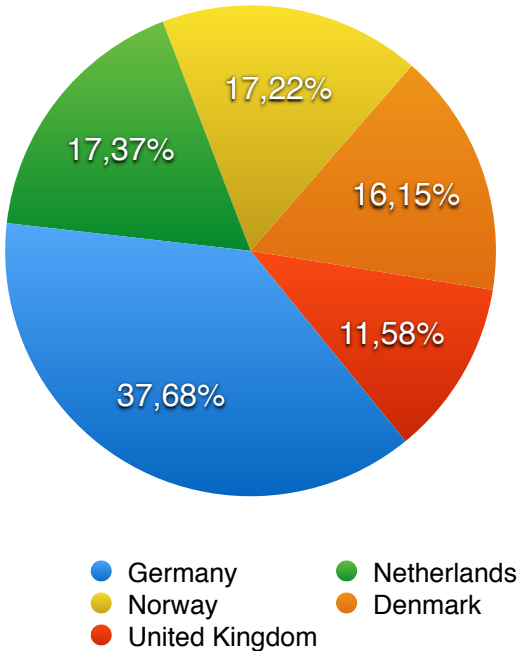
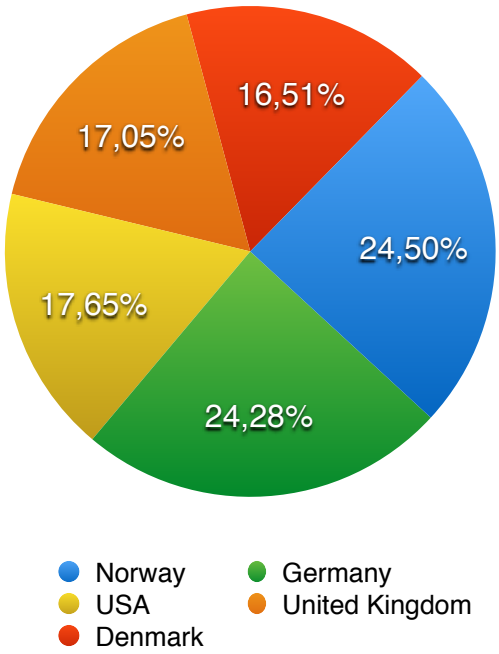


Figure 8.14 highlights Sweden top 5 export countries in 2015 (UN Comtrade).
Norway represents the major market for Sweden where the products are exported; the total value of this trade is 14,10 billion USD (24,50 per cent of top 5 export value).
Germany is ranked second with 13,98 billion USD (24,28 per cent); United States rank third, with the total value equal to 10,16 billion USD (17,65 per cent).
United Kingdom in fourth position, receive goods and services from Sweden with the total value of 9,81 billion USD (17,05 per cent). The last country receiving Swedish export is Denmark with the value equal to 9,50 billion USD (16,51 per cent) (see appendix F, table F.3, for details).
The percentage considered is based on the total value of top 5 export countries and not based on total value worldwide.

Figure 8.14 Sweden - Top 5 Export Countries 2015 (UN Comtrade)



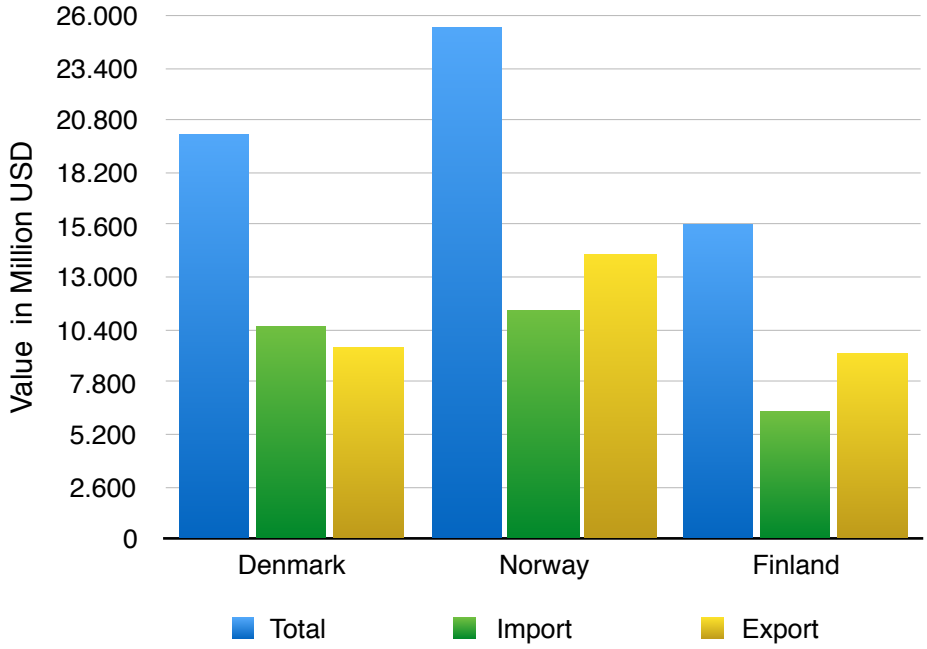
Analysing the details of the import and export trade between Sweden and Nordic countries is clear to highlight the major country partner - Norway.

Figure 8.15 shows the import/export trade value between Sweden and Norway-Denmark-Finland.

The Swedish total trade with Norway (figure 8.15) count for 25,43 billion USD, with import value equal to 11,32 billion USD, and total export equal to 14,10 billion USD.
Denmark total trade with Sweden counts for 20,12 billion USD. Sweden import from Denmark is 10,61 billion USD, and export 9,50 billion USD.
Finland, is ranked third, among the nordic countries (trade with Sweden) with the total import/export value with 15,62 billion USD (6,36 billion USD import; 9,26 billion USD export) (see appendix F, table F.4, for details).

The average import/export value from the Nordic countries to Sweden is equal to 13,59 billion USD.

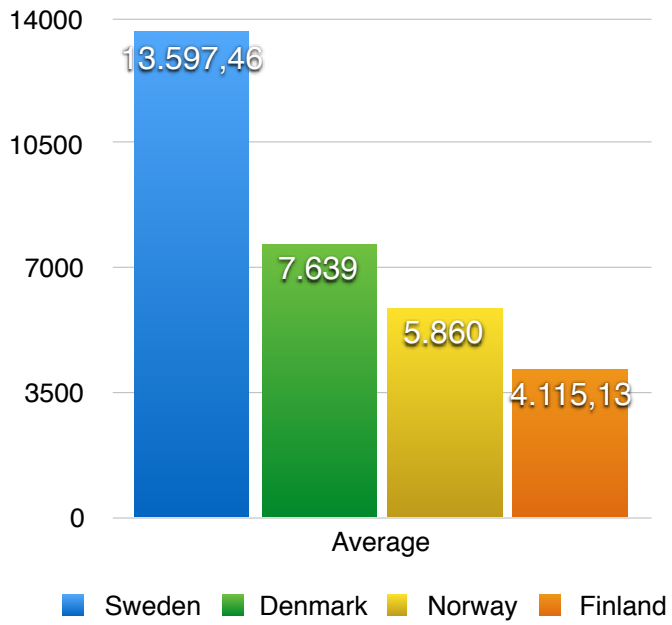
Figure 8.15 Sweden Import/Export 2015 Neighbours Countries (UN Comtrade)



8.6 Comparing the Average Value

This analysis is based on the average data calculated in the fig. 8.6, fig. 8.9, fig. 8.12; fig. 8.15. Figure 8.16 compares the different values of average according to the import/export trade value in USD between the four countries (value in thousands).
The result is that Sweden rank first for the trade value between the nordic countries, Denmark is second, third Finland, and fourth Norway.

Figure 8.16 Average Analysis - Import/ Export Countries



8.7 Comments

According to Ballou (1999, p.34) there are different products directed to the selected marketplaces (HS codes). Considering the figure 8.2, Sweden is the country with the highest level of export value for the selected products (6 categories out of 8 are higher compared with the other countries); instead, the figure 8.3 confirm Sweden as the top importer for the selected HS codes categories (8 out of 8).
It is confirmed by Mulcahy (1994) and Richards (2014) that one important element to consider, in warehouse investment, is the goods traffic flow; and Sweden definitely has the higher values in Import-Export compared to the selected countries. When discussing about *logistics centre,* Europlatform (2004) mention the goods flow on national and international basis; **in this case Sweden**, considering the trade values both by HS codes (categories) and by trade value among the Scandinavian countries (figures 8.6 - 8.9 - 8.12 - 8.15, summarised in figure 8.16), **is the country that perform better** (almost with the double

value fig. 8.16, compared to Denmark) **in Scandinavia** (trade flow perspective). Botha and Ittmann (2008) and Cullinane and Song (2002) confirm that the expansion of seaports (as critical link in SC) and economic growth (here the *trade* flow) are related; Sweden trade flow is higher compared to the rest of the countries (the seaports' expansion are investigated in the next sections).

The literature investigated and the supported data, highlight Sweden as the right location where to invest for a new warehouse/DC.

9. Analysis - Maritime

In this section several analyses are conducted in order to provide a general picture of the maritime sector in Denmark, Norway and Sweden. Finland is not taken into consideration because it is not part of the maritime research (only as a customer market).
A general overview of the maritime freight by country (and region), the port analysis investigation, and the navigation costs will contribute to a clearer picture of the selected countries and main ports (Oslo, Copenhagen-Malmo, Gothenburg, and Stockholm).

Image 9.1 Study Process Maritime Secto

9.1 Maritime Freight by Country

9.1.1 Denmark

According to Eurostat 2013, Denmark's national overall performance in freight (loaded and unloaded) counted for 74,500 thousand tonnes. Particularly the loaded in 2013 was 33,601 thousand tonnes and the unloaded 45,817 thousand tonnes. The port of Copenhagen is located in Hovedstaden region; this region counted 4,437 thousands tonnes and unloaded 8,933 thousand tonnes, with the total of 13,341 thousands tonnes. This data refers to the different regions and not the port itself.

Table 9.1 Denmark Maritime Freight

Maritime transport of freight - Denmark 2013 - Thousand tonnes	Loaded (1)	Unloaded (1)	Total (2)
Danmark	33.601	45.817	79.418
Hovedstaden	**4.437**	**8.933**	**13.370**
Sjælland	8.734	11.315	20.049
Syddanmark	13.098	12.783	25.881
Midtjylland	3.859	8.534	12.393
Nordjylland	3.474	4.251	7.725

Note

this table identify thousands with the "." "dot".
1) Eurostat 2013
2) Author analysis based on Loaded + Unloaded flow

9.1.2 Norway

According to Eurostat 2013, Norway nationally had a total of 187,287 thousands tonnes of freight. Particularly Oslo had 856 thousands tonnes loaded and 4,939 thousands tonnes unloaded, with a total of 5,794 thousands tonnes. In percentage terms Oslo accounts for 3.09 per cent of total Norwegian freight. This data refers to the different regions and not the port itself.

Table 9.2 Norway Maritime Freight

Maritime transport of freight - Norway 2013 - Thousand tonnes	Loaded (1)	Unloaded (1)	Total (2)
Norway	130.900	56.387	187.287
Oslo og Akershus	**856**	**4.939**	**5.795**
Sør-Østlandet	13.577	11.973	25.550
Agder og Rogaland	11.969	8.266	20.235
Vestlandet	51.602	20.791	72.393
Trøndelag	1.421	2.251	3.672
Nord-Norge	28.226	3.453	31.679
Extra-Regio level 1	23.251	4.715	27.966

Note

this table identify thousands with the "." "dot".
1) Eurostat 2013
2) Author analysis based on Loaded + Unloaded

9.1.3 Sweden

Sweden in 2013 accounted for 132,710 thousand tonnes of freight, with 59,745 thousands tonnes loaded and 72,965 thousands tonnes unloaded. Particular focus is on 3 different regions:

1) Stockholm
2) Sydsverige (Malmo)
3) Vastsverige (Gothenburg)

In 2013, Stockholm region had 9.009 thousands tonnes of freight by maritime transport, Sydsverige (Port of Malmo location) had 36,569 thousands of tonnes and Vastsverige (Port of Gothenburg location) had 47,025 thousands tonnes of freight.
This data refers to the different regions and not the port itself.

Table 9.3 Sweden Maritime Freight

Maritime transport of freight - Sweden 2013 - Thousand tonnes	**Loaded (1)**	**Unloaded (1)**	**Total (2)**
Sweden	**59.745**	**72.965**	**132.710**
Östra Sverige	6.806	13.610	20.416
Stockholm	**2.737**	**6.273**	**9.010**
Östra Mellansverige	4.070	7.338	11.408
Södra Sverige	39.943	47.874	87.817
Småland med öarna	1.777	2.230	4.007
Sydsverige	**16.033**	**20.586**	**36.619**
Västsverige	**22.134**	**25.057**	**47.191**
Norra Sverige	12.995	11.481	24.476
Norra Mellansverige	2.771	3.726	6.497
Mellersta Norrland	2.374	2.705	5.079
Övre Norrland	7.850	5.050	12.900

Note

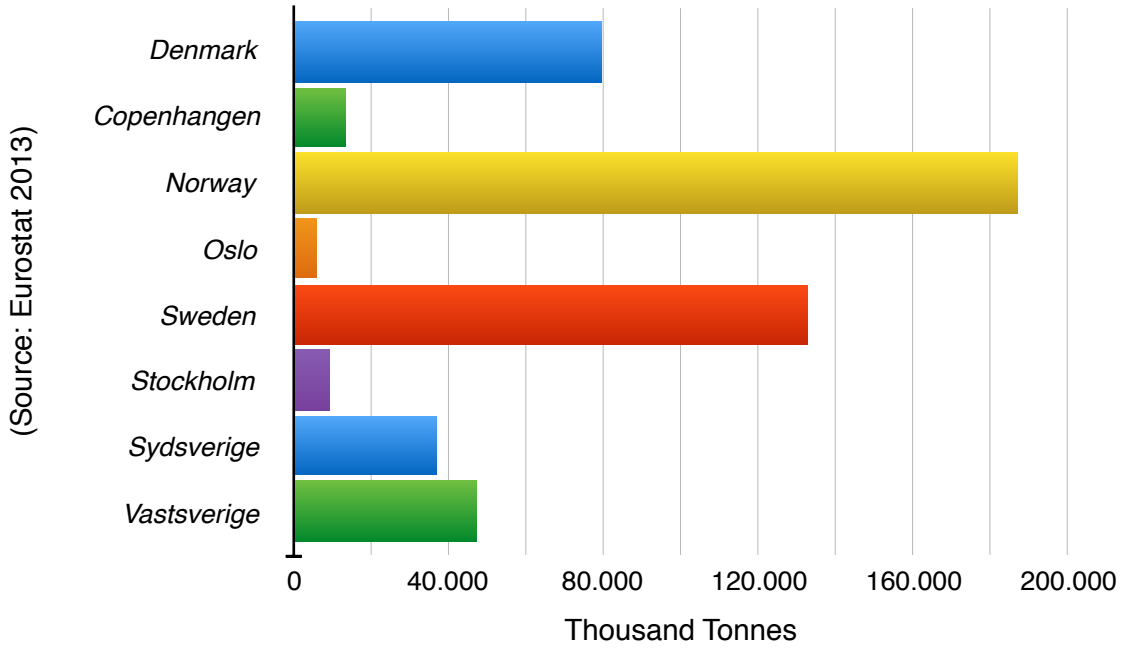
this table identify thousands with the "." "dot".

1) Eurostat 2013
2) Author analysis based on Loaded + Unloaded

9.1.4 Comparing the Freight Results

Figure 9.1 compares the results presented in the previous paragraphs.
In 2013 Norway had a higher turnover of freight compared to Sweden (2nd) and Denmark (3rd).

Figure 9.1 Comparing the Freight Results



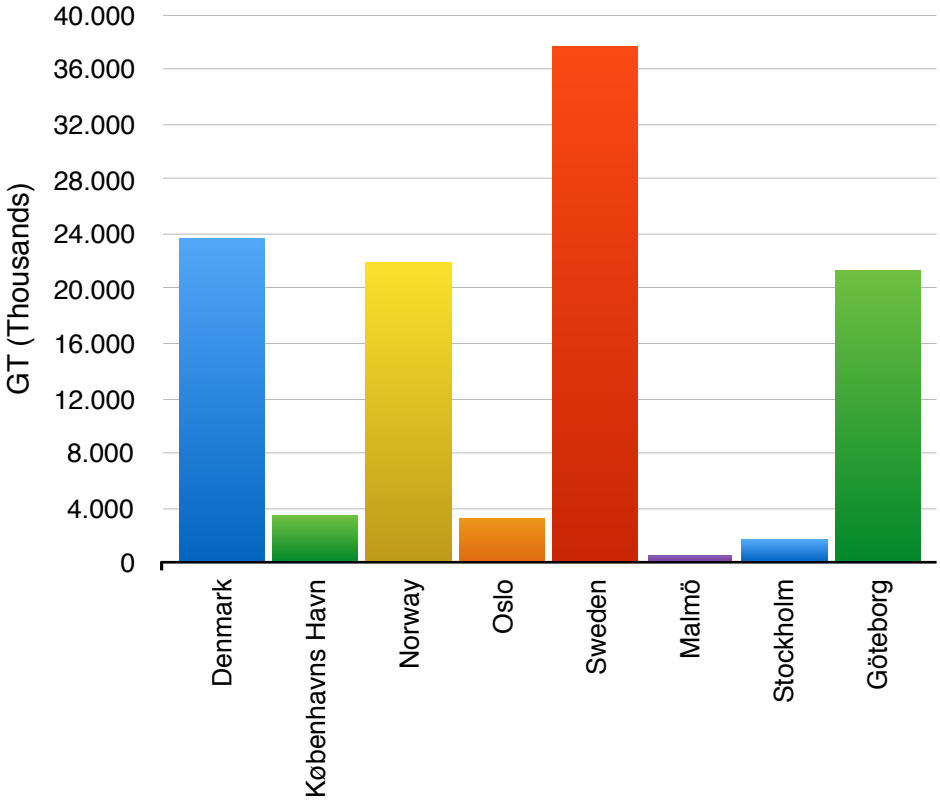
By contrast the region - Vastsverige, where Gothenburg is the capital, had the highest turnover freight compared to Sydsverige (Malmo, 2nd), Copenhagen (3rd), Stockholm (4th) and Oslo (5th).

9.2 Ports Overview

In order to show performance in gross tonnage (GT) by country, Eurostat (2014) reported the data by country and by port (Figure 9.2) (details in Appendix “H”, table H.0).

To better understand the port characteristics the appendix “G” provides some details for the selected ports; and the appendix “H” presents the *containerships data by port.*
Denmark in 2014 registered 23.59 million GT, while Copenhagen had 3.43 million GT, that represent the 14.55 per cent of the total Denmark.
Norway in 2014 registered 21.93 million GT, and Oslo registered 3.28 million GT, equivalent to 14.97 per cent of total Norway.
Sweden results being to largest country in terms of gross tonnage in 2014. Malmo registered 488 thousand GT, in percentage terms equal to 1.29. Stockholm registered 1.72 million GT (4.57 per cent); and last Gothenburg with 21.37 million GT (56.58 per cent of total Sweden). The PoG has almost the same GT levels of Norway (21,933 GT) and Denmark (23,595 GT). It results that Gothenburg represent the major port among the selected.

Figure 9.2 Gross Tonnage by Country and by Port

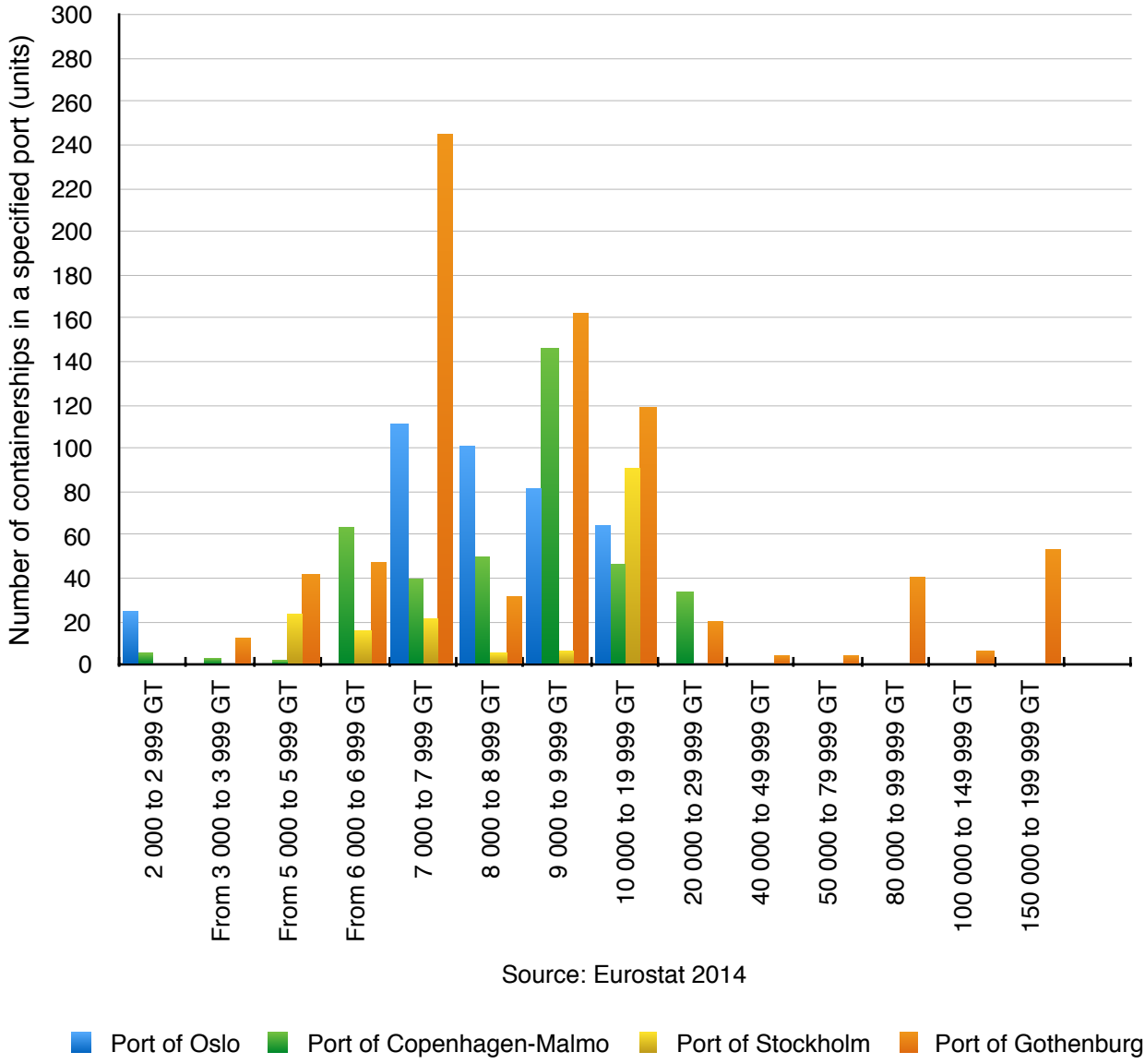


Source: Eurostat 2014

Figure 9.3 (Eurostat, 2014) (see appendix "H", table H.1 for details) contributes to the general understating of the number of containerships arriving to the Port of Oslo, Port of Copenhagen-Malmo, Port of Stockholm, and the Port of Gothenburg.
In total the four ports received 1,727 containerships (2014); 386 arrived at the port of Oslo (22,35 per cent), 389 to the port of Copenhagen-Malmo (22,52 per cent), 165 to the port of Stockholm (9,55 per cent), and 787 to the port of Gothenburg (45,57 per cent). In proportion, the Port of Gothenburg perform better than the other ports (see other tables in appendix H, from H.2 to H.5). Figure 9.3 shows the PoG as the only port (among the others) that receive calls by ships' GT range from 40.000 to 199.000.
The higher segment, for the PoG, is the calls by ships within 7.000 to 7.999 GT; the second higher segment is the call from ships within 9.000 - 9.999 GT.

Figure 9.3 can be considered as the shipping line preferences according to the most appropriate trade market (import-export) and port characteristics. The PoG is able to receive calls by larger containerships due to the water depth (introduced in the next sections).

Figure 9.3 Number of Containerships in Specified Ports (inwards) (2014)



Source: Eurostat 2014

The appendix H, table H.4, summarise the port's call performance. The PoG received a larger number of calls (compared with the selected ports) in different categories (in total 10 out of 14); it is the only port able to receive calls from containerships in different ranges, from 40,000 to 199,999 GT.

Instead the Port of Oslo received calls (25) for the segment 2.000-2.999 (equal to 83,33 per cent for the total segment), and 101 calls (segment 8.000-8.999) equal to 53,72 per cent. By contrast the Port of Copenhagen-Malmo (CMP) received 63 calls for the segment 6.000-6.999, equal to 49,61 per cent of the total segment; CMP performed better in the segment 20.000-29.999 with 34 calls, equal to 61,82 per cent of the total segment.

In the appendix "H" a comparison analysis is provided by port and by category.

9.3 Container Traffic for Selected European Ports

The previous paragraphs already provided an idea about the selected ports, showing Sweden - Gothenburg as the

Table 9.4 introduce the country's annual throughput, the liner shipping line index (LSCI), and liner shipping bilateral connectivity index (LSBC).

The *throughput rate* (2013 and 2014), in table 9.4, shows the total number of TEUs (and FEUs) by country. UNCTAD (2016a) define it as "*TEU (Twenty foot Equivalent Unit) include loading, unloading, repositioning and transshipment containers as well as Forty-foot Equivalent Units (FEUs) being counted as two TEUs."* Sweden, for the referred years, result being the country with the highest level of throughput, followed by Denmark and Norway.

UNCTAD (2016b) defines "*the Liner Shipping Connectivity Index captures how well countries are connected to global shipping networks*" and "[…] the number of ships, their container-carrying capacity, maximum vessel size, number of services, and number of companies that deploy container ships in a country's ports". It results that Sweden, has the higher connectivity index (58,84) compared to Denmark (54,85) and Norway (5,89).

Another index considered to compare the countries is the *liner shipping bilateral connectivity index*, which indicates a country pair's integration level into global liner shipping networks (UNCTAD, 2016b). China was considered as the second country, to compare, because the major shipping routes are from Asia (China) to Europe. It results that Sweden has the higher index (0.58) followed by Denmark (0.54) and by Norway (0.27); the maximum level is equal to 1.

Table 9.4 Containers Traffic by Country and Index

General data	Denmark	Sweden	Norway
Throughput 2013 (TEUs) (1)	873.464	1.602.472	360.635
Throughput 2014 (TEUs) (1)	918.011	1.684.198	379.027
Liner shipping connectivity index (2) 2016	54,85	58,84	5,89
Liner shipping bilateral connectivity index, annual, 2014 (3)	0,54	0,58	0,27

Note

this table identify thousands with the "." "dot"; the "comma" "," identify decimals

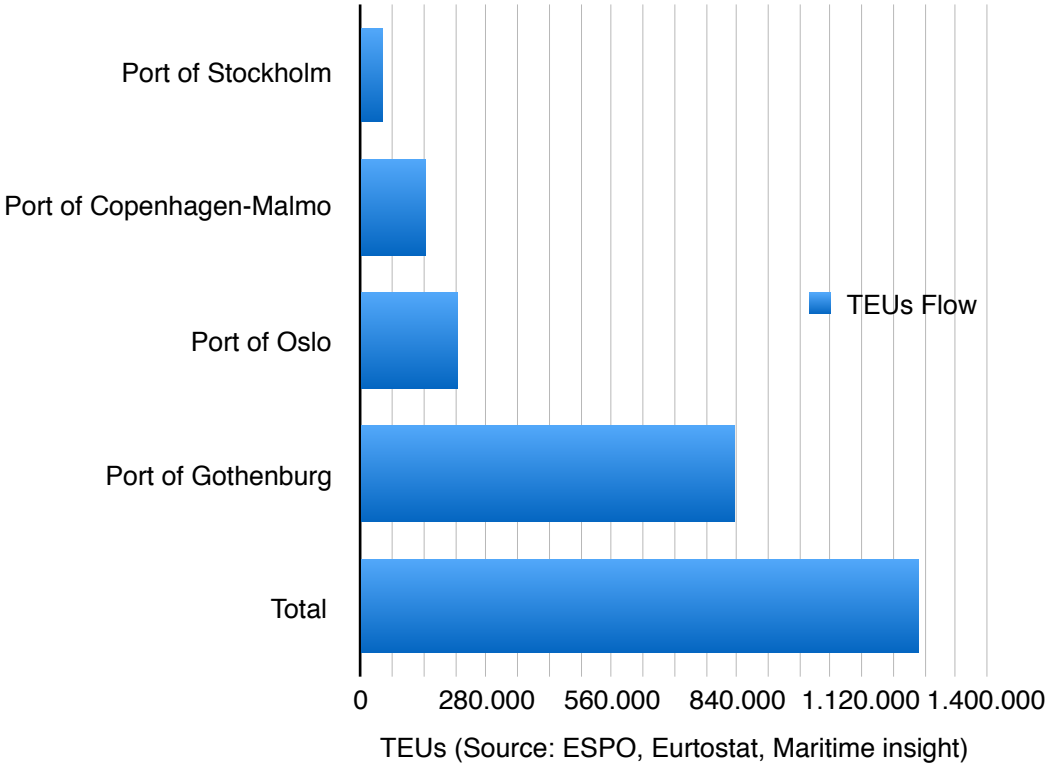
1) Unctadstat.unctad.org. (2016a)
2) Unctadstat.unctad.org. (2016b), Max = 100
3) Unctadstat.unctad.org. (2016c), Max = 1

Figure 9.4 represents the TEUs flow for the selected ports. The total TEUs flow is 1,245,210.

According to ESPO (2014), the Port of Stockholm, has the lowest TEUs level equal to 51,000 TEUs (4.09 per cent of the total), the Port of Copenhagen-Malmo, with 145,000 TEUs (11.64 per cent), the Port of Oslo with 212,579 TEUs (17.07 per cent), and last one, the Port of Gothenburg with 836,631 TEUs (67.17 per cent of the total), is the largest port

for TEUs flow in 2014 (see table H.6 in Appendix “H”). The data, in figure 9.4, were collected through ESPO, Eurostat and Maritime Insight.

Figure 9.4 Containers Traffic for Selected Scandinavian Ports (2014)



9.4 Ports' Traffic Data

A relevant investigation is the analysis of the traffic (containers, TEUs, throughput, number of vessels and Ro-Ro) in order to evaluate the ports' traffic. The table below (9.5) provides a general overview about the total throughput, number of vessels, number of containers and number of TEUs by port in 2015. From the data collected by ESPO (2015), is confirmed that the Port of Gothenburg has a better performance comparing to the other ports; by contrast the Port of Stockholm receives a higher number of vessels (16,084).

Table 9.5 Ports' Traffic Throughput-Containers 2015

	2015 (1)	Port of Oslo	Port of Stockholm	Port of Copenhagen -Malmo (3)	Port of Gothenburg	Total
1	**TOTAL THROUGHPUT (1.1+1.2)**	**5.773.000**	**8.336.000**	**14.500.000**	**38.200.812**	**66.809.812**
1.1	Inward	4.677.000	5.315.000		19.739.229	29.731.229
1.2	Outward	1.096.000	3.021.000		18.461.583	22.578.583
2	**NUMBER OF VESSELS**	**9.236**	**16.084**	**7.800**	**11.000**	**44.120**
3	**NUMBER OF CONTAINERS (3.1+3.2)**	**116.897**	**34.034**	**-**	**476.961**	**627.892**
3.1	**Empty (3.1.1+3.1.2)**	**42.512**	**9978**		**81.362**	133.852
3.1.1	Inward	2.361	888		51.749	54.998
3.1.2	Outward	40.151	9.090		29.613	78.854
3.2	**Loaded (3.2.1+3.2.2)**	**74.385**	**24.056**		**395.599**	494.040
3.2.1	Inward	60.118	18.039		193.932	272.089
3.2.2	Outward	14.267	6.017		201.667	221.951
4	**NUMBER OF TEUs (4.1+4.2)**	**195.459**	**50.943**	**164.000**	**819.953**	**1.230.355**
4.1	**Empty (4.1.1+4.1.2)**	**71.585**	**15.354**		**139.071**	226.010
4.1.1	Inward	3.764	1.523		97.358	102.645
4.1.2	Outward	67.821	13.831		41.713	123.365
4.2	**Loaded (4.2.1+4.2.2)**	**123.874**	**35.589**		**680.882**	**840.345**
4.2.1	Inward	99.109	27.130		323.029	449.268
4.2.2	Outward	24.765	8.459		357.853	391.077
5	**Number of Ro-Ro**	**726**	**3.943**	**715**	**9.288**	**14.672**

Note: this table identify thousands with the "." "dot", and decimals with the "comma" ","

1) Source data ESPO, 2015
2) Author's data elaboration
3) CMPort.com

9.5 Ports Characteristics Overview

Ports differs in infrastructural characteristics, different services provided, water condition during the winter, and facilities. Table 9.6 summarise the different characteristics for the selected ports (see appendix “G” for details). Other ports’ specifications are in the tables 9.7 - 9.8.

Table 9.6 Port’s Characteristics

	P. Malmo	P. Copenhagen	P. Oslo	P. Stockholm	P. Gothenburg
	Port details				
Port Number (1)	PO3225	PO1422	PO2303	PO2626	P2582
UNLOCODE	SEMMA	DKCPH	NOOSL	SESTO	SEGOT
Latitude (2)	55° 37' N	55° 42' N	59° 54' N	59° 20' N	57° 41' N
Longitude (2)	12° 59' E	12° 38' E	10° 44' E	18° 3' E	11° 51' E
Max Draught	12.5	11.5	11	11	19.05
Max LOA	260	NA	NA	295	350
Max Offshore BCM	NA	NA	NA	NA	NA
Max Beam	45	NA	NA	32.3	NA
MAX DWT	NA	NA	NA	NA	225.000
	Port Facilities				
Container Facilities	Y	Y	Y	Y	Y
RoRo Facilities	Y	Y	Y	Y	Y
	Navigation				
Dock density (3)	1010	1005	1025.	1005.	Average 1013.
Weather	**Malmo** : the harbour is practically never closed by ice, drift ice can be encountered in the outer part of the dredged channels even during normal winters. **Copenhangen:** Prevailing winds: W’ly.		-	Ice: Navigation is maintained throughout the year with the assistance of icebreakers. However, branch passages are often closed during severe periods of icing.	Ice: The harbour is generally ice free, although it may have ice in the period January to March in hard winters.

	P. Malmo	P. Copenhagen	P. Oslo	P. Stockholm	P. Gothenburg
Tugs	3	Compulsory for vessels over 100m in length, passing through bridges.	Tugs are available by arrangement with vessel's agent prior to arrival/ departure. The largest tugs are equipped for fire fighting	2 ("Tug" 2,400hp, 30 board pull; "Ted" 1,400hp, 15 bollard pull)	min. 3 tugs. Other info Appendix.
	Port Description				
Number of vessels	8000		Approx 9,020	NA	NA
Tons of cargo	14,400,000t cargo		5,820,000t of cargo	Approx 8,500,000 of cargo,	38,200,000t of cargo
TEUs	141,000TEU		202,500TEU	27,840TEU	820,000TEU
MAX size	LOA 260m, beam 45m, draught 12.5m	Provestenen Harbour: Draught 11.5m.	Max draught in Drobak Passage is 12.0m, alongside 11.0m.	Largest vessels handled: Passenger and dry cargo vessels: LOA 295m, beam 32.3m, draught 11.0m. Hammerby Lock: Length 115m, width 17.4m, depth 6.5m. Vessels transiting Lake Maleran max airdraught 25.2m.	LOA 350m, tanker draught 19.05m (18.6m if water level low), container draught 11.5m, 225,000DWT. Max airdraught in Inner harbour 45m. Gota River: LOA 89m, beam 13.4m, draught 4.7m, with special permission up to 5.4m. Airdraught 27.0m. Bohus: LOA 135m, beam 16.5m. Trollhattan Kanal: LOA 125m and beam 16.5m.

Note

1) Sea-web 2016
2) Conversion latitude and longitude ports in the appendix "G"
3) Dock density, see definitions.
4) Y = YES
5) NA = Not Available

Tables 9.5 and 9.6 show different results in terms of vessels traffic.
The port of Stockholm received 16,084 vessels (ESPO, 2015), instead the data are not available in Sea-Web for the year 2015 (2016). Instead, regarding the Port of CMP there is

a slight difference between the two sources; similar situation is for the port of Oslo. Instead the PoG received 11,000 vessels in 2015, but this data cannot be confirmed by Sea-web because it wasn't available.

Table 9.7 shows infrastructure available for the selected ports; some data were not available, even trying to combine different sources.

Table 9.7 Facilities Available in Ports

	P. Malmo (1)	P. Copenhagen (2)	P. Oslo (1)	P. Stockholm (1)	P. Gothenburg (1)
Warehouses (w)	200.000		88.500	4 (tot: 140,000m2)	137.200
Car storage (m2)	250.000		NA	NA	63.000 (5)
Container storage (m2)	50.000		NA	NA	180.000 (5)
Roofed storage (m2)	16.000		NA	NA	NA
Ro-Ro Storage:	NA		NA	NA	150.000 (5)
Land storage area (m2)	250.000		1.255.000 (land area) (3)	1,140,000 (land area) (4)	1.000.000
Terminal buildings	4.700		NA	NA	NA

Note

1) Sea-web 2016
2) CMPort.com
3) Port of Oslo 2016
4) Port of Stockholm 2014
5) Port of Gothenburg (private source)

Table 9.8 summarised the different cranes available in ports. The data have been elaborated in the next paragraphs in order to compare the cranes performance among the ports.

Table: 9.8 Equipment Available in Ports - Cranes

(1)	P. Malmo	P. Copenhagen	P. Oslo	P. Stockholm	P. Gothenburg
	Stationary cranes				
	3 * 20t		-	-	-
	Mobile crane				
< 50t	1 * 40t		1 * 16-23t	-	1 * 40-50t
< 100t	2 * 64t		1 * 20-100t	-	1 * 40-60t
<300t	-		-	1 * 260t	-
	Gantry Crane				
< 40t	1 * 40t	-	2 * 35-40t	-	-
< 50t	-	3 * 50t	1 * 35-50t	2 * 42t; Outreach 22m.	2 * 40-45t
< 50t 2	-	**-**	1 * 40-50t	-	-
< 70t	-	-	-	-	4 * 40-70t
Post Panamax crane	-	-	-	-	2 x 45-70t

Note

1) Sea-web 2016
2) CMPort.com

9.5.1 Berth descriptions

In this paragraph are reported several tables to highlight the different infrastructure characteristics (berth length, depth, and draught) to measure the competitiveness of the ports. The fours ports have other berths such as berth for cruises and berths for tankers, but in this investigation were considered only the following berths: RO-RO, containers and general cargo. The data are elaborated in the next paragraphs.

Table 9.9 Port of Stockholm Berth

Port of Stockholm Area (1)	Berth number	Length (m)	Depth Use (m)	Average depth (m)	draught	Use
Stadsgarden (and Masthamnen)	S162 to S163	200	7,5	7,5		Ferry Terminal. Cruise vessels. Ro-Ro ramp to SE of 163 (fore or aft) 25m wide.
	S164	200	7,5	7,5		Ferry Terminal. Cruise vessels. Ro-Ro ramp to SE of 163 (fore or aft) 25m wide.
Vartahamnen Cruise and Ferry terminal	V508	180	8,5	8,5		Ro-Ro. Fast passenger and freight ferries. Ramp (fore and aft loading) 14.0m to W end. (3 other side ramp areas 9m and 10m). Pier area due to be redeveloped and expanded.
	V509 to V512	298	8,0 to 8,5	8,25		Ro-Ro. Fast passenger and freight ferries. Ramp to W end (fore and aft loading) 23m wide. Pier area due to be redeveloped and expanded.
	V515 to V520	367	7,5 to 8,5	8		Ro-Ro. Fast passenger and freight ferries. Ramp to W end (fore and aft loading) 21m wide. Pier area due to be redeveloped and expanded.
Frihamnen Cruise and Ferry Termnal	F641 to 640 (Quay 4)	110	7,5	7,5		Ro-Ro berth (see F630 and F650)
	F650 to F652 (Quay 5)	222	7,5 to 8,5	8		Ro-Ro ramp at SW (Quay 4) 55m wide.
Container Terminal Frihamnen (CTF)	F653 to F655	240	8,5 to 9,0	8,75		Containers
Total (2)		**1817**		**64**		
Average (2)		**227,13**		**8**		

Note

this table identify thousands with the "." "dot", and decimals with "," "comma"

1) Source: Sea-web
2) Our analysis

Table 9.10: Port of Malmo Berth

Port of Malmo Area (1)	Berth number	Length (m)	Depth Use (m)	Draught (m)	Use
New Harbour	**504**	175	7,2	6,6	Ro-Ro, ferries, draught 6.6m
	505-506	180	7,2	6,6	Ro-Ro, ferries, draught 6.6m
Free port	**606-604**	120	9,1	8,6	Ro-Ro and general cargo, LOA 240m, beam 32.5m,
	605	185	8,1	-	Ro-Ro
	612-615	500	9,2	8,6	General cargo/Ro-Ro,
Toyota Nordic Hub Terminal	**616**	325	10,0	-	Ro-Ro
	617	190	9,0	-	Ro-Ro
Nordo-Link Ro-Ro Terminal	**702**	245	8,5	-	Ro-Ro and Ro-Pax ferries
	703	245	8,5	-	Ro-Ro and Ro-Pax ferries
	704	245	8,5	-	Ro-Ro and Ro-Pax ferries
Malmo Container Terminal (North Harbour)	**705**	150	9,2	-	LOA 240m
	706	150	9,2	-	LOA 240m
Total	**-**	**2535**	**103,7**	**-**	-
Average	**-**	**211,25**	**8,6**	**-**	-

Note this table identify thousands with the "." "dot", and decimals with "," "comma"

1) Source: Sea-web

Table 9.11 Port of Copenhagen Berth

Port of Copenhagen Area (1)	Berth number/ name	Length (m)	Depth Use (m)	draught	Use
MELLEMBASSIN (NU TOLDHAVN)	220, DFDS	27	9	-	Ro-Ro ramp area for Berth 221, 28m wide (fore or aft).
	221, DFDS Ostre leje	173	9	-	Passengers and cargo.
	222, DFDS Vestre leje	200	9	-	Passengers and cargo. Ro-Ro ramp area 22m wide (fore or aft).
	227, DFDS Ro/Ro leje	210	7	-	Passengers and cargo. Ro-Ro ramp 24m wide (fore or aft).
ORIENTBASSIN (FRIHAVN)	255, Traelastkaj	72	9,5	-	Containers. End of Orientbassinet.
	256, Traelastkaj	72	6	-	Containers. End of Orientbassinet.
	257, Levantkaj	98	6	-	Containers.
	258, Levantkaj	130	9,5	-	Containers.
	259, Levantkaj	33	9,5	-	Containers. Ro-Ro.
	260, Levantkaj	105	9,5	-	Containers.
	261, Levantkaj	100	9,5	-	Containers.
	262, Levantkaj	100	9,5	-	Containers.
	263, Levantkaj	112	9,5	-	Containers.
	264, Levantkaj	100	9,5	-	Containers.
	265, Levantkaj	100	9,5	-	Vehicles. General cargo. Ro-Ro.
	266, Levantkaj	98	9,5	-	Vehicles. Ro-Ro.
FAERGEHAVN NORD	393	100	6	-	Containers.
	394	150	6	-	Containers.
	395	100	6	-	Containers.
	396	100	6	-	Containers.
KALKBRAENDERIHAVNEN	401, Kalkbraenderilobskaj	115	6,7	-	Dry bulk. Ro-Ro (fore or aft).
	402, Kalkbraenderilobskaj	100	6,3	-	Ro-Ro (fore or aft)
CHRISTIANSHOLM	642, Vestkaj	147	6	-	Palletised cargo
Total (2)	**-**	**2542**	**184**	**-**	-
Average (2)	**-**	**110,5**	**8**	**-**	-

this table identify thousands with the "." "dot", and decimals with "," "comma"

Note

1) Source: Sea-web 2016
2) Our analysis

Table 9.12 Port of Oslo Berth

Port of Oslo Area (1)	Berth number/ name	Length (m)	Depth Use (m)	Average depth (2)	Draught	Use
Filipstad Terminal:	General cargo Berth	463	8,7-9,1	8,9	-	General cargo, breakbulk, Ro-Ro and containers
General Cargo Terminal:	Kneppeskjaer	165	6,4-8,0	7,2	-	PCC, containers and Ro-Ro
Container Terminal:	Sondre Sjursoykai	304	12	12	-	Containers
Container Terminal (South):	Ormsundkaia	287	9,3-9,6	9,45	-	Containers
Total (2)	**-**	**1219**	**-**	**28,65**		
Average (2)	**-**	**304,75**	**-**	**7,1625**		

this table identify thousands with the "." "dot", and decimals with "," "comma"

Note

1) Source: Sea-web
2) Our analysis

Table 9.13 Port of Gothenburg Berth

Port of Gothenburg Area (1)	Berth number	Length (m)	Depth Use (m)	Average depth (m)	Average
Alvsborgshamnen Ro-Ro Terminal	751	203	9,8	9,8	LOA 180m, draught 9.3m. Width of ramp 26m
	750A	47	9,8	9,8	Ro-Ro ramp width 50m. Draught 9.3m
	750	225	9,8	9,8	Ro-Ro. LOA 200m, draught 9.3. Width of ramp 26m.
	713	200	11,0	11,0	Ro-Ro. LOA 230m, draught 8.9m. Width of ramp 26m.
	712	149	11,0	11,0	Ro-Ro. LOA 230m, draught 10.5m. Width of ramp 43m.
	711	232	11,0	11,0	Ro-Ro. Draught 10.5m
	710	265	11,0	11,0	Ro-Ro. Draught 10.5m. Width of ramp 26m
	702	210	11,0	11,0	Ro-Ro. LOA 197m, draught 10.5m. Width of ramp 24m.
	700	190	9,5	9,5	Ro-Ro. LOA 184m, draught 9.0m. Width of ramp 28.7m.
AMP Container Terminal: Total length 1,750m (source PoG and sea-web.com)	643	135	14,2	14,2	Ro-Ro. Width of ramp 54m. Max LOA 250m when draught 10.5m, max LOA 300m when draught 9.5m
	642	95	14,2	14,2	Continuous length 640m, max LOA 250m when draught 10.5m, max LOA 300m when draught 9.5m
	641	190	14,2	14,2	Continuous length 640m, max LOA 250m when draught 10.5m, max LOA 300m when draught 9.5m
	640	190	14,2	14,2	Continuous length 640m, max LOA 250m when draught 10.5m, max LOA 300m when draught 9.5m
	615	190	14,2	14,2	Ro-Ro. Width of ramp 27m. Continuouse length 1,132m, LOA 200m, draught 10.4m
	614	190	14,2	14,2	Continuous length 1,132m, LOA 390m, draught 11.5m
	613	190	14,2	14,2	Continuous length 1,132m, LOA 390m, draught 11.5m
	from 610 to 612	570	14,2	14,2	From the east for 500m, the water depth is 14.2m MW. At the rest of berth, the water depth is 12.0m except for the last 220m where the depth is 11.9m MW. Continuous length 1,132m, draught 13.5m
Logent Ports & Terminals Car Terminal	601	135	14,2	14,2	Vehicles. LOA 290m
	600	170	14,2	14,2	Vehicles. LOA 170m
Stena Line Germany Terminal - Majnabbehamnen	46	60	9	9	Reserved space

Port of Gothenburg Area (1)	Berth number	Length (m)	Depth Use (m)	Average depth (m)	Average
	47	138	9	9	Ro-Ro, passengers, containers. Ramp 55m long by 27m width
	48	137	9	9	Ro-Ro, passengers, containers. Ramp 55m long by 27m width
	49	140	9	9	Ro-Ro, passengers. Ramp 55m long by 26.8m width
Total (2)		4251	271,9		
Average (2)		184,83	11,82		

this table identify thousands with the "." "dot", and decimals with "," "comma"

Note

1) Source: Sea-web, 2016
2) Our analysis

Table 9.14 add extra information about each single port, such as working hours, holiday, transport network availability.

Table 9.14 Extra info

(1)	SE	DK	NO	SE	SE
	Malmo	**Copenhagen**	**Oslo**	**Stockholm**	**Gothenburg**
Public holidays (fixed) (not days)	14	7	9 + All weekends	16 + ALL weekends	14
Public holidays (moveable) (not days)	7	8	8	7	7
Working hours	Straight time 0700-1600hrs, overtime 1600-0600hrs.	Normally Mon-Thu 0700-1500hrs, Fri 0700-1430hrs. All weekend work is overtime.	Open throughout 24 hours. Day watch 0700-1530hrs. Sat: Voluntary and with overtime pay.	Normally Mon-Fri 0700-1600hrs.	Normally Mon-Fri 0700-1600hrs; Container Terminal 0700-2359hrs, Fri 0630-2200hrs. All other hours are overtime. The oil ports work throughout 24 hours.
Surveyors:	Class and cargo surveyors are located at Malmo and Gothenburg.	-	Available.	All surveyors for both dry and liquid cargo are available.	-
Barges	available	none	available	-	vailable from towage company.
Drydocks:	Small drydock and shiplift available.	none	Not available in Oslo.	Two graving drydocks available. Size of vessels that can be handled: LOA 185m, max beam 22m, max draught 8.5m.	2
Transport	**Malmo Transport:** Nearest airport: Sturup/Malmo approx 30km; City International located in port area with service directly to Copenhagen Airport which has world wide connections. Nearest railway: Malmo Central (passenger and freight) 2km. Nearest motorway: Approx 2km. **Copenhagen** Nearest airport: Copenhagen (Kastrup), 8km from city centre. Nearest railway: Copenhagen.		Nearest airport: Gardermoen Airport, approx 50km from Oslo City Air Terminal. Nearest railway: Oslo Central, close to the port.	Nearest airport: Arlanda International Airport, 45km, Bromma Airport, 8km. Airport facilities: Arlanda International full facilities, Bromma mostly domestic flights. Nearest railway: Stockholm City.	Nearest airport: Landvetter 30km. Nearest railway: Central Station (city centre).

Note 1) Source: Sea-web

9.6 Ports' Characteristics Analysis

Considering the table 9.8 (Equipment available in Ports - Cranes), in the next table (9.15) the different cranes and handling capacity (in tonnes) are considered to develop the **port's crane tonnes efficiency indicator,** in order to analyse which port perform better comparing to the others.

Table 9.15 Port's Crane Tonnes Efficiency Indicator

	Stationery cranes (1)		Mobile cranes (1)		Gantry cranes (1)		WA by port (A)	Percentage on total (B)
	Quantity	Tonnes	Quantity	Tonnes	Quantity	Tonnes	-	-
Port of Copenhagen-Malmo	3	20	1 2	40 64	1 3	40 50	**268,70**	**19,14**
Port of Oslo			1 1	19,5 60	2 1 1	37,5 42,5 45	**197,22**	**14,05**
Port of Stockholm			1	260	2	42	**260,28**	**18,54**
Port of Gothenburg			1 1	45 50	2 4 2	42,5 55 57,5	**400,46**	**28,52**
Total tonnes	**970,5**							
Total Weighted Average	**1.404,12**							
Note	This table identify thousands with the "." "dot", and decimals with "," "comma" 1) Source: Sea-web 2016. 2) WA: Weighted average mean							

In order to calculate the port's crane tonnes efficiency indicator the weighted average is computed.
For those ports with the crane range (in tonnes), e.g. Oslo Gantry crane (quantity = 2) and different capacity (35-40t) (table 9.8), the average was calculated = 37.5t ((35+40)/2); the same formula was applied to the other ports's crane tonnes range.

The *first step* is to calculate the weighted average by port in column "A", as below:

Port of Stockholm = [(1*260) + (2*42) / (260+42)] = 260.28

The *second step* is to calculate the *total weighted average* (using the similar approach above), in order to compare the different ports' cranes. The total weighted average identified is **1.400,12.**

The *third step* is to relate the weighted average by port with the total weighted average (proportion); the proportion is calculated as below:

Port of Stockholm: [(260.28/1.404,12) * 100] = **18.54**

Table 9.15 highlights the PoG as the port with higher tonnes capacity (28.52 per cent, compared with the other ports). In second position the Port of Copenhagen-Malmo with 19.10 per cent crane efficiency; third is the Port of Stockholm with 18.52 per cent; and last one is the Port of Oslo with 14.03 per cent.
The figures above explain that PoG, compared to the others ports (cranes and capacity), has the most appropriate equipment (cranes) able to manage large vessels (in tonnes terms).

Table 9.16 Performance Indicators

	(1)	Port of Copenhagen-Malmo	Port of Oslo	Port of Stockholm	Port of Gothenburg	Total
1	**Port's Crane Tonnes Efficiency Indicator (%)**	19,14	14,05	18,54	**28,52**	-
2	**Weighted Average Berth (length and depth)**	8,34	9,57	8,05	**12,12**	-
3	**Throughput by Port (2015) / Total Four Ports (2015)**	21,70%	8,64%	12,48%	**57,18%**	-
4	**Throughput (2015) / Total Berth Length**	2.761	4.736	4.588	**8.986**	5.328,16
5	**TEUs (2014) / Containerships (2014)**	372,75	550,72	309,09	**1063,06**	721,02
6	**Throughput (2015) / Vessels (2015)**	1.858,97	625,05	518,28	**3.472,80**	1.514
7	**Vessels (2015) / 12 months**	650	770	**1.340**	917	3.677
8	**Containerships (2014) / 12 months**	32,42	32,17	14	**66**	144
9	**RO-RO (2015) / 12 months**	60	61	329	**774**	1.223
10	**Percentage of containerships by port (2014)**	22,52%	22,35%	9,55%	**45,57%**	-

Note This table identify thousands with the "." "dot", and decimals with "," "comma"
1) our analysis

The **Performance indicator 1)** *Port's Crane Tonnes Efficiency Indicator,* was previously calculated in table 9.15

The **Performance indicator 2)** *Weighted Average Berth* (see appendix G, table G.3) was calculated to identify which port in average terms has the longest berths length and depth.
The result is that PoG has a longer berths length and depth, in relation to the other ports.

The **Performance indicator 3)**, *Throughput by Port / Total Four Ports,* was calculated taking into consideration the figures in the table 9.5, n order to compare the port's throughput with the total throughput (four ports). The result is that PoG, in relation to the other ports, has 57.18 per cent of the total throughput.

The **Performance indicator 4)** *Throughout / Total Berth Length*, is calculated considering :
[(Cargo Throughput 2015) / (Tot. Berths Length)].
Cargo Throughput, data in table 9.5 (1).
Total berth length (dedicated port data in tables 9.9 - 9.10 - 9.11 - 9.12 - 9.13).
Example: Port of CMP = [Cargo Throughout (14,500,000) / Tot. Berth Length (2,710 + 2,542)] = 2,761. The result represent the berth utilisation rate (by meter). The *total* is calculated considering the *Total Throughout* and the *Total berths length (among the ports). PoG has the higher berth utilisation rate, considering the total length and total throughput.*

The **Performance indicator 5)** *Number TEUs / Number of Containerships* is calculated considering:
[(Number TEUs (2014) / (Number of container ships (2014)].
Number of TEUs (data in figure 9.4 or Appendix H, table H.6).
Number of Containerships (data in figure 9.3 or Appendix H, table H.1).
This indicator shows which port, in average terms, received more TEUs related to the number of containerships. The *total* considered the total number of TEUs 2014 (1,245,210) for the selected ports and the total number of containerships for the selected ports 2014 (1,727) (see Appendix H, table H.2). The PoG, in relation to the number of containerships, receives (discharge) more TEUs (1,063) in relation to number of ships.

The **Performance indicator 6)** *Throughput / Vessels* is calculated considering:
[(Throughput by port, 2015) / (Number of Vessels by port, 2015)].
Throughput (data in table 9.5 (1). Number of Vessels (data in table 9.5 (2).
This indicator shows which port receive the higher level of throughput by vessels. The *total* considered (1) 66,809,812 and the total number of vessels (2) 44,120. In average terms the PoG has the higher level of throughout by vessels.

The **Performance indicator 7)** *Vessels / 12 months* is calculated considering:
[(Number of vessels by port (2015) / (12 months)].
Figures of vessels in table 9.5 (2).
This indicator shows, in average terms, the number of vessels per month by port. The port of Stockholm has, in average terms, the higher number of vessels.

The **Performance indicator 8)** *Containerships / 12 months* is calculated considering:
[(Number of containerships (2014) / (12 months)].
Figures of containerships (2014) in table H.1 (appendix H).
This indicator shows, in average terms, the number of containerships per month by port. The PoG has, in average terms, the higher number of containerships (66 per month).

The **Performance indicator 9)** Ro-Ro / 12 months
[(Number of Ro-Ro (2015) / (12 months)].
Figures of Ro-Ro (2015) in table 9.5 (5).
This indicator shows, in average terms, the number of Ro-Ro's per month by port. The PoG has, in average terms, the higher number of Ro-Ros (774 per month).

The **Performance indicator 10)** *Percentage of containership by port,* is calculated considering:
the figures in tables H.1 and H.2 (appendix H). The percentage calculated considered the total number of containerships by port and the total number of containerships.
Example: PoG = [(787) / (1727) * 100] = 45.57 per cent
It results that PoG received in 2014, 45 per cent of the total containerships, for the selected ports.

9.7 Port's Latest Developments

In order to understand the ports' economical performance a short summary about future development is provided. This will provide the reader a general overview about port's investment, goals to achieve and in some cases country's preferences.

9.7.1 Port of Copenhagen-Malmo (CMP)

In **Copenhagen** ports' side, a new dry bulk area in South part of Provestenen is underway. When the infill work is complete Provestenen area will be extended by 50% and water depth at the new quays will be 13.5m (Sea-web.com, 2016a).
Malmo: a Low Sulfer Fuel Terminal is being built to help ships with Emission Control Area (ECA).The project if being financed by the port in partnership with Scandinavian Tank Storage, and will store fuel supplied by Statoil. It is expected that 170 vessels will use the new terminal for refuelling per year (Sea-web.com, 2016b).
Development of a 900,000m2 industrial park is currently underway in the Northern Harbour (Norra Hamnen). As increasing number of companies begin operating in the Northern Harbour, capacity will be increased by the addition of more terminals, docks, berths and railway tracks. In addition to the industrial park two facilities for LNG are planned. Container operations in Free Port are due to be moved to the Northern Harbour, freeing up space to increase the car storage capacity (Sea-web.com, 2016b).
There are plans for expansion in the Dry Bulk area of Berths 740 to 760 with a new wharf side area providing extra berths and two extra piers in the Nordo Link Ro-Ro harbour area.
CMP announced on 27th November 2014 that a barge service will be introduced between the two cities. "Daily barge traffic between the cities will simplify transportation of containers and other freight. The shortcut over the strait will be flexible and cost-effective for freight customers, however it will also deliver environmental benefits". CMP officials have said that they want to develop the port into a regional, northern European transport hub. The airports of both cities are also located along the motorway and railway link between the two cities, which further contributes towards the realisation of the transport hub ambitions (Sea-web.com, 2016).

9.7.2 Port of Oslo

According to Sea-web (2016d) the port of Oslo announced "Norway project looks to spur port and ship electrification (Sea-web, 2016d); "*Inspired by Norway's successful promotion of electric cars, maritime organisations are working with engineers and investors to study*

how to expand the country's shore power and boost its use of electric- and hybrid-powered ships".
Bjorvika (Oslo area) is due for urban development, Sorenga (Oslo area) will act as a temporary transit depot for empty containers until new facilities are developed at Sydhavna (from Kongshavn down through Sjursoya, Kneppeskjaer Pier to Ormsund Quay). A seabed tunnel has to be constructed under Bjorvika before the other developments start (Se-web, 2016c).

9.7.3 Port of Stockholm

The Port of Stockholm is developing the entire Vartahamnen, Frihamnen and Loudden area in a joint project with the City of Stockholm. The largest project is the Varta Pier expansion. Due to complete in 2016 at a cost of $300M, it will have a new passenger terminal, five quay-berths and a total of quay length of 1200 m.
Vaatahammen Cruise Terminal: Construction and dredging is underway to develop a dedicated cruise terminal by converting the existing 3,000m2 cargo warehouse located at Frihamnen. The adjacent pier will also be extended by 130m, and increase depth from 9m to 10.5m, to enable the facility to accommodate 3 Panamax cruise vessels simultaneously, with completion expected in 2015 (Sea-web, 2016e).
According to Port of Stockholm, (2014), new development are planned and partially realised as the new container terminal (CTF) where several actors are involved such as Hutchinson Port Holding (HPH), Greencargo, MSC Sweden AB, Team Lines Sverige AB, Unifeeders Sweden AB, CMA-CGM (Port of Stockholm, 2016).

9.7.4 Port of Gothenburg

The Port of Gothenburg, has announced the construction of a new freight terminal to be completed after 2020 to handle the increase in demand for sea transport via the port. The terminal will have an area of 220,000m2 and a depth of 11.0m (Sea-web.com, 2016g).
"We are extremely pleased to receive this decision, which will strengthen Gothenburg as the logistics capital of the Nordic region. The terminal is an important part of our future expansion and will present us with an opportunity to handle the increase in demand for sea transport via the Port of Gothenburg," said Magnus Kårestedt, Port of Gothenburg CEO, in a statement (3rd March 2016) (Sea-web.com, 2016f).

The port of Gothenburg is a type of port seeking on continuous improvements, for example it simplified the *call notification system* as reported by the authority and local news: "Ships making calls at the largest port in the Nordic countries can now notify the relevant authorities through a new platform using Swedish Maritime Administration system Reportal. It replaces Port of Gothenburg's now redundant VTMS system (Sea-web.com, 2015a).

PoG announced to create a new 1 million m² logistics park with industry partners. The new investment expected to generate more than 2,000 jobs and be completed by 2025.
Speaking to IHS Maritime, a port spokeswoman stated, “Gothenburg Port Authority will invest approximately SEK1 billion (USD122 million) and the other four land owners involved – NCC Property Development, Prologis Nordic, Eklandia Fastighets, and Bockasjö – about SEK3 billion.” (Sea-web.com, 2015b). The new park will be built directly adjacent to the port's Hisingen freight terminals and Gothenburg CEO Magnus Kårestedt described the project as an enormous investment and a golden opportunity for every company looking to establish a warehouse directly beside the largest port in Scandinavia (Sea-web.com, 2015b).

Gothenburg is currently the only port in Sweden with the capacity to receive the world's largest container vessels and has just opened a 900 m quay extension to the container terminal operated by APM Terminals. The port also has terminals for oil, cars, ro-ro, and passengers (Sea-web.com, 2015b).

PoG, in order to maintain his green philosophy, decided to attract green ships with a discount on harbour dues from 10 to 30 per cent. Seven shipping lines were involved and 25 ships already signed for the agreement and environmental scheme. (Sea-web.com, (2015c)
Vessels scoring 30 points or less on the Environmental Ship Index and Clean Shipping Index qualify for the lower figure, while those using LNG get the higher one (Sea-web.com, (2015c).

According to IHS and Sea-web.com (2015d), PoG decided to maintain the same tariffs of 2015 for 2016.

Image 9.2 New PoG Logistics Park

Source: Sea-web (2015d)

"Our aim behind this move is to reinforce industrial growth, shipping, and the port," stated PoG managing director Magnus Kårestedt, "Shipping costs become transport costs for industry. By doing our best to keep port charges down, we can contribute to maintaining a strong cluster of shipping companies in Gothenburg and a broad range of services to key markets." "We also hope other parties in the transport chain do everything to keep costs to a minimum. The state fairway charge, for example, doesn't exist throughout the rest of Europe (except Finland) and simply makes transport more expensive for Swedish industry." (Sea-web.com, 2015d).

The port of Gothenburg is planning a new energy port at Risholmen, situated at the entrance to the port of Gothenburg. Five new berths are planned, start of construction is due in 2018 and completion expected by 2030. Future development projects should increase forest exports through the port including new road and rail links and a weather-protected forest terminal (Sea-web.com, 2016g).

In the shorter term PoG:
New dolphins/mooring posts at Alvsborg Ro/Ro AB: to replace a number damaged in various collisions and projects at the Vehicle Terminal in order to receive even larger car carriers.
Extensive repair and reinstatement of 70,000 square metres of ground space is in progress in Alvsborg Ro/Ro AB's terminal
Upgrade of the container areas within the container terminal: APM Terminals Gothenburg and The Port of Gothenburg are co-funding the upgrade. Also in the container terminal, work is in progress on upgrading bollards to ensure the safe arrival of larger vessels within the whole terminal.
Product pipelines are being extended to put in place a complete system for oil right out to the Rya Harbour. This is being done in order to be able to use the Rya Harbour more to ease the pressure on the Skarvik Harbour and thus be able to carry out maintenance work at Skarvik. At the same time, redevelopment of service platforms is in progress to improve the working environment.
Dredging sludge at the Lundby Harbour: A strategically important issue is the potential to take care of contaminated dredging sludge, thus ensuring that in time our fairways and docks do not silt up again. As part of this process, we have completed an area in the old dock at the Lundby Harbour during the year and planning of new areas is underway.
In the long term, expansion of the fairways is planned into the Tor Harbour to increase the depth in order to receive very large, fully loaded tankers (VLCCs). The aim is to develop the energy harbour as a transit harbour for, for example, oil from Russia. Alongside depths at the Container Terminal may also be deepened (Sea-web.com, 2016g).

9.8 Voyage Calculation

A voyage calculation is provided in order to compare part of the costs necessary to reach the four ports.
The identified departure port is Shanghai - China, because the major navigation route is ASIA - EUROPE.

In order to perform a proper calculation, the following characteristics are identified:
Containerships : Triple E class Mærsk Mc-Kinney Møller
Capacity : 18,270 TEU
Length : 400 metres
Draft : 14.5 metres
Beam : 59 metres
Height : 73 metres
Top speed : 25 knots (46 km/h)
Deadweight : 165,000 tonnes
Gross Tonnage : 194,849 GT
Deadweight Tonnes (DWT) : 194,153

Our assumption:
Contract type : Time charterer
Fixed costs : 60,000USD/day
Capacity : 18,000TEUs (9,000 containers 40feet)
Weight per TEUs : 2 tonnes
Total containers weight: 36,000 tonnes
Fuel consumption per day: 190tons
Voyage speed : 20 knots
Fuel price (open sea) (IFO 0380): 233USD/mt
Fuel price for SECA area (MGO): 465USD/mt
Discharging day: week days
Suez Canal charges: are not considered because Suez Canal tool calculator required two parameters : SCGT (Suez Canal Gross Tonnage) and SCNT (Suez Canal Net Tonnage); those parameters are only available for the shipping company (Suez Canal Tonnage Certificate).
The containerships will discharge 18,000 TEUs to the dedicated port. The Port of Stockholm, the Port of Oslo, and the Port of Copenhagen-Malmo do not have the depth water adapted to host *Maersk Triple E.* The Northern Sea route is considered with the same vessel, and during the period between March/April and September; no icebreakers costs are considered.
This calculation want demonstrate the different navigation routes and related discharging ports' costs. Ports apply different prices : per container (in tonnes), per TEUs, or total vessel GT.

Table 9.17 Voyage Calculation

From Shanghai to /	via Suez-Gibraltar		via Cape of Good hope		via Cape Horn		Northern Sea Route (passing by: 70° 26' 47"N 171° 39' 57"W	
Port of Copenhagen-Malmo	23,7 days	$3.146.391,43	30,80 days	$3.886.829,32	37,61 days	$4.596.750,38	16,10 days	$2.315.805,74
Port of Oslo	23,16 days	$2.766.507,83	30,23 days	$3.504.259,14	37,08 days	$4.218.496,51	15,50 days	$1.927.232,41
Port of Stockholm	24,43 days	$3.147.674,32	31,49 days	$3.883.805,59	38,34 days	$4.598.039,48	16,80 days	$2.313.846,40
Port of Gothenburg	23,03 days	$2.497.196,62	30,09 days	$3.233.330,13	36,95 days	$3.948.641,07	15,40 days	$1.663.341,19

The voyage calculation cost show that the less expensive port, to transport 18,000 TEUs (or 9,000 containers, with the weight of 2 tonnes) is the Port of Gothenburg.
The preferred route by the shipping lines might be the Northern sea or the Suez-Gibraltar route.
In the analysis was also considered the different fuel to use in open sea and in SECA area.
Ports applies different rates to the discharged containers, and in our case was considered only the discharging fees by TEU or container. The fees were published on the considered ports web site.
The results in details are presented in the appendix “I”, tables I.1 - I.2 - I.3 - I.4.

9.9 Comments

According to Cullinane and Song (2002), Botha and Ittman (2008), seaports are the main components in determining the competitiveness of nation’s economy, the result is that Sweden has the largest gross tonnage (fig. 9.2) and higher throughput level (table 9.4) compared to the considered countries.
de Langen and Pallis (2005) discussed about the port hinterland (e.g. lower prices), and regarding the voyage costs, the Port of Gothenburg has competitive advantages over the competing ports. It means that PoG has a higher bargaining power compared to the other ports versus port users. Also, Zhang (2008) and Talley (2009) specify that a large captive hinterland is recognised by frequent services by shipping lines; the general performance of the PoG is definitely higher, compared with the competitors.

The Mohring effect is confirmed (Zhang, 2008; Janson and Shneerson, 1987) by the higher frequencies of shipping lines, and the result is, in average terms, the PoG is the location receiving more Ro-Ros (per month), more containerships and higher levels of TEUs and containers, compared to the other ports.
Culinane (2011) and Talley (2009) introduce the shipping lines preferences to a specific port; the shipping line will prefer call the port of Gothenburg because the depth water is higher compared to the other ports, and the handling fees at the Port of Gothenburg are lower. The trade lane is an important factor, because the shipping line will prefer call a port if located in the ship’s navigation route and the environmental regulation affect this choice.

For example, considering that all four ports are in SECA area, the different type of fuel to use in this area (MGO) is more expensive compared to the open sea fuel (IFO 0380), this represent another positive element for the PoG and its location, because shipping lines will travel less nautical miles in the SECA area, meaning lower fuel costs.

The authors Notteboom and Winkelmans (2001), Fleming and Baird (1999), Goss (1990), Verhoeff (1981), in order to compare the port performances, and *interport competition,* confirm that the four ports compete because located in the port range or coastlines; the competition is not only among ports but also to the total logistics chain; particularly the voyage cost showed PoG as the less expensive port where to navigate and discharge the containership with 18,000TEUs; the hinterland is characterised by several operators (intermodal transport) and infrastructure able to satisfy the entire logistics chain.
The shipping lines prefer to discharge larger volume to fewer ports (Talley, 2009), in order to negotiate on volumes, and PoG has the largest TEUs volume compared to the other ports.
Talley (2009) introduces the *strategic position analysis (SPA);* one component is the *product portfolio analysis (PPA)*. Part of our analysis, in line with the author (ibid.), confirm that the PoG has the largest market share compared to the other ports, in terms of containers, TEUs, containerships traffic categories (RO-RO) in table 9.5 - 9.16 and figure 9.5.

Tongzon (2007) when discussing about the country competitiveness, some key parameters were identified. According to the author (ibid.) Sweden, and PoG perform better compared to the other countries; such as port water depth, shipper preferences and port operations efficiency (Wilson et al, 2003).

Fleming and Baird (1999) confirm that the collaboration between the port and government is a competitive advantage. The presented ports collaborate with government and special investments are planned. The PoG, recentely invested in many infrastructures (new warehouses, terminal expansion, etc.), freezing the containerships fees and adopting lower fees to the green containerships (confirmed by Bryan et al, 2006).

Cheng (2001), Song and Panayides (2012) pointed out that modern ports need efficient infrastructure, to accomplish better logistics operations, because all players are part of the global transport system. The PoG offers more efficient infrastructures compared to the other ports.

10. ANALYSIS - POPULATION - E-BUYERS

In this section are presented the buyer characteristics by country and major cities. Companies when investing in a new country take into consideration several factors such as the population size (as a potential market), economic growth, income, labor force and internet access for the e-buyers.

Image 10.1 Study process - E-buyers Analysis

10.1 Country's Economy and Population Overview

In order to show the country economic performance several macro data have been collected. Table 10.1 show the characteristics of each single country, according to its own GDP (gross domestic product). The appendix "L" shows extra figures about this chapter.
Sweden is first ranked among the nordic countries for GDP growth in 2014 (both in USD and Euro) with 571.1 billion USD, followed by Norway (499.81 billion USD), Denmark (342.4 billion USD) and Finland (272.2 billionUSD).

Table 10.1 Country Economic Overview

Country Overview	Denmark	Finland	Norway	Sweden
GDP 2014 (billion USD) (4)	346.12	272.22	500.52	571.09
GDP Growth Annual 2014 (1)	1.1	-0.4	2.2	2.4
GDP Growth 2004-2014 (2)	0.4	0.7	1.4	1.7
GDP/capita USD 2015 (1)	61,294	49,678	97,226	58,856
GNI per capita, PPP (current international $USD) (3)	46,850	40,630	67,100	46,870
GDP 2015 world rank (2)	36	44	28	23
GDP 2014 (billion EUR) (2)	257	204	377	429
GDP per capita 2015 (EUR) - (2)	45,600	37,400	73,400	44,300

Note

this table identify thousands with the "," "comma", and decimals with "dot "."

1) Eurostat
2) International Monetary Found (IMF) 2016
3) Worldbank

The annual growth is higher in Sweden, with 2.4 per cent, followed by Norway (2.2 per cent), Denmark (1.1 per cent) and Finland with a negative growth (-0.4 per cent). The growth among the nordic countries between 2004 and 2014, was higher in Sweden with 1.7 per cent, Norway (1.4 per cent), Finland (0.7 per cent), followed by Denmark that performed the lowest growth in the Nordic countries with 0.4 per cent.
In 2015 the registered GDP per capita was higher in Norway with 97,226 US dollars, followed by Denmark with 61,294 US dollars, in third position Sweden with 58,856 US dollars and last is Finland with 49,678 US dollars.

In terms of global ranking, Sweden perform better comparing to the rest of the three countries (no. 23), followed by Norway (no. 28), Denmark (no. 36) and Finland (no. 44). (Eurostat, 2015)

Table 10.2 *Population characteristics*, highlights the residents in the specific country.
Sweden rank no. 1 for *population* (ca. 9 million), number of e-buyers (9 million ca.), labor force (5 million ca.) and employed people (ca. 4.8 million).
Denmark is the second largest market in Scandinavia in terms of population, e-buyers and number of employed people.

Unemployment rate is lower in Norway with 3.60 per cent, Denmark (4.93 per cent) and Sweden (7.50 per cent), and the highest unemployment rate is in Finland (9.38 per cent).

Norway is the country with the youngest population (39.1 years old) (in average) followed by Sweden (41.2) and Denmark (41.8) and Finland (42.4). All the four countries have a life expectancy higher than 80 years old, where the first position in rank is Sweden with 82 years, showing the country's quality life. The life expectancy can be read, from the retailer

point of view, as a future products' market expansion because the population will have different needs.

Table 10.2 Population Characteristics

Category	Denmark	Finland	Norway	Sweden
Population (1)	5,638,530	5,461,512	5,136,886	9,696,110
e-Buyers (2)	5,479,054	5,107,402	5,167,573	9,169,705
Labor Force (2015) (3)	2,905.88	2,688.93	2,760.05	5,226.04
Employment (2015) (3)	2,714.13	2,436.84	2,639.10	4,772.50
Unemployment rate (2015) (3)	4.93	9.38	3.60	7.50
Average age 2015 (4)	41.8	42.4	39.1	41.2
Life expectancy (2014) (1)	80.5	81.1	81.8	82
Internet users (per 100 people) 2015 (1) (range 16-74 for Finland and Sweden)	96	92.4	96.3	92.5
Mobile cellular subscriptions (per 100 people) 2014 (1)	126.9	139.7	116.1	127.8
Population density (people per sq. km of land area) (1)	132.9	18	14.1	23.8
Surface (sq. km) (1)	43,090	338,420	385,178	447,420
CO2 emissions (1) (metric tons per capita) 2011	7.2	10.2	9.2	5.5

Note: this table identify thousands with the "," "comma", and decimals with "dot "."

1) Eurostat 2015
2) International Monetary Found (IMF) 2016
3) Worldbank
4) UNCTAD

Regarding internet, as relevant part of e-retailers, is necessary to highlight the number of *internet users* in a specific country. According to Eurostat (2015), internet users for 100 people are higher in Norway (96.3 per cent), Denmark is second with 96 per cent, and Sweden and Finland (92.5 and 92.4 respectively) third and fourth position with customer ages between 16-74 years old.
Eurostat (2014) takes into analysis the *mobile subscriptions*; Finland rank no. 1 for this category, with 139.7 per cent, showing that all users have multiple devices and possibilities to access to internet. Sweden is ranked second, with 127.8 per cent, followed by Finland (126.9 per cent) and last is Norway (116.1 per cent). In detail this category highlight the willingness to invest in multiple internet devices for the same user.

The category *population density* is higher in Denmark (smaller country) where 132.9 people live per square kilometre, with a surface of 43,090 sq. km, followed by Sweden with 23.8 people per sq. km with a total surface of 447,420 sq. km., Finland has an

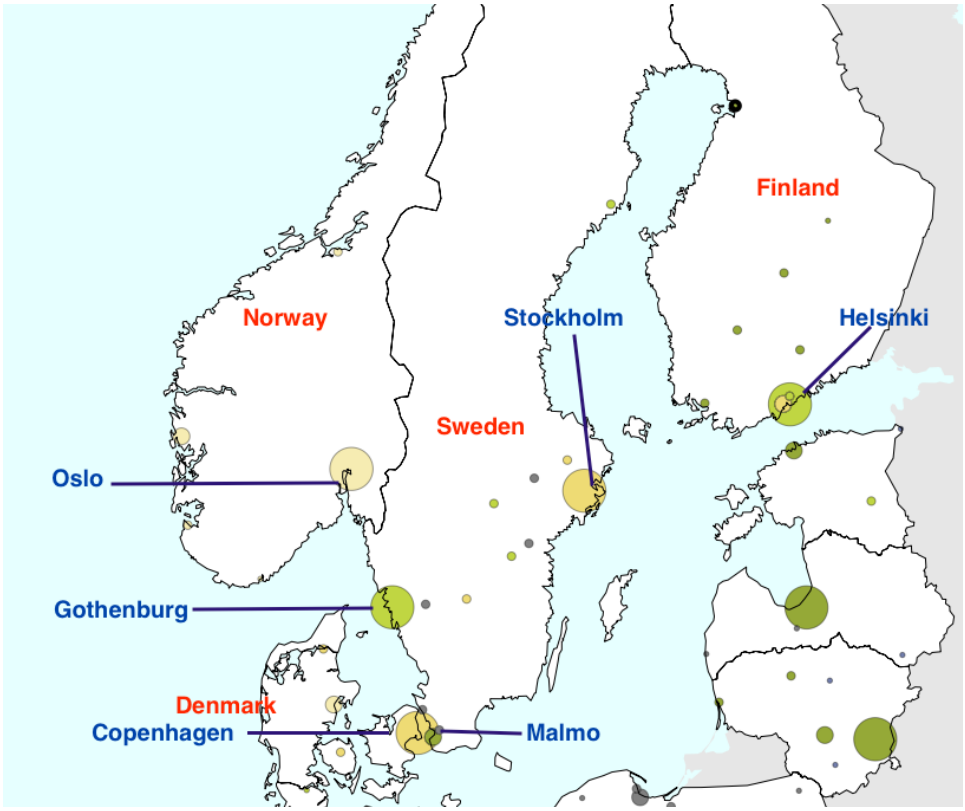
average of 18 people per sq. km. with a total surface of 338,420 sq. km, Norway has the lowest population density among the nordic countries with 14.1 people per sq. km.

The category *CO2 emission* highlighted by Eurostat (2011, last data available) shows the willingness of the local population in eco-friendly practices such as the use of public transport; Sweden rank first for the lowest CO2 emissions (5.5 metric tons per capita) among the Nordic countries.

Eurostat 2016 identified the four countries *Denmark, Finland, Norway, and Sweden, by the major cities* (Image 10.2).
Retailers and Online retailers when considering an investment in a new location, take into account the number of potential users (population) in a specific area (city).

Image 10.2 shows the population density by major urban centres such as Olso, Gothenburg, Malmo, Copenhagen, and Helsinki.

Image 10.2 Population Concentration by Country



Source: image with population bubbles provided by EU statistics, and adapted by the author

In the next paragraphs (10.2 - 10.3 - 10.4 - 10.5) the four countries and the major urban centres are analysed in details.

10.2 Denmark

According to Eurostat 2015, the major cities (urban centres) in Denmark are Copenhagen, Arhus, Alborg and Odense (table 10.3).
Copenhagen, the Danish capital, counts 559,440 residents, followed by Arhus (319,09 ab.), in third position Alborg with 203,448 residents and last is Odense with 193,370 people. Arhus and Alborg have the lowest unemployment rate, 3.90 and 4.80 per cent respectively. In opposite the Danish capital unemployment rate is 5.90 per cent, and Odense rank first for the unemployment rate in 2014 (6 per cent).

Table 10.3 Population in Denmark

	City			
	Copenhagen	**Arhus**	**Alborg**	**Odense**
Population 2015 (1)	559.440	319.094	203.448	193.370
Unemployment rate (2014) (1)	5,90%	3,90%	4,80%	6,00%

Note: this table identify thousands with the "." "dot", and decimals with "comma ","
1) Eurostat

10.3 Finland

Comparing to Denmark, Finland has a different situation. The Finnish population is mostly concentrated around Helsinki, in Vanta, Espo, Tampere and Turku. The rest of the cities Oulu, Lahti, Kuopio and Jvaskyla are located in a more remote areas.
Considering the closest cities around Helsinki as Vanta - Espo - Tampere and Turku, the population resident reach 872,179 people, reaching ca. 1.48 million with Helsinki. In opposite the remote areas such as Oulu, Jvaskyla, Lahti and Kuopio count in total for 479,374 habitants. Table 10.4 shows the detail of the habitants in different cities.

Table 10.4 Population in Finland

	City								
	Helsinki	**Vanta**	**Espo**	**Tampere**	**Turku**	**Oulu**	**Jvaskyla**	**Lahti**	**Kuopio**
Population 2015 (1)	612.664	208.908	260.753	220.446	182.072	143.909	134.658	103.364	97.443
Unemployment rate (2014) (1)	7,5%	8,2%	5,5%	12,6%	12,5%	12,7%	12,9%	13,7%	12,5%

Note this table identify thousands with the "." "dot", and decimals with "comma ","
1) Eurostat

The highest unemployment rate is in Lahti (13.7 per cent) (ca. 100 km North-east from Helsinki), followed by Jvaskyla (12.9 per cent) (ca. 270 km North from Helsinki). In third position Oulu with 12.7 per cent unemployed people, followed by Turku and Kuopio both with 12.5 per cent unemployed rate.
Different situation is for Helsinki's suburbs area, Vanta (8.2 per cent) and Espo with 5.5 per cent who repent the lowest unemployment rate in Finland. Helsinki, the Finnish capital, maintain an unemployment rate equal to 7.5 per cent.

10.4 Norway

Norway, comparing with the previous two countries - Denmark and Finland, the higher number of habitants is concentrated in four major urban centres: Oslo (the capital), Bergen, Trondheim, and Stavanger. (Eurostat, 2015)

In order to better understand the geographical disposal of Norway, the table 10.2 (previous pages) shows the different country's surface among the four countries (DK-FI-NO-SE). Norway is the second largest Nordic country, followed by Finland and Denmark.

As mentioned earlier, the major city is Oslo, with 623,996 ab. and 3 per cent of unemployment rate (table 10.5).
Bergen, the second largest city, is located in the extreme west part of Norway; it counts for ca. 267,950 ab. with the second lowest unemployment rate (1.9 per cent), and with a distance of ca. 300miles (ca. 500km) from the capital.
Trondheim, third most populated city, is located in the north of Norway; it counts ca. 179,692 ab., unemployment rate equal to 2.4 per cent, and with a distance of ca. 305 miles (ca. 495km) from Oslo. Stavanger, furthest urban centre, is located in the South-West part of Norway; it counts ca. 179,692 ab., unemployment rate equal to 1.8 per cent (the lowest in Norway), and the distance from the capital is 343miles (ca. 553km).

Table 10.5 Population in Norway

	City			
	Oslo	**Bergen**	**Trondheim**	**Stavanger**
Population 2015 (1)	623.966	267.950	179.692	129.191
Unemployment rate (2014) (1)	3%	1,9%	2,4%	1,8%

Note this table identify thousands with the "." "dot", and decimals with "comma ","
1) Eurostat

10.5 Sweden

Sweden, Scandinavian largest country, with 447,420 sq. km and with a population of 9.6 million. Eurostat (2015) classified major cities (table 9.6) and one extra was added for the purpose of this research - Luleå (suggested by the PoG). The total population living in the major urban centres is ca. 3.1 million habitants.
The major cities in Sweden are Stockholm (the capital) who counts ca. 864,324 ab. with the unemployment rate of 6.5 per cent; the second urban centre is Gothenburg with 520,374 ab. (9.3 per cent unemployment rate); the last largest urban centre is Malmo with 302,835 ab. with the 14.3 per cent of unemployment rate.
The rest of the cities, from Uppsala to Boras, have a range of habitants between 200,000 (Uppsala) and 100,000 (Boras); the unemployment rate wasn't available for all cities (table 10.6). The smallest urban centre is Lulea, with ca. 76 thousands habitats. Table 10.6 presents the details of the Swedish population.

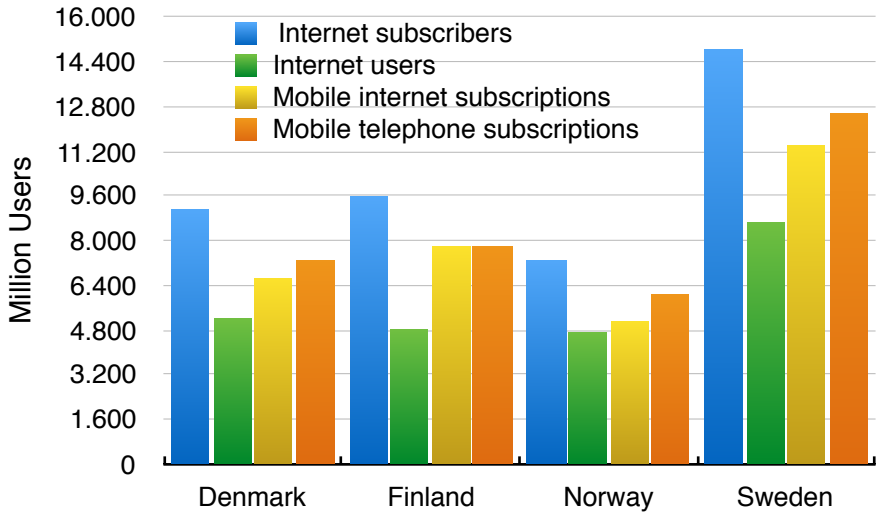
Table 10.6 Population in Sweden

Cities	Population 2015 (1)	Unemployment rate (2014) (1)
Stokholm	864.324	6,5%
Gothenburg	520.374	9,3%
Malmo (2012)	302.835	14,3%
Uppsala	200.001	6,1%
Linkoping	147.334	8,8%
Orebro	137.121	10,1%
Vasteras (2012)	134.684	NA
Jonkoping	128.305	6,2%
Norrkoping (2012)	128.060	NA
Helinborg (2012)	126.754	NA
Umea	116.465	8%
Lund	107.351	NA
Boras (2012)	101.487	NA
Luleå	75.966	NA
Note	this table identify thousands with the "." "dot", and decimals with "comma "," 1) Eurostat 2015	

10.6 E-buyers Characteristics and Retailing

In order to introduce the Scandinavian population characteristics, several charts present the four countries.
Figure 10.1 shows the number of internet subscribers, internet users, mobile internet and mobile telephone subscriptions, by country. It is pretty clear that Sweden has the higher percentage of users and subscriptions (larger population).
Sweden has ca. 14.4 millions of internet subscribers, 8.5 millions of internet users, 11.2 millions of mobile internet subscriptions and ca. 12.8 millions of mobile telephone subscriptions (see appendix "L.1", table L.1 for details).

Figure 10.1 Internet & Devices Users

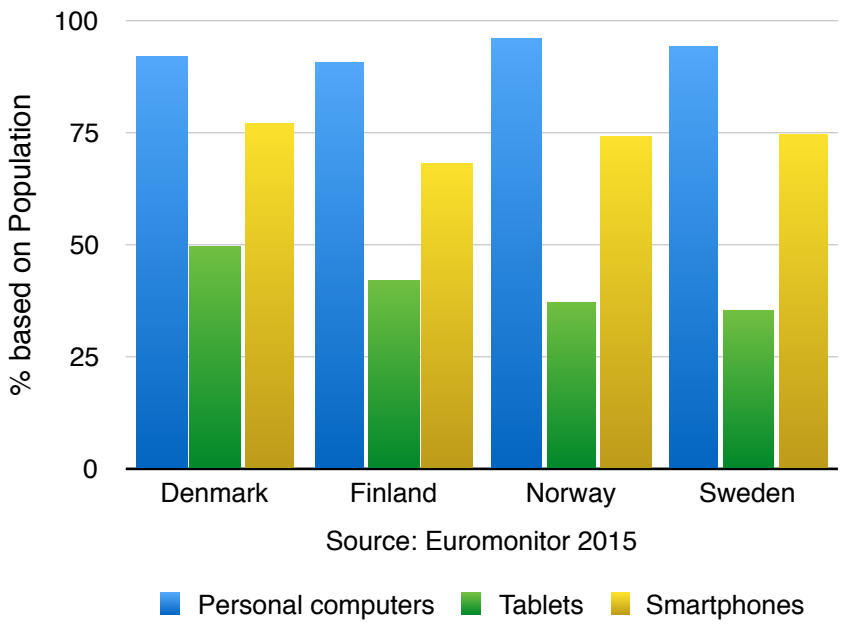


Source: Euromonitor, 2015

A relevant element to consider when investing in a new country (e-retailers point of view) is the presence of the number of devices hold by the population. Figure 10.2 shows the four countries *personal computers, tablets,* and *smartphones* (in percentage terms).
94 per cent of the Swedish population has a personal computer, 35.5 per cent has a tablet, and 74.9 per cent has a smartphone. By contrast, 50 per cent of the Danish population own a tablet (see appendix "L.1", table L.1 for details). Overall the four countries show a high level of devices.

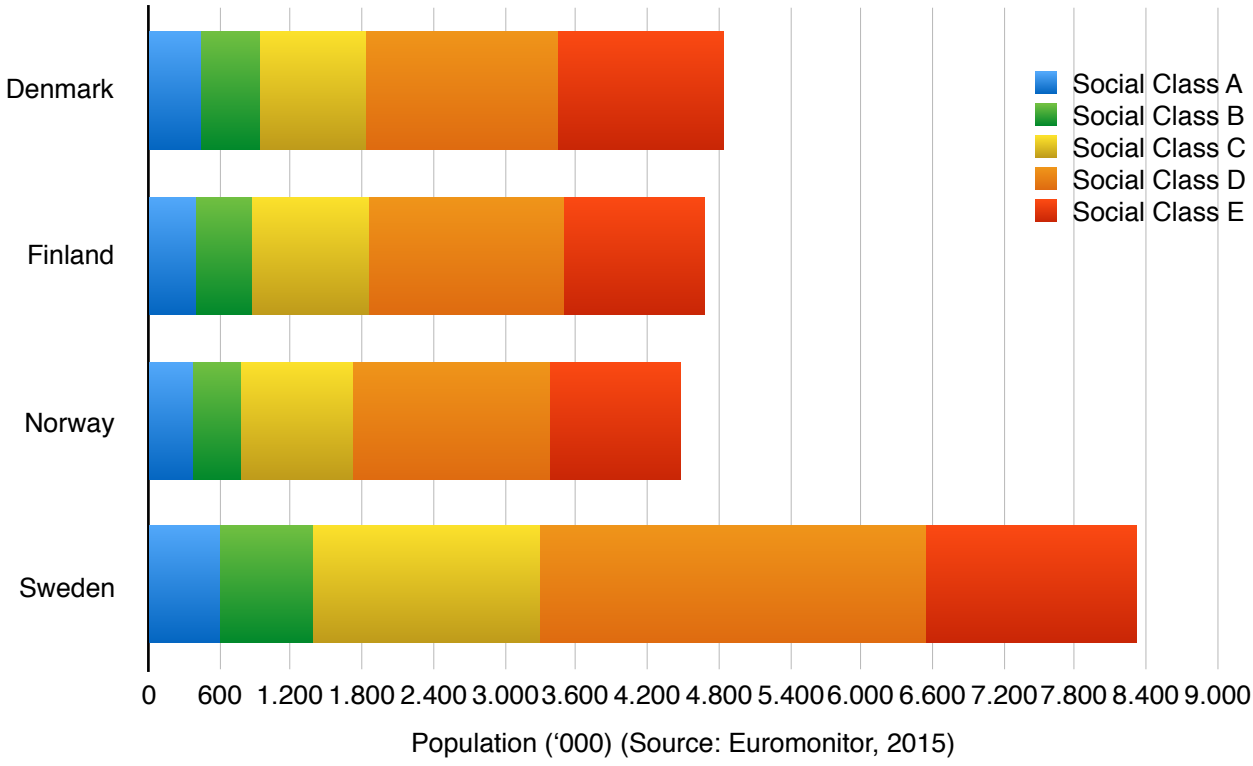
E-retailers are interested in the economical performances of the country, several economical indicators and the different social classes, in order to have an idea about the products and services the customer are interested. Figure 10.3 shows the social classes by country. Euromonitor (2015) classified the population in five classes (A-B-C-D-E) (see appendix "L", table L.2).

Figure 10.2 Devices by Country



Social Class **A** refers to the number of individuals with a gross income over 200 per cent of an average gross income of all individuals aged 15+. Social Class **B** with a gross income between 150 and 200 per cent of an average gross income of all individuals aged 15+. Social Class **C** with a gross income between 100 and 150 per cent of an average gross income of all individuals aged 15+. Social Class **D** with a gross income between 50 and 100 per cent of an average gross income of all individuals aged 15+. Social Class **E** with a gross income less than 50 per cent of an average gross income of all individuals aged 15+.

Figure 10.3 Social Classes by Country



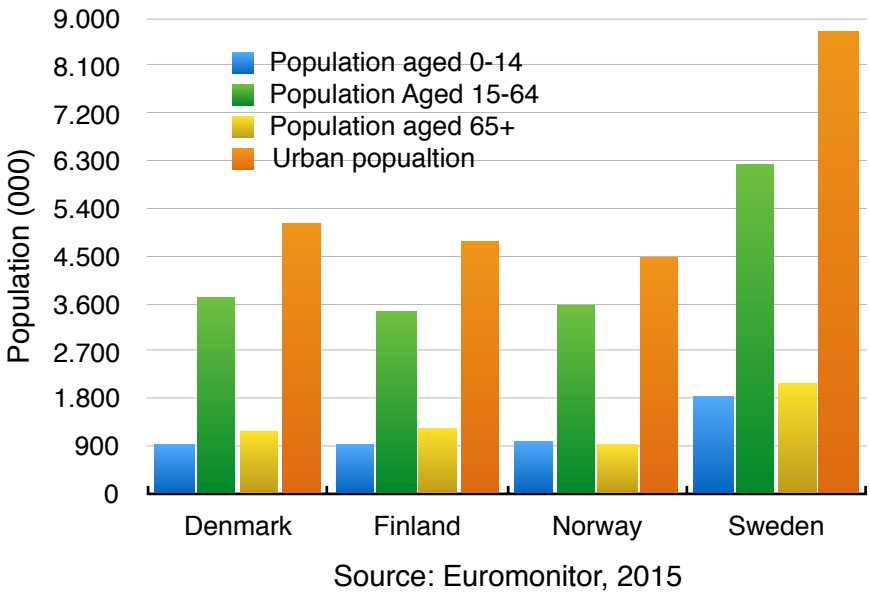
Three countries out of four have almost the same level of people belonging to social class A, by contrast Sweden has almost 600,000 people in that range.
Denmark, Finland and Norway have almost the same level (ca. 400,000 people), with slight differences, for the segment B. Sweden has ca. 800,000 people in the same class.
The relevant segments are C and D where Sweden count 1.9 million and 3.2 million respectively. Denmark, Finland and Norway have similar levels (ca. 900,000 (C) and ca. 1.6 million (D)).
The segment E is described has the following results: Denmark 1.4 million habitants, Finland 1.18 million, Norway 1.1 million, and Sweden has 1.76 million habitants.

In order to clarify the population in the four countries, figure 10.4 classify the population by age and people living in urban centres.
The segment, 0 to 14 years, Denmark-Finland-Noway have almost the same level (900,000 people), instead Sweden counts 1.8 million people.
The segment, 15-64 is almost constant among the first three countries (Denmark, Finland and Norway) equal to 3.6 million people (by country). By contrast Sweden reach 6.3 million people.

The Population over 65 years old (in yellow) is almost the same in Denmark and Finland (1.16 and 1.24 million respectively). Norway counts 900 thousands and Sweden counts 2.07 million people.

The last chart in this section is the offline retailing and internet retailing market. Figure 10.5 highlights the four countries, comparing them with the data of 2015 and the forecast of 2020 (Euromonitor, 2015). Data are available in the appendix “L” table “L.3”.

Figure 10.4 Population by Segment

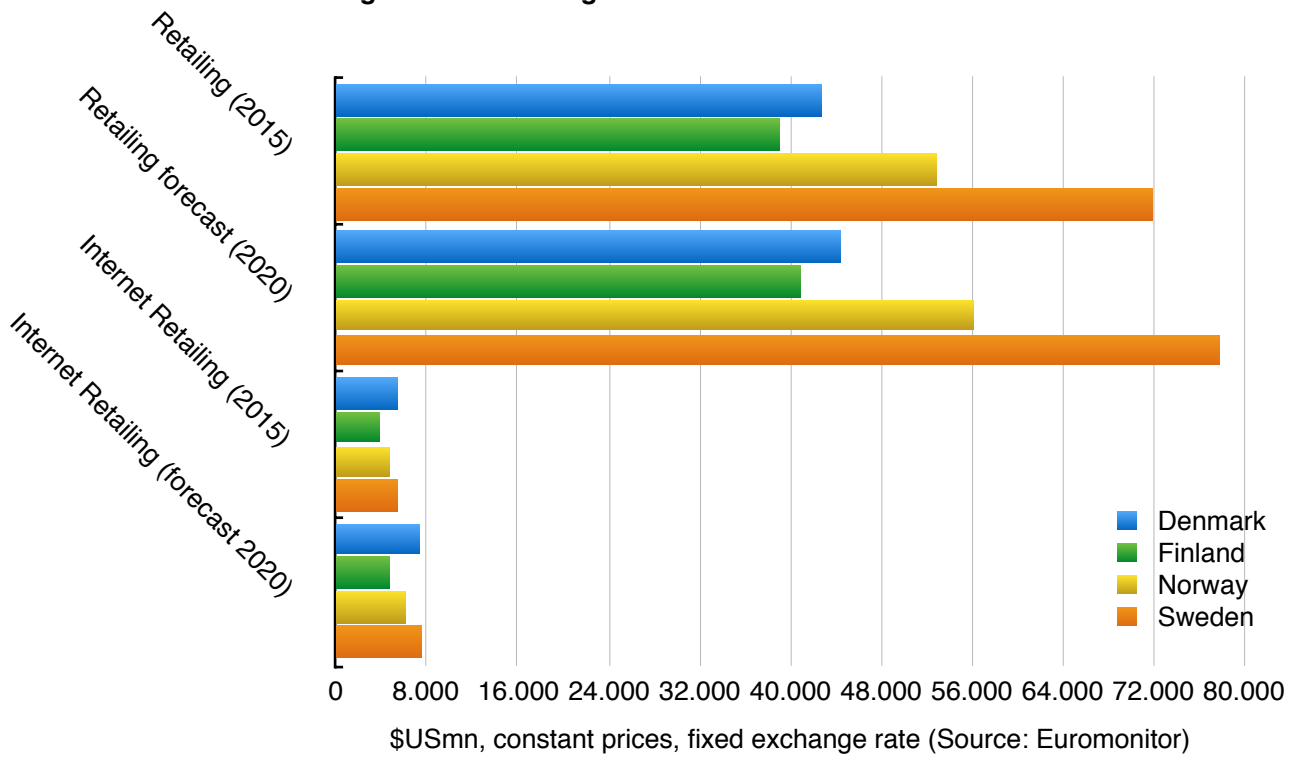


Source: Euromonitor, 2015

The growth is registered for the four countries (2020) and particular emphasis is on Norway and Sweden (retailing). Instead, internet retailing in forecast to growth in the four countries as well. From the author perspective, the difference (in USmillion) between retailing and internet retailing must be seen as a big opportunity for the first mover big player entering in the Scandinavian market, in order to get competitive advantages compared to other e-retailers.

In the appendix “L”, table L.4 are are provided some sales data (apparel and footwear; beauty and personal care; consumer electronics) and Sweden has a better performance compared to the other countries.

Figure 10.5 Retailing and Internet



10.7 Comments

According to Croucher, Baker and Ruston (2014) the *home delivery (e-fulfillment)* level in the selected countries will continue to grow in the next years (fig. 10.5), with Sweden as a driver.
Fernie and Sparks (2014) state that several demographic variables are necessary to identify the e-buyers, and the figures introduced in tables 10.1 - 10.2, show the better performance of Sweden. Doherty and Ellis-Chadwick (2010) confirm that internet shoppers are wealthier, and the previous data show the higher income level in Sweden and Norway (table 10.1); by contrast figure 10.3 shows the higher level of income in Sweden, with different social classes.
Bigne et al (2005), state that internet shoppers prefer buying on mobile devices and Denmark and Sweden are the countries with the higher level of mobile devices (smartphone and tablets). By contrast figure 10.1 shows Sweden with higher level of *mobile internet subscription* (11.2 millions people).
IGD (2011) refers to the segment age 65+ (figure 10.4) as not potential buyers for online groceries. By contrast, the other segment 15-64 years are more willing to buy products online. Sweden represents the major market compared with Denmark, Finland and Norway.

11. ANALYSIS - WAREHOUSE LOCATION

The following section analyse the warehouse location. The centre of Gravity (COG) has been considered under several perspectives. In order to perform a warehouse analysis is relevant taking into consideration the maximum number of potential customers reachable from one of the four locations (Port of Copenhagen-Malmo, Port of Oslo, Port of Stockholm and Port of Gothenburg). Furthermore the analysis consider different transport modes by road, rail and sea.

Image 11.1 Study Process - Warehousing

11.1 Scandinavian Centre of Gravity

According to the literature introduced previously (Watson et al, 2013), in order to identify the best location for a warehouse, is necessary to identify the centre of gravity (COG). For our purposes, several destinations (cities) have been identified across Denmark, Finland, Norway, and Sweden. The cities are the same mentioned in the population section (Image 10.2, and table 11.1).
The centre of gravity (COG) identified takes into consideration the longitude and latitude (of the city) and (weighted by) the local population.

Applying the formulas F3.2 and F3.3, the new latitude and longitude are identified. COG 1 has coordinates *Latitude 59.1* and *Longitude 16.2* see (Image 11.2).

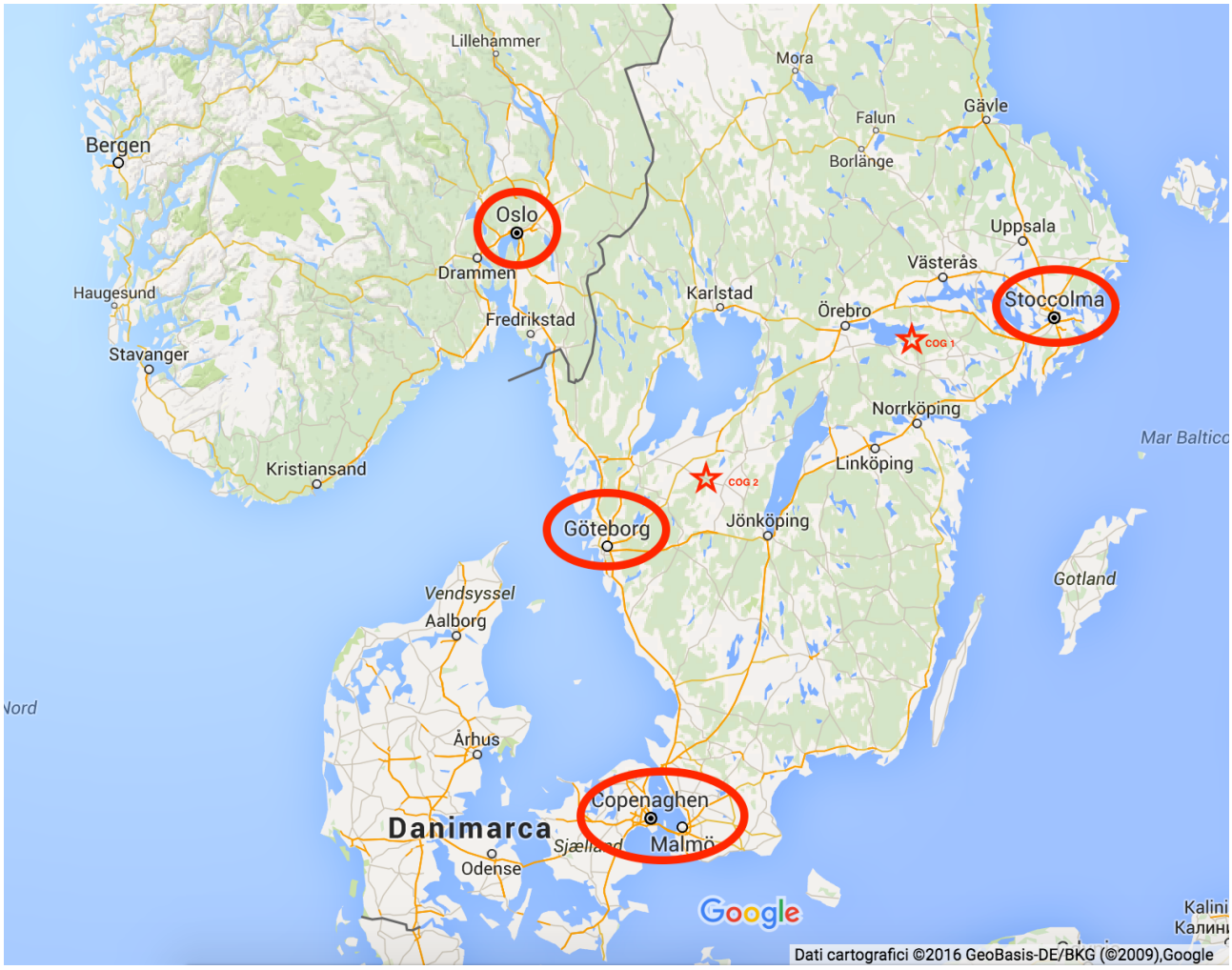
The total population identified is **7.531.429** potential customers (for the considered cities).

Table 11.1 Cities Coordinates, Population, and COG

City	Latitude (1)	Longitude (2)	Population (3)
Copenahgen	55,676097	12,568337	559.440
Arhus	56,162939	10,203921	319.094
Alborg	57,04882	9,921747	203.448
Odense	55,403756	10,40237	193.370
Helsinki	60,169856	24,938379	612.664
Vanta	60,293352	25,037769	208.908
Espo	60,205491	24,6559	260.753
Tampere	61,497752	23,760954	220.446
Turku	60,451813	22,26663	182.072
Oulu	65,012089	25,465077	143.909
Jvaskyla	62,242603	25,747257	134.658
Lathi	60,982675	25,66121	103.364
Kuopio	62,89797	27,678172	97.443
Oslo	59,913869	10,752245	623.966
Bergen	60,391263	5,322054	267.950
Trondheim	63,430515	10,395053	179.692
Stavanger	58,96998	5,733107	129.191
Stockholm Port	59,329323	18,068581	864.324
Gothenburg	57,70887	11,97456	520.374
Malmo (2012)	55,604981	13,003822	302.835
Uppsala	59,858564	17,638927	200.001
Linkoping	58,410807	15,621373	147.334
Orebro	59,275263	15,213411	137.121
Vasteras (2012)	59,6099	16,544809	134.684
Jonkoping	57,782614	14,161788	128.305
Norrkoping (2012)	58,587745	16,192421	128.060
Helinborg (2012)	56,046467	12,694512	126.754
Umea	63,825847	20,263035	116.465
Lund	55,70466	13,191007	107.351
Boras (2012)	57,721035	12,939819	101.487
Luleå	65,584819	22,156703	75.966
Centre of Gravity (COG)	**59,1**	**16,2**	**7.531.429**
Note	Note: in the column (1) and (2) decimals are after the “comma” “,” . In the column (3) thousands are after the “dot” “.” Column *Latitude*, a negative sign (-) is used in the excel sheet formula.		

Using the same formulas F3.2 and F3.3, a second centre of gravity (COG 2) is identified. In this particular case a dummy variable (= 1) was considered. COG 2 is the centre of gravity, considering the four ports (longitude and latitude distances). The new coordinates are the followings: *latitude* 58.2 *and longitude* 13.3 (Image 11.2)

Image 11.2 Centres of Gravity in Scandinavia



Source: Google maps; and author adaptation

Image 11.2 identifies geographically Stockholm, Oslo, Gothenburg and Copenhagen-Malmo.

The first centre of gravity (COG 1) (latitude 59.1 and longitude 16.2), weighted by the population (from Denmark, Finland, Norway and Sweden) (table 11.1). It is located in Sweden, route 56, 15 km north from Katrineholm. It is located 130 miles (209km) from Stockholm, 307 miles (494km) from Gothenburg, 344 miles (553km) from Copenhagen, 327 miles (526km) from Malmo, and 380 miles (611km) from Oslo.

A second COG (COG 2) was identified (latitude 58.2 and longitude 13.3), comparing only the four ports geographical location. The new COG 2 is located in north-east from Gothenburg, starting from Highway E20, and when in Vara the route 47 direction Falkoping (for ca. 20km).

COG 2 is located 106 miles (170km) from Gothenburg, 179 miles (288km) from Copenhagen, 212 miles (341km) from Oslo, and 337 miles (542km) from Stockholm (euclidean distances). A second centre of gravity (COG 2) was considered, in case the investors (online retailers) need to make a decision among the considered ports. It shows the closest port is PoG.

11.2 Centre of Gravity and City's Distance

The centre of gravity identified in the coordinate (latitude 59,1; longitude 16,2) is the **geographical position** that better satisfy all customers (Watson et al, 2013). But, the centre of gravity calculated by the longitude and latitude considered the euclidean distance weighted by the population.

In order to identify the best location for a warehouse, is necessary to proceed with other considerations. For instance retailers consider important to satisfy the higher number of customers within 500miles (804,6km).

The first step is to calculate the distance, in miles, from each port to the selected cities (table 11.2) (using the formula F3.1).

Table 11.2 Euclidean Distances from Ports and COG to Cities

Country/City	Port of Copenhagen-Malmo	Port of Oslo	Port of Stockholm	Port of Gothenburg	Centre of Gravity 1
Denmark					
Copenahgen	5	318	455	147	344
Arhus	171	260	584	155	461
Alborg	209	205	583	140	456
Odense	155	311	593	186	474
Finland					
Helsinki	903	980	479	919	607
Vanta	913	987	487	928	615
Espo	886	961	460	901	588
Tampere	866	906	421	863	547
Turku	741	797	301	744	429
Oulu	1.094	1.076	644	1.067	758
Jvaskyla	1.011	1.048	568	1.009	694
Lathi	970	1.033	537	980	666
Kuopio	1.151	1.187	708	1.150	834
Norway					
Oslo	318	2	505	172	380
Bergen	599	375	881	488	756
Trondheim	555	245	599	409	500
Stavanger	527	351	850	431	722
Sweden					
Stockholm city	451	508	1	444	130
Gothenburg	146	174	434	9	307
Malmo (2012)	26	335	433	164	327
Uppsala	449	476	46	427	112
Linkoping	278	353	179	265	62
Orebro	304	312	196	257	69
Vasteras	382	401	106	350	42
Jonkoping	178	278	289	160	167
Norrkoping	316	387	138	306	35
Helinborg	24	298	434	127	321
Umea	769	711	346	719	430
Lund	38	335	418	165	313
Boras	141	214	370	75	244
Luleå	947	880	516	896	608
Total miles	**15.523**	**16.704**	**13.561**	**15.053**	**12.998**

Note conversion in miles to km: 100 miles = 160,93km ; 200 miles = 321,86km ; 300 miles = 482,80km ; 400 miles = 643,73km ; 500 miles = 804,67km

We proceed to the identification of the port that satisfy the higher percentage of customers within a certain range of miles and in particular 500miles (table 11.3).

Table 11.3 Percentage of Customers Covered by Destination

Miles	Port of Copenhagen-Malmo	Port of Oslo	Port of Stockholm	Port of Gothenburg	Centre of Gravity 1
% within 100 miles	15%	8%	14%	8%	7%
% within 200 miles	31%	15%	21%	42%	23%
% within 300 miles	36%	29%	23%	46%	24%
% within 400 miles	50%	55%	28%	50%	54%
% within 500 miles	64%	60%	67%	71%	70%
Note	conversion in miles to km: 100 miles = 160,93km ; 200 miles = 321,86km ; 300 miles = 482,80km ; 400 miles = 643,73km ; 500 miles = 804,67km				

Table 11.3 identifies the higher number of customers within a certain range of miles.
The Port of Copenhagen-Malmo (base Copenhagen port latitude and Longitude) satisfy 15 per cent of the population within 100 miles. The Port of Gothenburg satisfies 42 per cent of the population within 200 miles and 46 per cent within 300 miles.
The Port of Oslo satisfies 55 per cent of the population within 400 miles.
Finally, the Port of Gothenburg satisfies 71 per cent of the total population within 500miles.
This analysis considered the euclidean distance.
The result of this first investigation is that the centre of gravity identified, by euclidean distance, doesn't satisfy the higher number of customers, in all categories.

In order to know exactly the total number of potential customers within a certain range (of miles), the next table shows the population reachable from the ports (table 11.4), taking into consideration the euclidean distance.
The Port of Copenhagen-Malmo satisfies ca. 1 million of potential customers; the PoG reach 2.5 millions people from 101 to 200 miles; the Port of Oslo is able to reach ca. 1 million people from 201 to 300 miles; the COG 1 reach 2.2 millions people from 301 to 400 miles; and the Port of Stockholm reach 2.9 million people from 401 to 500 miles. Finally the PoG is able to satisfy 5.37 million customers within 500 miles.

Table 11.4 Population Within Specified Range (Euclidean Distance)

Miles	Port of Copenhagen-Malmo	Port of Oslo	Port of Stockholm	Port of Gothenburg	Centre of Gravity 1
from 0 to 100 miles	1.096.380	623.966	1.064.325	621.861	547.199
from 101 to 200 miles	1.262.630	520.374	547.199	2.564.563	1.192.630
from 201 to 300 miles	147.543	1.058.780	128.305	284.455	101.487
from 301 to 400 miles	1.023.831	1.972.652	400.024	262.744	2.240.720
from 401 to 500 miles	200.452	334.685	2.919.525	1.641.158	1.194.141
Total customer penetration	**3.730.836**	**4.510.457**	**5.059.378**	**5.374.781**	**5.276.177**

Note

Note 1: this table identify thousands with the "." "dot".
Note 2: conversion in miles to km: 100 miles = 160,93km ; 200 miles = 321,86km ; 300 miles = 482,80km ; 400 miles = 643,73km ; 500 miles = 804,67km

A relevant factor for retailers is the maximisation of the number of clients within a certain range. The next table (11.5) shows the number of clients reachable by different ports and COG (by euclidean distance). Table 11.5 summarised the figures from the previous table (11.4) and merged by miles range.

Table 11.5 Maximum Number of Customers in a Specified Range (Euclidean Distance)

Miles range	Port of Copenhagen-Malmo	Port of Oslo	Port of Stockholm	Port of Gothenburg	Centre of Gravity 1
from 0 to 100 miles	1.096.380	623.966	1.064.325	621.861	547.199
from 0 to 200 miles	2.359.010	1.144.340	1.611.524	3.186.424	1.739.829
from 0 to 300 miles	2.506.553	2.203.120	1.739.829	3.470.879	1.841.316
from 0 to 400 miles	3.530.384	4.175.772	2.139.853	3.733.623	4.082.036
from 0 to 500 miles	3.730.836	4.510.457	5.059.378	5.374.781	5.276.177

Notes

this table identify thousands with the "." "dot".
Note: conversion in miles to km: 100 miles = 160,93km ; 200 miles = 321,86km ; 300 miles = 482,80km ; 400 miles = 643,73km ; 500 miles = 804,67km

Table 11.5 identifies the Port of Copenhagen-Malmo as the location able to reach ca. 1.1 million customers (range from 0 to 100 miles). The Port of Gothenburg, appear to be the location able to reach 3.18 million people within the range from 0 to 200 miles; and 3.47 millions people within the range from 0 to 300 miles.
The Port of Oslo is the location within 400 miles, that can cover 4.17 million potential consumers.
And finally, the Port of Gothenburg seems to be the location that better satisfy 5.37 million people within 500 miles (confirmed by table 11.4).
The point of Gravity doesn't cover the maximum number of customers as the other cities (highlighted in yellow).

Other considerations are presented in the next paragraphs.

12.3 Time range

After the miles/km distance calculation identified in the previous paragraph, a second consideration is necessary. Ballou (1999) and Mulchay (1994) suggest to identify the delivery time for a quicker response and closer proximity to consumers.

Retailers are interested in time reduction, shorter lead time, in order to satisfy customer's demand (e.g. deliver products within 24 hours).
Considering the same data in the table 11.1 (latitude and longitude by city), using Google Maps®, a road-time calculation is provided in the table 11.7. The departure points identified are the Port of Copenhagen-Malmo, the Port of Oslo, the Port of Stockholm, the Port of Gothenburg and COG 1. Table 11.6 shows the coordinates *latitude* and *longitude* for different departure points.

Table 11.6 Coordinates Ports and COG

	Port of Copenhagen-Malmo (1)	Port of Oslo (1)	Port of Stockholm (1)	Port of Gothenburg (1)	from Centre of Gravity (2)
Latitude	55.7000	59.90000	59.333333	57.683333	59.1
Longitude	12.6333	10.7333	18.0500	11.8500	16.2

Note this table identify decimals with the "." "dot".
(1) Source: sea-web.com® ; (2) Our calculation. Results in table 11.1

Table 11.7 Travel Distances from Ports/COG to Cities

Country/City	Copenhagen-Malmo Port	Port of Oslo	Port of Stockholm	Port of Gothenburg	from Centre of Gravity 1
Denmark					
Copenahgen	0h16m	6h25m	6h40m	3h30m	5h47m
Arhus	3h38m	9h10m	9h30m	6h15m	9h45m
Alborg	4h35m	8h20m	10h00m	5h19m	9h15m
Odense	2h17m	7h55m	8h20m	5h04m	7h15m
Finland					
Helsinki	18h23m	17h35m	11h55m	16h44m	13h45m
Vanta	18h30m	17h36m	12h03m	16h47m	13h50m
Espo	18h12m	17h20m	11h40m	16h30m	13h30m
Tampere	18h35m	17h40m	12h00m	16h53m	13h50m
Turku	16h45m	15h55m	10h10m	15h02m	12h00m
Oulu	19h12m	17h05m	12h35m	17h6m	13h45
Jvaskyla	20h10m	19h25m	13h43m	18h30m	15h25m
Lathi	19h15m	18h25m	12h45m	17h37m	14h30m
Kuopio	21h48m	20h55m	15h30m	2h10m	17h04m
Norway					
Oslo	6h18m	0h15m	6h10m	3h18m	5h10m
Bergen	13h33m	7h10m	13h20m	10h27m	12h20m
Trondheim	13h05m	6h35m	9h36m	9h46m	10h15m
Stavanger	13h00m	7h20m	13h10m	9h51m	12h30m
Sweden					
Stockholm city	6h50m	6h15m	0h10m	5h02m	2h05m
Gothenburg	3h24m	3h15m	4h50m	0h15m	4h00m
Malmo (2012)	0h51m	5h55m	6h12m	2h59m	5h20m
Uppsala	7h30m	6h00m	1h00m	5h19m	2h10m
Linkoping	4h45	5h40m	2h10m	3h04m	1h25m
Orebro	5h42	4h10m	2h13m	3h29m	1h15m
Vasteras	6h40m	5h00m	1h15m	4h25m	1h25m
Jonkoping	3h35m	4h45m	3h20m	1h56m	2h30m
Norrkoping	5h08m	5h46	1h52m	3h27m	1h00m
Helinborg	1h27m	5h20m	5h35m	2h27m	4h45m
Umea	13h22m	11h00m	6h47m	11h14m	7h55m
Lund	1h00m	5h46	6h05m	2h55m	5h10m
Boras	3h50m	3h50m	4h10m	0h58m	3h20m
Luleå	16h25m	13h55	9h45m	14h17m	11h00m
Note	**Results from Google Maps®. Car time.**				

Table 11.7 shows the different time-distances by departure point (e.g. COG 1) and related city.

Summarising the data from the table 11.7, and combining with the population (table 11.1), is possible to identify the number of potential customers within a certain time-range (table 11.8). For example locating a warehouse in the Port of Stockholm, e-retailers are able to cover 1,327,069 people within 2 hours driving, and PoG is able to cover 2,230,304 potential consumers in a time range between 2 and 4 hours.

Table 11.8 Distances by Time range Single Category

Time range	Copenhagen-Malmo Port	Port of Oslo	Port of Stockholm	Port of Gothenburg	from Centre of Gravity 1
from 0h to 2hours	1.096.380	623.966	1.327.069	750.166	547.199
from 2h01m to 4hours	1.262.630	621.861	412.760	2.230.304	1.814.491
from 4h01m to 6 hours	615.963	1.412.445	748.615	1.595.827	1.720.346
from 6h01m to 8 hours	1.822.975	2.193.967	1.710.057	319.094	309.835
from 8h01m to 10 hours	0	522.542	971.570	308.883	522.542
from 10h01m to >	2.733.481	2.156.648	2.361.358	2.327.155	2.617.016
Note	this table identify thousands with the "." "dot".				

Merging the results from the table 11.7, combined with the population (table 11.1) and sorted by port, table 11.8 identifies the total population able to be served by ports and COG 1 in a different *time ranges.*

Table 11.9 identifies the higher number of potential consumers within a specific time range. For instance, taking into consideration the PoG (as a departure point), e-retailers are able to deliver products to ca. 3 millions of potential customers within 4 hours driving, and ca. 5 millions customers within 8 hours driving. By contrast the Port of Oslo is able to reach 5,3 millions of potential consumers.
What is relevant in this table is the maximisation of the number of potential consumers in the shortest delivery time; overall PoG performs better comparing to the other departure points, because within a lower time-range it maximises the number of clients; and as a consequence, it reduces the P-time and D-time and contributing to the company's efficiency.

Table 11.9 Distances by Time Multiple Categories

Time range multiple categories	Copenhagen-Malmo Port	Port of Oslo	Port of Stockholm	Port of Gothenburg	from Centre of Gravity (COG 1)
from 0 to 2 hours	1.096.380	623.966	1.327.069	750.166	547.199
from 0 to 4 hours	2.359.010	1.245.827	1.739.829	2.980.470	2.361.690
from 0 to 6 hours	2.974.973	2.658.272	2.488.444	4.576.297	4.082.036
from 0 to 8 hours	4.797.948	4.852.239	4.198.501	4.895.391	4.391.871
from 0 to 10 hours	4.797.948	5.374.781	5.170.071	5.204.274	4.914.413
from 0 to > 10 hours	7.531.429	7.531.429	7.531.429	7.531.429	7.531.429
Note	this table identify thousands with the "." "dot".				

11.4 Road-Rail and Emissions calculation

The potential warehouse location consider the transport network efficiency by truck and rail point view. The green house emissions (GHG) are a relevant part for a new sustainable warehouse network.

The tool EcotransIT® (Ecological Transport Information Tool for Worldwide Transports) that calculates the environmental impacts for any freight transport service, is used. EcoTransIT World provides energy consumption and GHG Emissions for trucks, trains, ships and airplanes in accordance with the European standard EN 16258:2012 (ecotransit.org, 2016). For our investigation the truck, rail, and ship are considered as transport modes.

In EcoTransIT the user can select several options from basic to advanced. For our purposes the *standard* option was preferred:

Input mode: *Standard*
Freight: Amount = *1* ; **Unit**: *Container (TEU)*
Origin: Coordinates: *port or COG latitude/longitude* (our table 11.6)
Choose transport mode: *truck + train*
Destinations: Coordinates: latitude/longitude (our table 11.1)

Ecotransit® shows the following results:
Weight: *1 container (TEU)*
t/TEU: *10*

Transport Service Truck: 26-40 t, EURO 5 (this is the truck type)
Vehicle type: Class40
Load factor (LF): 95.77%,
Empty run factor (ETF): 20%

Transport Service Train:
Train Type: container
Train weight: 1000t
Emission class: electrical
Load factor: 49.8%, Empty run factor: 20%,
Ferry routing: Normal
KM: it is not possible to switch in miles.

The author proceeded with the calculation for different departure points (ports and COG latitude and longitude) and the arrival city point (latitude and longitude). The calculation doesn't consider the optimal routing but just the results from point A to point B. Table 11.10 summarised the results.

Table 11.10 Energy consumption from Ports/COG to Cities

	Port of Copenhgen	Port of Oslo	Port of Stockholm	Port of Gothenburg	from COG 1 to cities
Truck results					
Energy consumption (Detailed) truck (kilowatthours) - WTW	63.013	58.394	44.636	52.615	47.121
GHG emissions as CO2e (WTW) - Tonnes	16,47	15,25	12,23	13,77	12,35
Travel by road - KM	20.895,090	17.293,210	13.238,210	15.622,860	12.724,170
Rail results					
Energy consumption (Detailed) rail (kilowathours) WTW	19.705	19.274	17.327	17.905	17.012
GHG emissions as CO2e (WTW) - Tonnes	1,864	1,766	1,744	1,760	1,726
Travel by rail km	30.850,740	25.601,51	25.040,550	23.078,970	25.420,490

Note: this table identify thousands with the "." "dot", and decimals with "comma" ","

Table 11.10 shows the Port of Stockholm as better departure point to satisfy the different cities consuming a lower level of kilowatthours (44,636) and GHG emissions CO2e (carbon dioxide equivalent) (12.23 tonnes).
Instead the COG has the lowest total kilometres to satisfy the cities by road. By rail, instead, the COG, as a departure point, has the lowest energy consumption in kilowathours (17,012) and GHG emissions as CO2e (1,726 tonnes). Instead the Port of Gothenburg maintain the best performance in railway network.

Another consideration to take into account is the transport of the same container (1TEU, 10t) from each single port to the Centre of Gravity (hypothetical warehouse location). The author proceed to calculate the single data and afterwards results have been merged (table 11.11).

Table 11.11 shows the new environmental and network scenario for the considered container (1TEU, 10t) from the ports to the COG.
It appear that the port of Stockholm has better performance (in truck terms) than the other ports; and the Port of Gothenburg perform better compared to the others two ports.
In rail terms, moving the container from the port of Stockholm to COG 1 to the network (cities), has a lower environmental impact compared to the other ports. Compared with PoG there is a slight difference. By contrast, if the container (1TEU, 10t) is transported from the Port of Gothenburg to the COG 1 and afterward to the different cities, there is a lower rail GHG emissions levels (CO2e).

The total number of km by rail are lower from the Stockholm network.

Table 11.11 New Scenario with Container Transport from Ports to COG 1 to Cities

	Port of Copenhagen-Malmo	Port of Oslo	Port of Stockholm	Port of Gothenburg
Truck results				
Energy consumption (Detailed) truck (kilowatthours) - WTW	48.534	48.162	47.522	48.087
GHG emissions as CO2e (WTW) - Tonnes	12,71	12,62	12,45	12,60
Travel by road - KM	13.284,98	13.123,78	12.882,06	13.104,86
Rail results				
Energy consumption (Detailed) rail (kilowathours) WTW	17.216	17.199	17.068	17.138
GHG emissions as CO2e (WTW) - Tonnes	1,731560	1,727180	1,727460	1,726910
Travel by rail km	25.965,80	25.875,68	25.569,71	25.768,66

Note: this table identify thousands with the "." "dot", and decimals with "comma" ","

In order to perform a "global transport network energy and GHG calculation", and adding extra value to the previous figures, the author decided to investigate the transport emissions from China - Shanghai.

The shipping departure point is Shanghai (latitude 30.626539 and longitude 122.064958) to the considered destinations (Class: DryFreight type; via Suez trade (4,7-7k TEU); Speed: 25.0% LF:67.0%; (1TEU, 10t); with EcotransIT carbon calculator). Results are provided in table 11.12.

Table 11.12 Emissions and KM from Shanghai to Dedicated Points (ports and COG 1)

from Shanghai to	Port of Copenhagen -Malmo	Port of Oslo	Port of Stockholm	Port of Gothenburg	COG 1
Sea results					
Energy consumption (Detailed) (kilowatthours) - WTW (total trip)	8.942	10.412	10.542	9.703	10.306
GHG emissions as CO2e (WTW) - Tonnes	2,47	2,85	2,88	2,66	2,82
Travel in KM by sea and by road (from Hamburg)	20.559,28	21.146,42	21.199,20	20.863,90	21.101,90

Note: this table identify thousands with the "." "dot", and decimals with "comma" ","

The results from EcotransIT (table 11.12) show the transport from Shanghai to the port of Copenhagen-Malmo as the optimal option. However, EcotransIT, when the user select longitude and latitude (departure Shanghai and arrival Copenhagen-Malmo Ports), the system takes Hamburg (Germany) as discharging port (and it is not possible to modify it), and from Hamburg a road transport is provided to the final destination (ports or COG 1).

Table 11.13 shows merged data from table 11.10 (Energy consumption from Ports/COG to Cities) and table 11.12 (Emissions and KM from Shanghai to Dedicated Points (ports and COG 1), in order to calculate the most appropriate freight system with the lower level of *energy consumption*, *GHG emissions*, and *total kilometres (by road or by by rail and road).*

Table 11.13 Emissions and KM Merged

from Shanghai to dedicated city passion by the ports	Port of Copenhagen -Malmo	Port of Oslo	Port of Stockholm	Port of Gothenburg	COG
By Sea and Truck					
Energy consumption (Detailed) (kilowatthours) - WTW (total trip)	71.955	68.806	55.178	62.318	57.427
GHG emissions as CO2e (WTW) - Tonnes	18,94	18,10	15,11	16,43	15,17
Travel in KM	41.454,37	38.439,63	34.437,41	36.486,76	33.826,07
By Sea and Rail					
Energy consumption (Detailed) (kilowatthours) - WTW (total trip)	36.921	36.473	34.395	35.043	27.318
GHG emissions as CO2e (WTW) - Tonnes	4,33	4,62	4,62	4,42	4,55
Travel in KM (by sea, truck (Hamburg) and rail)	51.410,02	46.747,93	46.239,75	43.942,87	46.522,39

Note Note: this table identify thousands with the "." "dot", and decimals with "comma" ","

The results from table 11.13 shows the Port of Stockholm (by sea and truck) as the ideal port for the lower level of energy consumption and GHG emissions: arrival (from Shanghai) and departure to the different cities. Instead COG 1, is the distribution point requiring less kilometres to receive and distribute the container (total 33,826.07 km).
Instead, considering the following transport modes: Vessel from Shanghai to Hamburg, road from Hamburg to dedicated port/COG 1, and from dedicated port/COG 1 to final destination (cities); the centre of gravity 1 would generate the lower level of energy consumption; with the Port of Copenhagen-Malmo with the lower level of GHG emission;

and the PoG has the lower number of kilometres to distribute the containers (from port to cities).

11.5 Investment Considerations

According to Mulcahy (1994), several parameters have been considered when evaluating the most appropriate country.

Sweden (3rd on global rank) results being the most appropriate choice when considering the *Networked Readiness Index* (NRI) (the performance of 143 economies in leveraging information and communication technologies to boost competitiveness and well-being) (see definitions), followed by Norway (5th), and Denmark (15th).

Regarding the *corporate tax*, Denmark and Sweden maintain the same level equal of 22 per cent; by contrast Norway has a higher rate (27 per cent).

The *industrial and logistics costs* have different prices among the three countries.
It was mentioned in the previous sections that Oslo is one of the most expensive city worldwide for warehouses.
Considering Denmark, Copenhagen area, official resources weren't available, and it was necessary to investigate third sources. "Colliers", one of the most reputed real estate company worldwide, had two warehouses on sale; the first warehouse is located nearby the port are and the second is located in proximity to the international airport.
The first one has a total surface of 1,119sqm2 with the sale cost equal to 152,792.00USD (136.54USD, price per square meter). The second warehouse has the total surface equal to 1,229sqm2 with the sale cost equal to 176,724.00USD (average cost is 143.79USD per square meter) (Collier, 2016). From other sources (PoG) is suggested to identify the rent cost dividing the sale price per square metre, and adding 10 per cent margin. The potential rental price for the first warehouse (port area) is 150.19USD/sqm2 and the second warehouse (airport area) rental cost is 158.17USD/sqm2.
Official warehouses costs were not available through the Ministry of Foreign Investment (Investindk.com) or other third party agencies.
Swedish warehouses infrastructure cost, in average terms across the country, is 570SEK (69USD per square meter per month); the price per square meter is the same for Stockholm, Malmo and Gothenburg.
Certainly one important element to consider is the private negotiation between the parties, where are negotiates terms-conditions-benefits.

Table 11.14 Comparing Three Countries

	Denmark (2)	Norway (3)	Sweden (4)
Networked Readiness Index's (NRI) (9)	15	5	3
Corporate tax rate %	22	27	22
Industrial/Logistics cots (10)	(5) Warehouse in Port area (to buy) 1,119sqm2 = 1,002,000DK = 152,792.00 USD. Potential rental cost 150.19USD/ sqm2. Warehouse in Airport area 1,229sqm2 = 1,158,954DK = 176,724 USD. Potential rental cost 158.17USD/sqm2.	NA	570SEK/sqm2 = 69USD average
Utilities electricity (US cents per kWh)	14,5 (6)	12,9 (7)	13,3 (8)
VAT - VALUE ADDED TAX (1)	25	24	25
Reduced VAT no. 2	15	15	12
Reduced VAT no. 3	5	8	6
Labor hours	36	38	40

Note:

1) USCIB, 2016
2) InvestinDK.com (2016); considered as main source (if not specified)
3) Innovasjonnorge.no, (2016); considered as main source (if not specified)
4) Business in Sweden (2016); considered as main source (if not specified)
5) Colliers (2016a)
6) Doing Business Denmark, (2016a)
7) Doing Business Norway, (2016b)
8) Doing business Sweden ((2016c)
9) World Economic Forum (2016)
10) Conversion rate by XE.com on 10 May 2016.

The *utility price,* different in Norway, in Denmark and Sweden is one of the factors influencing the warehouse location. The example below shows the different electricity costs per month.
It is assumed that the warehouse operates 8 hours a day for 30 days a month, with equipment utilized at 80 per cent of capacity on average, and that there are no electricity cuts (assumed for simplicity). The subscribed capacity of the warehouse is 140 kVA, with a power factor of 1 (1 kVA = 1 kW). The monthly energy consumption is therefore 26,880 kWh, and the hourly consumption 112 kWh (26,880 kWh/30 days/8 hours).

Denmark Electricity Cost : 26,880 kWh * 14,5 US/cents = 389,760USD/month
Norway Electricity Cost : 26,880 kWh * 12,9 US/cents = 346,752USD/month
Sweden Electricity Cost : 26,880 kWh * 13,3 US/cents = 357,504USD/month

It results that Norway has the lowest cost per month (346,752 USD), followed by Sweden (357,504USD) and last is Denmark (389,760USD).

Value Added Tax maintain different levels in the three countries; VAT category 1 refers to the electronics or sports equipment; VAT category 2 applies to accommodations, entertainment; VAT category 3 applies to basic products as food.

Labor hours are different in Denmark, Norway and Sweden; in general terms, Sweden has the higher number of working hours per week, comparing to the other two countries.

12.4 Comments

From the logistics point of view, the warehouse/DC should be seen as part of the global supply chain, and not as an independent operation (confirmed by Tompkins and Smith, 1998). The importance of this consideration is how the products can be delivered from the manufacturing country (e.g. Shanghai) and delivered to the Scandinavian consumers in amore efficient and effective way.

Lambert and Stock (1993) confirm that the warehouse can be used to receive products (containers) from the manufacturing country, and afterwards smaller deliveries can be organised to satisfy the needs of many consumers. The authors

According to Lambert and Stock (1993) the facility location can be considered under the *macro* and *micro* perspectives. The *macro* perspective is where PoG belong because several geographical areas can be served. From the *micro* perspective the retailer services (sales and delivery) will benefit from this location, offering a quick delivery, and able to satisfy a higher percentage of the Scandinavian market (confirmed by Mulcahy, 1994).

Panayides and Song (2006) assert that ports can contribute to improve the performance of the supply chain as whole. In this case the development of new warehouses in the Port of Gothenburg will contribute to a better distribution, compared to the other ports.

The importance of the warehouse/DC is confirmed by Croucher, Baker and Ruston (2014) because necessary to the distribution of several products. The identified warehouse location is the Port of Gothenburg because from this location three main markets can be served (Norway, Denmark and Sweden) with a shorter delivery time-miles. The location of the warehouse at the PoG can be considered as *Scandinavian geography (to serve multiple geographical - international markets)* and the warehouse can be classified *for finished goods* (to be distributed to the potential customers) or even *returned goods* (after purchase). The authors discuss the importance of the product surround; *deliver service* as an important element in determining the final demand for a product. The same author confirm that a new distribution system can be established with small deliveries on small

vehicles into residential areas. The distribution from the PoG will contribute to those areas with frequent deliveries due to the distance and lower time needed to serve dedicate consumers.

In order to increase the sales, a faster delivery is necessary and the positive consequence is the *improved customer service* (Ballou, 1999). Watson et al (2008) confirm that the warehouse must be located in proximity of the market where the product is consumed; and it is confirmed that the PoG is the preferred location to satisfy different markets (cities). The proximity to the market is confirmed by Lambert and Stock (1993; from Edgar Hoover). Bonacich and Wilson (2008) agree with the proximity to population centres where large proportions of goods can be delivered; confirming PoG as the closest place where to satisfy millions or potential consumers.

For example Mulcahy (1994) states that the site selection project must cover a radius of 150-200 miles (241-321km), and PoG has the higher number of potential consumers within this range; PoG is able to cover 42 per cent of the Scandinavian market within 200 miles, 3,18 millions people. Savills (2013) and NCFRP (2013) focus on central location and proximity to consumers, confirming the results of the PoG.

The centre of gravity identified (COG 1) as suggested by Mulcahy (1994) and Watson et al (2013) shows the lower level of total miles needed to satisfy the selected locations. By contrast the centre of gravity doesn't satisfy at all this statement. The COG 1 cannot take advantage of true road distance or even travel restrictions; it is a straight-line based on latitude and longitude (Watson et al, 2013). Another reason for not accepting COG 1 is the present of the sea between Sweden and Finland. In this case the formulas was weighted by the population and not other variables were considered (e.g. lake and sea/ocean).
The PoG is able to satisfy a larger geographical market (euclidean distance) compared with the COG 1.

In order to compare the different destinations, Mulcahy (1994) suggests to use another approach: *serve-a-cluster-of-customer-method;* where time and distance and considered. This method confirmed the PoG as location able to satisfy different locations in shorter delivery travel time-miles. This is confirmed by Richards (2014) in shorter lead time distribution.

NCFRP (2013) asserts that the location is also chosen by the negotiation process with the warehouse's owner. The average rental cost was identified and online-retailers can base part of their negotiation on that data.

Sustainability is a relevant issue in 2016, and the warehouse of the future should take into consideration the environment. According to Richards (2014) the warehouse is part of the global supply chain and the alternative forms of transport must be considered. From the global perspective (Shanghai - Port/COG 1 - Final consumers), the Port of Stockholm

seems being the location where there is a lower level of emissions; by contrast COG 1 is the location able to use the lower number of kilometres to deliver the container (to the identified cities). PoG has the lower level of kilometres, if the distribution is by rail.

Noteboom and Winkelmans (2001a), UNESCAP and KMI (2005), Bichou and Gray (2004), Verhoeven (2010) specify the importance of the ports as value-added logistics services, and central links in the complex supply chain, where intermodal transports is able to satisfy multiple consumers. The PoG can be seen as distripark, because the location of new warehouses facilities in that area will contribute to redefine the port-supply chain integration and centre of trade (Branch, 2007; Woo and Pettit, 2009); Nottemboom and Rodrigue, 2005).
Johnson and Wood (1996) consider the logistics centre as cost reduction infrastructure; and in our analysis we assume that the lower distance (kilometres and miles) and travel time, from the PoG to consumers, contribute to reduce the retailers costs.

According to Robinson (2002) the competition between individual ports is along the logistics chain and the geographical location of the PoG (and warehouses located in the port) contribute to perform the distribution in a more efficient and effective way compared to the other ports. It is confirmed by Song and Panayides (2012) that ports contribute to the supply chain through the creation of value added-delivery and competitive advantage, and the distribution system from the PoG has a relevant impact for online retailers.
Mangan et al (2008) discuss about port-centric logistics services such as warehousing, contributing to higher profits margins for the port itself. The new warehouses, located in the Port of Gothenburg area will contribute to better distraction operations such as *no double transportation for containers, enable hauliers to reduce wastage and make the most efficient use of trucks and drivers' hours.* Carbon and de Martino (2003) confirm that the customer is willing to pay for those services contributing to adds value to the product.

Worldbank (2001) and Talley (2009) define the non-traditional port services who contribute to cost reduction; the PoG with the "new" and future port warehousing service will contribute to reduce the cost related to distribution (assumption based on kilometres and voyage shipping costs).

Concluding, the delivery service must meet customer expectations otherwise sales can be lost (Harrison, Hoek and Skipworth, 2014); nowadays customers expectations are related to the same day or next day delivery, and the PoG warehouse's location can contribute to have amore efficient distribution and potential sales will not be lost.

12. CONCLUSIONS

This section provides a summary of the conducted research.

Considering the research questions mentioned at the beginning of this research:

1) Assuming that all four ports included in the research provide warehouses to e-retailers, which location has the most convenient distribution (e.g. short lead time and large e-buyer customer base)?

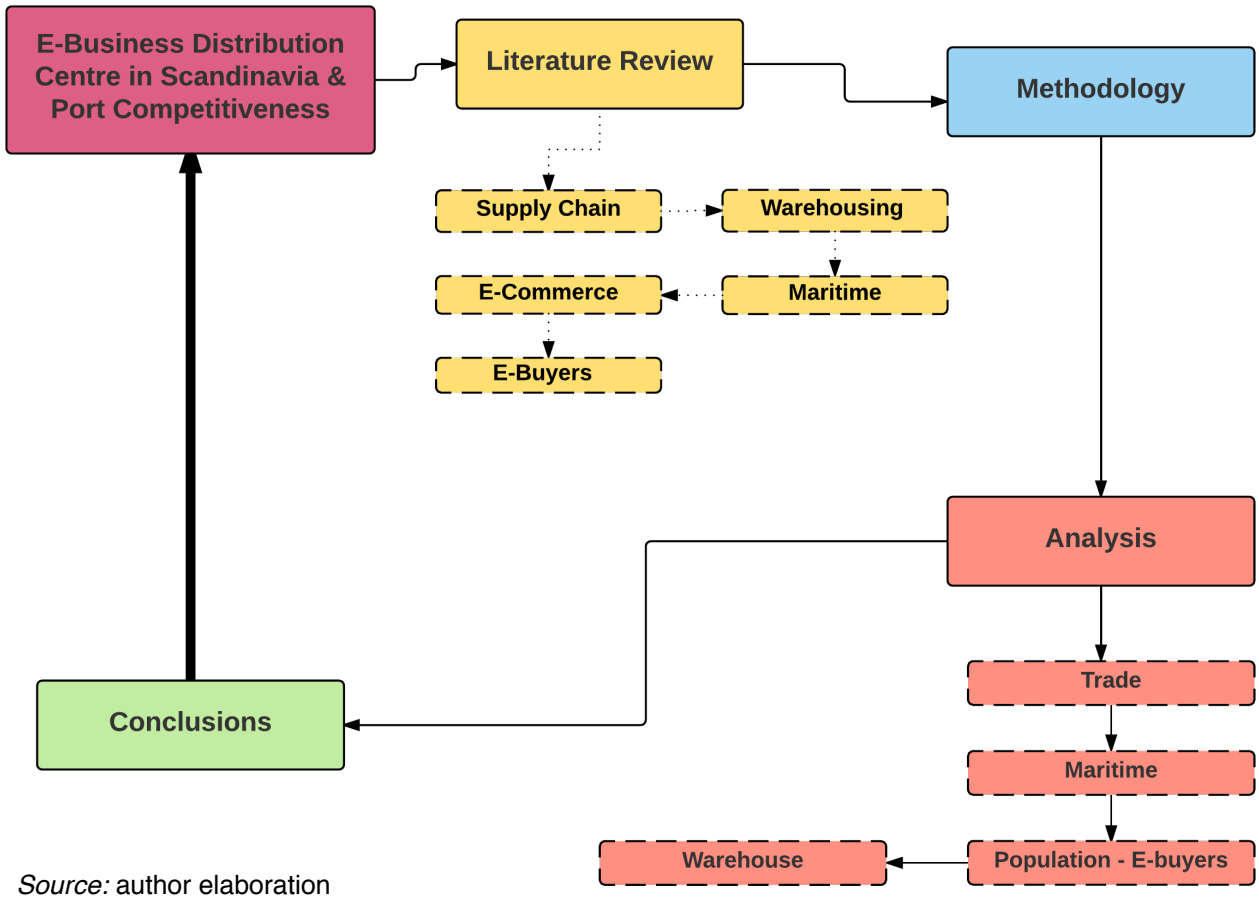
2) How can the Port of Gothenburg (PoG) contribute to the success of online retailers?

3) Which factors create a competitive advantage for e-retailers?

4) Which factors influence the choice of location for a warehouse/DC?

In order to answer to the research questions a literature investigation was conducted under several key topics. The considered topics are the supply chain, maritime, warehousing, e-commerce and e-buyers. Image 12.1 shows the research process.

Image 12.1 Summary Research



Source: author elaboration

Once the literature review was identified, a proper methodology was necessary in order to have the most appropriate data collection methods, and models applied in the analysis.

The analysis section investigated the followings:

1) The *international trade* in order to identify the trade value of goods in Scandinavia and the country with higher levels of Import-Export; it was necessary to understand the consumptions, the type of goods consumed, the trade value with the world and the Import-Export in Scandinavia.
2) The *maritime sector,* considered the throughput levels by country, region and port; the number of vessels per port and related TEUs/containers, ports characteristics, efficiency indicators, and voyages costs simulation to identify potential-preferred port.
3) *E-Buyers characteristics* such as geo-demographic data, country economic overview, social classes, the level of internet penetration in the countries, and retailing consumptions
4) *Warehouse location*, investigated the most appropriate location for a warehouse, considering the potential consumers (to satisfy) in the shorter lead time and larger radius in miles, warehouses prices, and global distribution simulation (from Shanghai to dedicated cities in Scandinavia).

In the analysis section, several comments related to the literature clarified the results.
It is possible now to answer to the following research questions:

1) Assuming that all four ports included in the research provide warehouses to e-retailers, which location has the most convenient distribution (e.g. short lead time and large e-buyer customer base)?

The preferred location who better satisfy the higher number of consumers is Gothenburg. The Port of Gothenburg, with the new warehouses, will contribute to a more efficient distribution penetrating the higher number of potential consumers with a shorter distribution time compared to the ports' competitors; thanks to Gothenburg's geographical location, 5.37 millions of potential consumers can be reached within 500 miles; it means that consumers in Norway, Denmark, and Sweden will incur in positive benefits, as faster products delivery.

2) How can the Port of Gothenburg (PoG) contribute to the success of online retailers?

The PoG as a central distribution centre for e-retailers will positive influence the global supply chain thanks to the higher level of efficiency.

Containers will be discharge at the port and moved directly to the warehouses located 1.5 km from the container terminal. This activity will contribute to have a lower delivery time to the retailer warehouses and the products will be dispatched quicker and sooner to the consumers (port-centric logistics). In this case sales will not be lost.

Shipping companies will prefer call PoG for the lower voyage costs, lower containers handling fees, higher level of efficiency (indicators) compared to the other ports. PoG perform higher calls from containerships and Ro-Ros. It means that shipping companies prefer PoG to other ports.

3) Which factors create a competitive advantage for e-retailers?

Sweden has a larger population, compared to the rest of the three countries. The Country economy perform better compared to Denmark, Finland and Norway.

The international trade in Scandinavia is definitely something to take into consideration because Swedish consumers are willing to spend more in retailing products. The higher income and Scandinavian economy contribute to be a very attractive market.

The four ports have different infrastructures, dimensions, throughput, containers and TEUs flow; the port with a better performance is definitely Gothenburg.

In total there are ca. 24.7 million E-buyers in Scandinavia, and 19.6 millions can be reached from Gothenburg.

Sweden is the country with higher sales in apparel, footwear, beauty, personal care, and consumer electronics.

Market penetration in 2-4 hours by truck to deliver products to the customer

4) Which factors influence the choice of location for a warehouse/DC?

The warehouse location, that is the most relevant part of this research. One important element is the customer satisfaction in the shortest lead time. It means that the more convenient location is where the company can dispatch several times, during the day, products to major urban centres.

Infrastructure investment costs such as warehouse's rent price, utilities prices, negotiable salaries, working hours, international trade volume, and income of the potential market to be served.

Considering that the final users of the warehouse/DC are e-retailers, is necessary to identify if the level of technology of the population. The four countries have pretty young population, in average, and particularly Sweden; the habitants have multiple devices, multiple internet and mobile subscriptions.

12.1 Future Research

This research is quite extensive and wasn't possible to cover all the aspect related to e-retailers, distributions, maritime, E-commerce and e-buyers.

Starting from the supply chain, some possible investigations are related to the transport costs from the manufacturing country, the transport to the first port, and a more detailed voyage cost analysis.

In warehousing, something relevant to investigate is what type of infrastructure the e-retailer is interested in; online retailers might be interested in high technological advanced "spiders" to collect goods in few minutes (Amazon DC). The level of technology inside the distribution centre affect the delivery time. If e-retailers spend 6 hours or even 10 to collect the goods in the warehouse, the product can be collected the day after or even 2 days later (depending on 3PL distribution and delivery schedule). It interesting to understand the reasons why retailers such as Zalando and others, dispatch their products from other countries (e.g. Germany) this process influence the delivery time to the Scandinavian users, because are necessary 7-10 days to receive an order in Gothenburg.

Regarding the maritime sector, particular focus can be on port time efficiency. It would be interesting identifying the time necessary to discharge a containerships and related costs (e.g. labor, cranes, quay cranes, berthing, and pilotage). Several authors identified some performance indicators, but due to the lack of informations and time wasn't possible to investigate them.
The containers flow, inward and outward, wasn't considered. Containers when moving from the port to the retailers' warehouse, are in stand-by for a certain time, and the retailers incur in extra costs for this stand-by.

Under the e-commerce analysis, it would be interesting investigate in details the order delivery; what happen next an order is received by the retailers? how long does it take to process the order? how many people can be involved in a single order? how e-retailers negotiate with 3PL (e.g. for faster deliveries)?

One thing the author was interested, was the routing optimisation. The identified routes, in this research, considered the departure point (Port) and arrival (city). It would be interesting to analyse in details the routes optimisation for those cities reachable in the same time range (e.g. within 2 hours; or within 200 miles).

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APPENDIX “A” - HS CODES

The Appendix “A” refers about the Harmonised system codes, applied during the import/export analysis.

Below are classified the categories by type of products (HS Codes by category):

HS from 01 to 05 Animal & Animal Products
HS from 06 to15 Vegetable Products
HS from 16 to 24 Foodstuffs
HS from 25 to 27 Mineral Products
HS from 28 to 38 Chemicals & Allied Industries
HS from 39 to 40 Plastics / Rubbers
HS from 41 to 43 Raw Hides, Skins, Leather, & Furs
HS from 44 to 49 Wood & Wood Products
HS from 50 to 63 Textiles
HS from 64 to 67 Footwear / Headgear
HS from 68 to 71 Stone / Glass
HS from 72 to 83 Metals
HS from 84 to 85 Machinery / Electrical
HS from 86 to 89 Transportation
HS from 90 to 97 Miscellaneous
HS from 98 to 99 Service

Source: Foreign-Trade.com (2016)

The author’s classification is focused primarily on the main trade categories, classified by the Port of Gothenburg, because the products are part of the e-commerce (B2C).

The author’s analysis was focused primarily on each single code data (e.g. HS 30 import-export-country), afterwards all the categories belonging to the HS range (e.g. 28-38) were merged and summed, in order to provide a general overview about the HS range category.

A detailed analysis is presented in the Appendix A-B-C-D-E-F.

Table A.1 Selected HS Codes by Range (macro category) and by Description (sub-category)

HS range	HS code	HS Description
28-38 Chemicals & Allied Industries	30	Pharmaceutical Products
	33	Oils & Resinoids, Perfumery, Cosmetic Or Toilet Preparations
	34	Soaps, Waxes, Scouring Products, Candles, Modeling Pastes, Dental Waxes
	37	Photographic Or Cinematographic Goods
41-43 Raw Hides, Skins, Leather, & Furs	42	Articles Of Leather, Saddlery & Harness, Travel Goods, Handbags, Articles Of Gut
44-49 Wood & Wood Products	48	Paper & Paperboard, Articles Of Paper Pulp
	49	Printed Books, Newspapers, Pictures, Manuscripts, Typescripts & Plans
50-63 Textiles	57	Carpets & Other Textile Floor Coverings
	60	Knitted Or Crocheted Fabrics
	61	Articles Of Apparel & Clothing Accessories-Knitted Or Crocheted
	62	Articles Of Apparel & Clothing Accessories-Not Knitted Or Crocheted
	63	Made-Up Textile Articles Nesoi, Needlecraft Sets, Worn Clothing, Rags
64-67 Footwear / Headgear	64	Footwear, Gaiters, & The Like
	65	Headgear & Other Parts
	66	Umbrellas, Sun Umbrellas, Walking-Sticks, Whips, Riding-Crops & Parts
68-71 Stone / Glass	69	Ceramic Products
72-83 Metals	71	Pearls, Stones, Prec. Metals, Imitation Jewelry, Coins
84-85 Machinery / Electrical	84	Nuclear Reactors, Boilers, Machinery & Mechanical Appliances, Computers
only selected sub category	8467	Tools for working in the hand, pneumatic etc, pts
only selected sub category	8468	Machines, solder etc, gas surf temper machines, pt
only selected sub category	8469	Typewriters & word processing machines
only selected sub category	8470	Calculating & account machines, cash registers etc
	85	Electrical Machinery & Equip. & Parts, Telecommunications Equip., Sound Recorders, Television Recorders

HS range	HS code	HS Description
90-97 Miscellaneous	90	Optical, Photographic, Cinematographic, Measuring, Checking, Precision, Medical Or Surgical Instruments & Accessories
	91	Clocks & Watches & Parts Thereof
	92	Musical Instruments, Parts & Accessories
	94	Furniture, Bedding, Cushions, Lamps & Lighting Fittings Nesoi, Illuminated Signs, Nameplates & The Like, Prefabricated Buildings
	95	Toys, Games & Sports Equip, Parts & Acces.
	96	Miscellaneous Manufactured Articles

Source: Foreign-Trade.com, 2016

If the reader is interested in a deeper investigation about HS codes' categories, is suggested to review the following link www.foreign-trade.com/reference/hscode.htm; in opposite World Custom Organisation provide the official source (www.wcoomd.org)

APPENDIX “B” - OVERVIEW TRADE COUNTRIES

Table B.1 Import-Export Value Selected Countries

1)	Import (Trade in USD)	Export (Trade in USD)	Total (USD)
Denmark	85.275.438.764	94.425.784.552	179.701.223.316
Finland	60.174.387.730	59.682.311.206	119.856.698.936
Norway	76.979.322.634	106.251.085.040	183.230.407.674
Sweden	137.986.741.780	140.089.772.744	278.076.514.524

Source: UN Comtrade, 2015

Table B.2 Export - Selected HS Codes by Country

HS codes	HS Description	Sweden	Finland	Denmark	Norway
28-38	Chemicals & Allied Industries	8.443.048.244	1.127.514.058	12.659.737.628	834.793.149
41-43	Raw Hides, Skins, Leather, & Furs	211.428.561	34.433.673	201.023.900	13.642.689
44-49	Wood & Wood Products	8.988.436.856	8.236.355.044	1.237.368.831	507.833.302
50-63	Textiles	2.066.164.806	368.473.432	4.296.400.450	123.968.088
64-67	Footwear / Headgear	348.046.409	117.598.048	619.801.848	23.160.046
68-71	Metals	1.225.121.467	656.972.372	408.112.125	501.144.176
84-85	Machinery / Electrical	15.895.580.086	5.175.400.498	5.274.490.072	2.967.785.766
90-97	Miscellaneous	7.742.468.820	3.244.270.981	7.837.449.258	2.721.165.950
	Total	44.920.295.249	18.961.018.106	32.534.384.112	7.693.493.166

Source: UN Comtrade, 2015

Table B.3 Import - Selected HS codes by Country

HS codes	HS Description	Sweden	Finland	Denmark	Norway
28-38	Chemicals & Allied Industries	5.345.119.519	2.796.001.394	4.943.932.835	2.879.054.102
41-43	Raw Hides, Skins, Leather, & Furs	480.539.116	177.773.552	373.306.306	275.791.578
44-49	Wood & Wood Products	1.820.695.233	717.156.570	1.765.214.555	1.413.451.958
50-63	Textiles	4.612.020.740	1.618.216.918	4.877.269.456	2.707.999.190
64-67	Footwear / Headgear	1.019.245.504	396.859.937	1.024.446.899	709.933.125
68-71	Metals	609.609.362	255.478.727	524.884.341	558.381.408
84-85	Machinery / Electrical	17.613.259.480	5.920.572.519	8.382.165.235	7.008.866.893
90-97	Miscellaneous	8.054.959.383	3.331.098.527	5.797.264.615	6.611.223.602
	Total	39.555.448.337	15.213.158.144	27.688.484.242	22.164.701.856

Source: UN Comtrade, 2015

APPENDIX “C” - DETAIL TRADE DENMARK

Table C.1 Denmark Import - Export 2015

Import (Trade in USD)	Export (Trade in USD)	Total (USD)
85.275.438.764	94.425.784.552	179.701.223.316

Source: UN Comtrade, 2015

Table C.2 Denmark - Top 5 Import Countries (Value in USD)

Denmark - top 5 Import Countries	Trade in USD 2015
Germany	17.400.249.204
Sweden	10.498.794.750
Netherlands	6.815.631.900
China	6.374.960.249
United Kingdom	3.831.320.193

Source: UN Comtrade, 2015

Table C.3 Denmark - Top 5 Export Countries (Value in USD)

Denmark - top 5 Export Countries	Trade in USD 2015
Germany	15.291.829.247
Sweden	10.446.351.869
United Kingdom	5.417.966.597
Norway	6.007.744.956
USA	5.219.600.875

Source: UN Comtrade, 2015

Table C.4 Denmark, Import/Export 2015 Neighbours countries

Denmark - Import/Export Neighbours countries	Trade in USD 2015
Sweden	**20.945.146.619**
Import	10.498.794.750
Export	10.446.351.869
Norway	**10.000.714.488**
Import	3.992.969.532
Export	6.007.744.956
Finland	**3.430.167.664**
Import	1.107.212.473
Export	2.322.955.191

Source: UN Comtrade, 2015

Table C.5.1 Denmark Import Data 2015 by HS category

HS groups - Import 2015	Description	Total trade in USD
28-38	Chemicals & Allied Industries	4.943.932.835
41-43	Raw Hides, Skins, Leather, & Furs	373.306.306
44-49	Wood & Wood Products	1.765.214.555
50-63	Textiles	4.877.269.456
64-67	Footwear / Headgear	1.024.446.899
68-71	Metals	524.884.341
84-85	Machinery / Electrical	8.382.165.235
90-97	Miscellaneous	5.797.264.615

Source: UN Comtrade, 2015

Figure C.1 Import Denmark selected HS codes 2015 (value in USD) (table C.5.1)

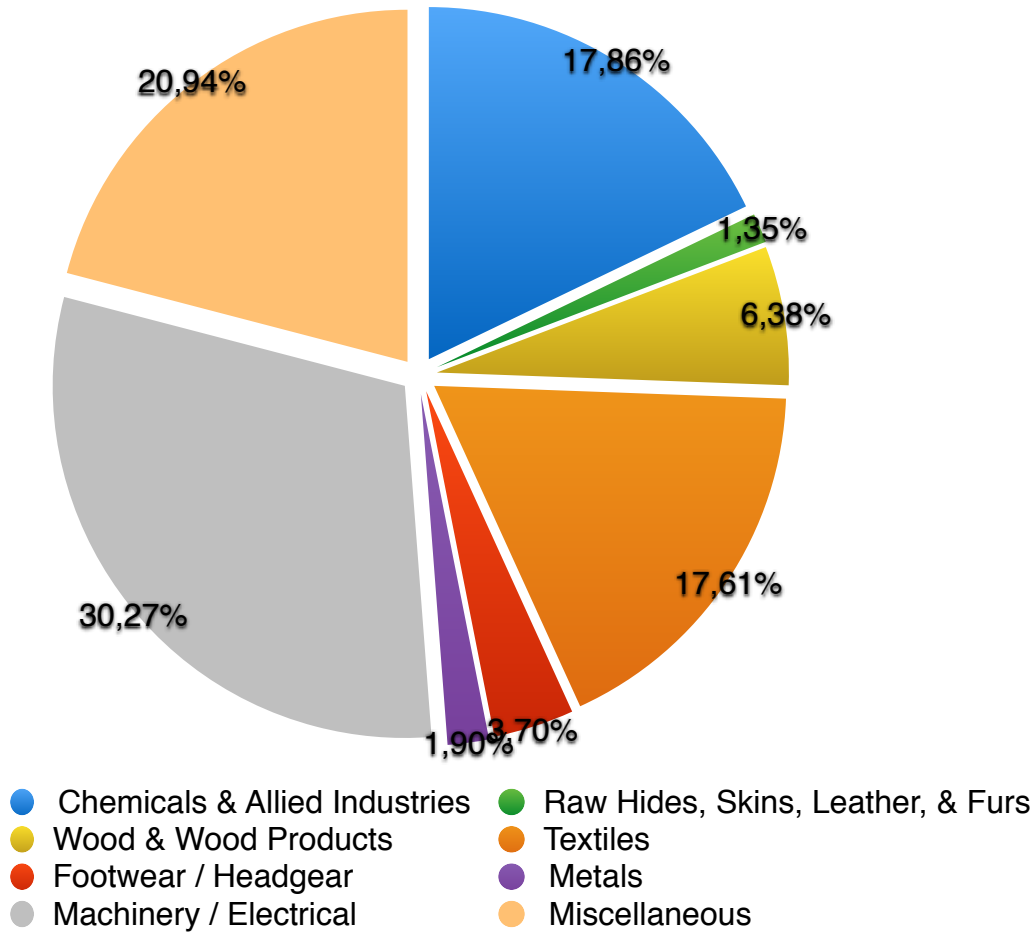

Table C.5.2 Denmark Import Data 2015 by HS Category (Detail)

HS code	HS description	Trade Value (US$) 2015
30	Pharmaceutical Products	3.846.069.412
33	Oils & Resinoids, Perfumery, Cosmetic Or Toilet Preparations	636.266.721
34	Soaps, Waxes, Scouring Products, Candles, Modeling Pastes, Dental Waxes	419.584.612
37	Photographic Or Cinematographic Goods	42.012.090
42	Articles Of Leather, Saddlery & Harness, Travel Goods, Handbags, Articles Of Gut	373.306.306
48	Paper & Paperboard, Articles Of Paper Pulp	1.399.430.863
49	Printed Books, Newspapers, Pictures, Manuscripts, Typescripts & Plans	365.783.692
57	Carpets & Other Textile Floor Coverings	83.918.682
60	Knitted Or Crocheted Fabrics	38.562.817
61	Articles Of Apparel & Clothing Accessories-Knitted Or Crocheted	1.977.621.465
62	Articles Of Apparel & Clothing Accessories-Not Knitted Or Crocheted	2.325.413.639
63	Made-Up Textile Articles Nesoi, Needlecraft Sets, Worn Clothing, Rags	451.752.853
64	Footwear, Gaiters, & The Like	948.528.852
65	Headgear & Other Parts	58.169.290
66	Umbrellas, Sun Umbrellas, Walking-Sticks, Whips, Riding-Crops & Parts	17.748.757
69	Ceramic Products	304.248.035
71	Pearls, Stones, Prec. Metals, Imitation Jewelry, Coins	220.636.306
8467	Tools for working in the hand, pneumatic etc, pts	191.973.671
8468	Machines, solder etc, gas surf temper machines, pt	4.132.588
8469	Typewriters & word processing machines	134.926
8470	Calculating & account machines, cash registers etc	17.167.900
85	Electrical Machinery & Equip. & Parts, Telecommunications Equip., Sound Recorders, Television Recorders	8.168.756.150
90	Optical, Photographic, Cinematographic, Measuring, Checking, Precision, Medical Or Surgical Instruments & Accessories	2.419.001.699
91	Clocks & Watches & Parts Thereof	135.034.584
92	Musical Instruments, Parts & Accessories	26.432.696
94	Furniture, Bedding, Cushions, Lamps & Lighting Fittings Nesoi, Illuminated Signs, Nameplates & The Like, Prefabricated Buildings	2.081.219.411
95	Toys, Games & Sports Equip, Parts & Acces.	876.003.832
96	Miscellaneous Manufactured Articles	259.572.393

Source: UN Comtrade, 2015

Table C.6.1 Export Denmark selected HS codes 2015 (value in USD)

HS groups Export DK 2015	Description	Total trade in USD
28-38	Chemicals & Allied Industries	12.659.737.628
41-43	Raw Hides, Skins, Leather, & Furs	201.023.900
44-49	Wood & Wood Products	1.237.368.831
50-63	Textiles	4.296.400.450
64-67	Footwear / Headgear	619.801.848
68-71	Metals	408.112.125
84-85	Machinery / Electrical	5.274.490.072
90-97	Miscellaneous	7.837.449.258

Source: UN Comtrade, 2015

Figure C.2 Export Denmark selected HS codes 2015 (value in USD) (table C.6.1)

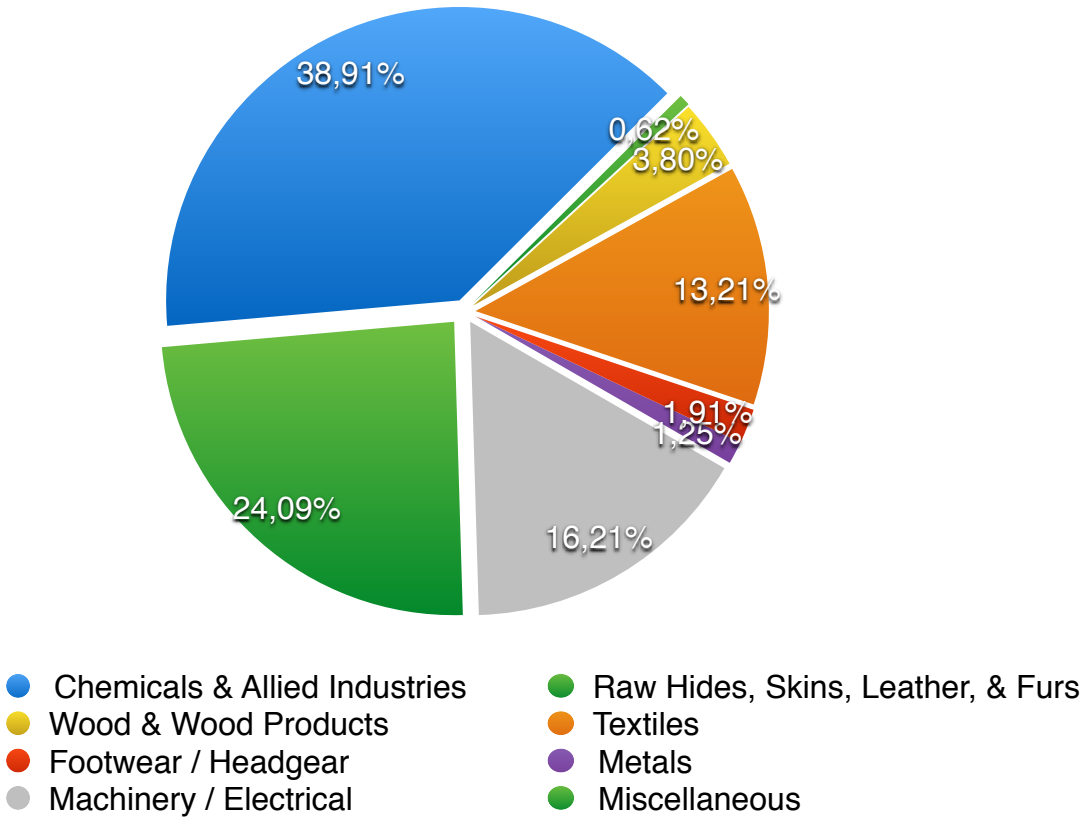

Table C.6.2 Export Denmark selected HS Codes 2015 (value in US$)

HS code	HS description	Trade Value (US $) 2015
30	Pharmaceutical Products	11.689.501.202
33	Oils & Resinoids, Perfumery, Cosmetic Or Toilet Preparations	420.633.703
34	Soaps, Waxes, Scouring Products, Candles, Modeling Pastes, Dental Waxes	539.735.303
37	Photographic Or Cinematographic Goods	9.867.420
42	Articles Of Leather, Saddlery & Harness, Travel Goods, Handbags, Articles Of Gut	201.023.900
48	Paper & Paperboard, Articles Of Paper Pulp	708.929.350
49	Printed Books, Newspapers, Pictures, Manuscripts, Typescripts & Plans	327.415.581
57	Carpets & Other Textile Floor Coverings	173.734.115
60	Knitted Or Crocheted Fabrics	47.091.291
61	Articles Of Apparel & Clothing Accessories-Knitted Or Crocheted	1.702.210.536
62	Articles Of Apparel & Clothing Accessories-Not Knitted Or Crocheted	2.106.652.950
63	Made-Up Textile Articles Nesoi, Needlecraft Sets, Worn Clothing, Rags	266.711.558
64	Footwear, Gaiters, & The Like	583.105.924
65	Headgear & Other Parts	30.789.906
66	Umbrellas, Sun Umbrellas, Walking-Sticks, Whips, Riding-Crops & Parts	5.906.018
69	Ceramic Products	206.095.965
71	Pearls, Stones, Prec. Metals, Imitation Jewelry, Coins	202.016.160
8467	Tools for working in the hand, pneumatic etc, pts	-881.343.960,7
8468	Machines, solder etc, gas surf temper machines, pt	-1.104.901.269
8469	Typewriters & word processing machines	-1.328.458.578
8470	Calculating & account machines, cash registers etc	6.739.758
85	Electrical Machinery & Equip. & Parts, Telecommunications Equip., Sound Recorders, Television Recorders	8.582.454.122
90	Optical, Photographic, Cinematographic, Measuring, Checking, Precision, Medical Or Surgical Instruments & Accessories	3.887.464.625
91	Clocks & Watches & Parts Thereof	46.222.365
92	Musical Instruments, Parts & Accessories	21.263.277
94	Furniture, Bedding, Cushions, Lamps & Lighting Fittings Nesoi, Illuminated Signs, Nameplates & The Like, Prefabricated Buildings	2.673.363.475
95	Toys, Games & Sports Equip, Parts & Acces.	874.565.498
96	Miscellaneous Manufactured Articles	334.570.018

Source: UN Comtrade, 2015

APPENDIX “D” - DETAIL TRADE FINLAND

Table D.1 Finland Import - Export 2015

Import (Trade in USD)	Export (Trade in USD)	Total (USD)
60.174.387.730	59.682.311.206	119.856.698.936

Source: UN Comtrade, 2015

Table D.2 Finland - Top 5 Import Countries (Value in USD)

Country	Trade in USD 2015
Germany	8.990.539.819
Sweden	6.744.042.668
Russian Federation	6.587.281.553
China	4.368.658.494
Netherlands	3.167.943.473

Source: UN Comtrade, 2015

Table D.3 Finland - Top 5 Export Countries (Value in USD)

Country	Trade in USD 2015
Germany	8.099.889.695
Sweden	6.049.930.545
USA	4.003.917.948
Netherlands	3.825.796.158
Russian Federation	3.443.649.012

Source: UN Comtrade, 2015

Table D.4 Finland, Import/Export 2015 Neighbours countries

Country	Trade in USD 2015
Sweden	12.793.973.213
Import	6.744.042.668
Export	6.049.930.545
Norway	2.799.577.917
Import	1.089.040.375
Export	1.710.537.542
Denmark	2.924.759.588
Import	1.914.137.937
Export	1.010.621.651

Source: UN Comtrade, 2015

Table D.5.1 Finland Import Data 2015 by HS Category

HS description		Total value USD
28-38	Chemicals & Allied Industries	2.796.001.394
41-43	Raw Hides, Skins, Leather, & Furs	177.773.552
44-49	Wood & Wood Products	717.156.570
50-63	Textiles	1.618.216.918
64-67	Footwear / Headgear	396.859.937
68-71	Metals	255.478.727
84-85	Machinery / Electrical	5.920.572.519
90-97	Miscellaneous	3.331.098.527

Source: UN Comtrade, 2015

Figure D.1 Finland Import Data 2015 by HS category (table D.5.1)

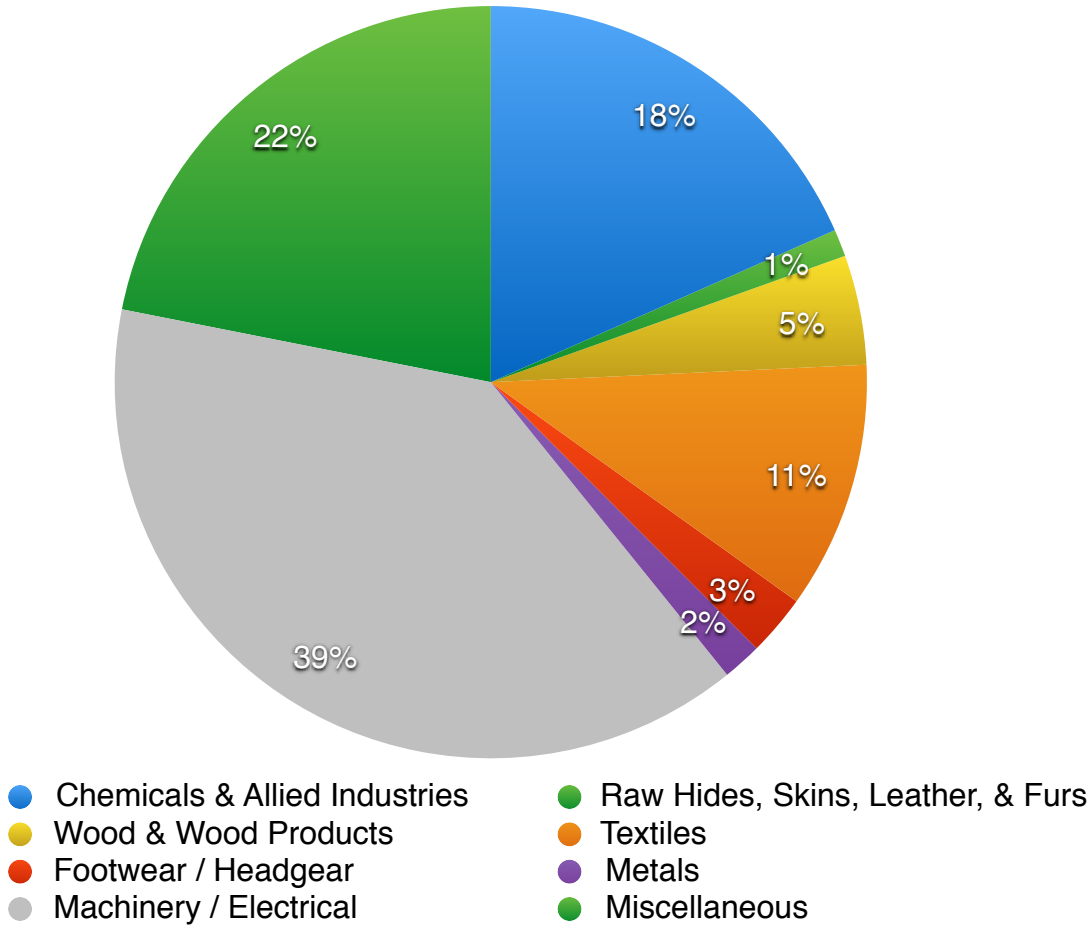

Table D.5.2 Finland Import Data 2015 by HS Category (detail)

HS code	HS description	Trade Value (US$) 2015
30	Pharmaceutical Products	2.198.839.844
33	Oils & Resinoids, Perfumery, Cosmetic Or Toilet Preparations	270.269.048
34	Soaps, Waxes, Scouring Products, Candles, Modeling Pastes, Dental Waxes	308.671.680
37	Photographic Or Cinematographic Goods	18.220.822
42	Articles Of Leather, Saddlery & Harness, Travel Goods, Handbags, Articles Of Gut	177.773.552
48	Paper & Paperboard, Articles Of Paper Pulp	565.119.752
49	Printed Books, Newspapers, Pictures, Manuscripts, Typescripts & Plans	152.036.818
57	Carpets & Other Textile Floor Coverings	66.483.013
60	Knitted Or Crocheted Fabrics	16.061.218
61	Articles Of Apparel & Clothing Accessories-Knitted Or Crocheted	648.324.545
62	Articles Of Apparel & Clothing Accessories-Not Knitted Or Crocheted	711.175.173
63	Made-Up Textile Articles Nesoi, Needlecraft Sets, Worn Clothing, Rags	176.172.969
64	Footwear, Gaiters, & The Like	338.568.381
65	Headgear & Other Parts	52.478.130
66	Umbrellas, Sun Umbrellas, Walking-Sticks, Whips, Riding-Crops & Parts	5.813.426
69	Ceramic Products	166.356.611
71	Pearls, Stones, Prec. Metals, Imitation Jewelry, Coins	89.122.116
8467	Tools for working in the hand, pneumatic etc, pts	154.302.831
8468	Machines, solder etc, gas surf temper machines, pt	8.183.755
8469	Typewriters & word processing machines	14.591
8470	Calculating & account machines, cash registers etc	29.665.880
85	Electrical Machinery & Equip. & Parts, Telecommunications Equip., Sound Recorders, Television Recorders	5.728.405.462
90	Optical, Photographic, Cinematographic, Measuring, Checking, Precision, Medical Or Surgical Instruments & Accessories	1.681.259.243
91	Clocks & Watches & Parts Thereof	96.079.817
92	Musical Instruments, Parts & Accessories	30.020.221
94	Furniture, Bedding, Cushions, Lamps & Lighting Fittings Nesoi, Illuminated Signs, Nameplates & The Like, Prefabricated Buildings	990.514.319
95	Toys, Games & Sports Equip, Parts & Acces.	369.550.686
96	Miscellaneous Manufactured Articles	163.674.241

Source: UN Comtrade, 2015

Table D.6.1 Finland Export Data 2015 by HS Category

Finland Top 10 HS - Export	HS description	Trade Value (US$) 2015
28-38	Chemicals & Allied Industries	1.127.514.058
41-43	Raw Hides, Skins, Leather, & Furs	34.433.673
44-49	Wood & Wood Products	8.236.355.044
50-63	Textiles	368.473.432
64-67	Footwear / Headgear	117.598.048
68-71	Metals	656.972.372
84-85	Machinery / Electrical	5.175.400.498
90-97	Miscellaneous	3.244.270.981

Source: UN Comtrade, 2015

Figure D.2 Finland Export Data 2015 by HS Category (table D.6.1)

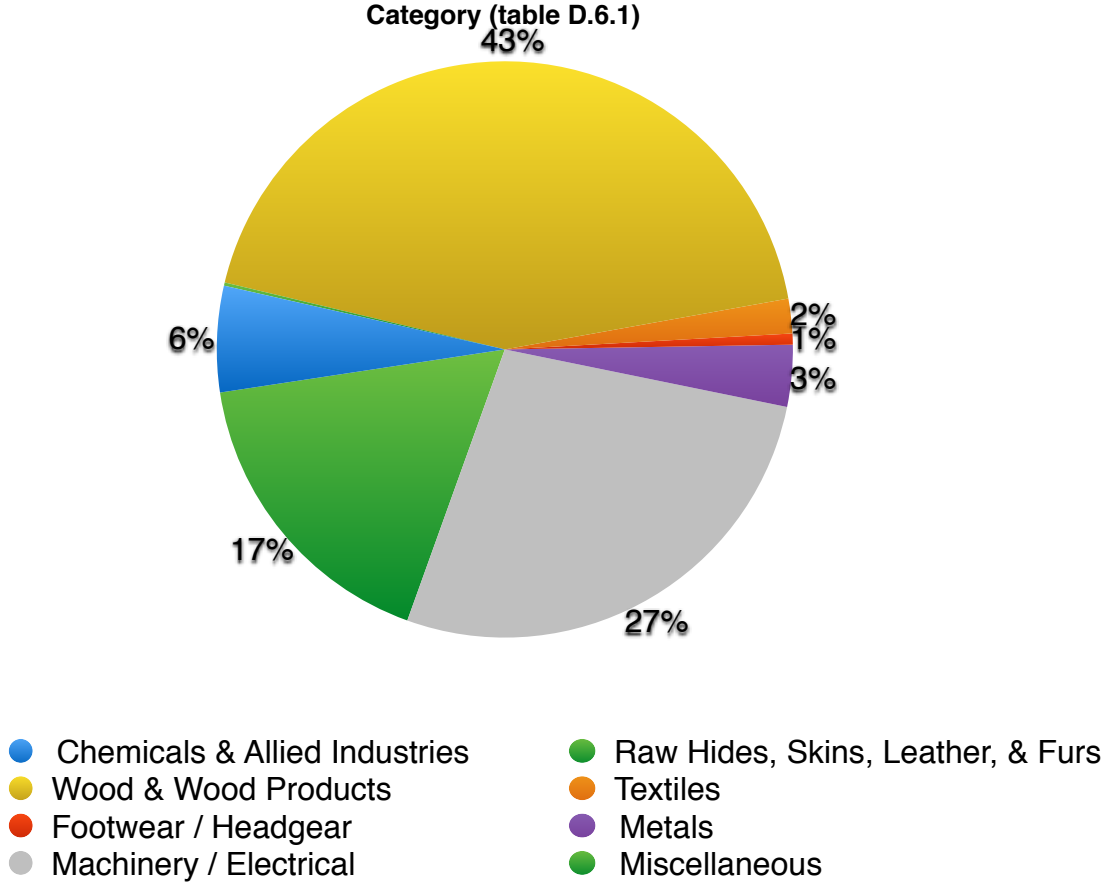

Table D.6.2 Finland Export Data 2015 by HS Category (detail)

HS code	HS description	Trade Value (US$) 2015
30	Pharmaceutical Products	942.293.452
33	Oils & Resinoids, Perfumery, Cosmetic Or Toilet Preparations	62.393.176
34	Soaps, Waxes, Scouring Products, Candles, Modeling Pastes, Dental Waxes	120.476.131
37	Photographic Or Cinematographic Goods	2.351.299
42	Articles Of Leather, Saddlery & Harness, Travel Goods, Handbags, Articles Of Gut	34.433.673
48	Paper & Paperboard, Articles Of Paper Pulp	8.061.651.2
49	Printed Books, Newspapers, Pictures, Manuscripts, Typescripts & Plans	140.270.112
57	Carpets & Other Textile Floor Coverings	10.846.082
60	Knitted Or Crocheted Fabrics	9.523.235
61	Articles Of Apparel & Clothing Accessories-Knitted Or Crocheted	96.412.710
62	Articles Of Apparel & Clothing Accessories-Not Knitted Or Crocheted	199.939.728
63	Made-Up Textile Articles Nesoi, Needlecraft Sets, Worn Clothing, Rags	51.751.677
64	Footwear, Gaiters, & The Like	108.291.682
65	Headgear & Other Parts	8.627.423
66	Umbrellas, Sun Umbrellas, Walking-Sticks, Whips, Riding-Crops & Parts	678.943
69	Ceramic Products	74.803.518
71	Pearls, Stones, Prec. Metals, Imitation Jewelry, Coins	582.168.854
8467	Tools for working in the hand, pneumatic etc, pts	87.351.450
8468	Machines, solder etc, gas surf temper machines, pt	407.789
8469	Typewriters & word processing machines	276
8470	Calculating & account machines, cash registers etc	1.924.015
85	Electrical Machinery & Equip. & Parts, Telecommunications Equip., Sound Recorders, Television Recorders	5.085.716.9
90	Optical, Photographic, Cinematographic, Measuring, Checking, Precision, Medical Or Surgical Instruments & Accessories	2.618.054.5
91	Clocks & Watches & Parts Thereof	44.156.406
92	Musical Instruments, Parts & Accessories	1.488.789
94	Furniture, Bedding, Cushions, Lamps & Lighting Fittings Nesoi, Illuminated Signs, Nameplates & The Like, Prefabricated Buildings	454.526.018
95	Toys, Games & Sports Equip, Parts & Acces.	109.445.474
96	Miscellaneous Manufactured Articles	16.599.721

Source: UN Comtrade, 2015

APPENDIX “E” - DETAIL TRADE NORWAY

Table E.1 Norway Import Export 2015

Import (Trade in USD)	Export (Trade in USD)	Total (USD)
76.979.322.634	106.251.085.040	183.230.407.674

Source: UN Comtrade, 2015

Table E.2 Norway - Top 5 Import Countries (Value in USD)

Country	Trade in USD 2015
Sweden	8.863.712.690
Germany	8.711.615.499
China	8.019.352.303
United Kingdom	4.942.683.167
USA	4.843.748.237

Source: UN Comtrade, 2015

Table E.3 Norway - Top 5 Export Countries (Value in USD)

Country	Trade in USD 2015
United Kingdom	23.157.203.189
Germany	18.680.629.157
Netherlands	10.531.232.767
France	6.922.624.963
Sweden	6.321.703.951

Source: UN Comtrade, 2015

Table E.4 Norway Import/Export 2015 Neighbours Countries

Country	Trade in USD 2015
Denmark	8.313.278.320
Import	4.414.250.424
Export	3.899.027.896
Finland	2.874.673.563
Import	1.730.863.844
Export	1.143.809.719
Sweden	15.185.416.641
Import	8.863.712.690
Export	6.321.703.951

Source: UN Comtrade, 2015

Table E.5.1 Norway Import Data 2015 by HS Category

HS code	HS description	Total value USD
28-38	Chemicals & Allied Industries	2.879.054.102
41-43	Raw Hides, Skins, Leather, & Furs	275.791.578
44-49	Wood & Wood Products	1.413.451.958
50-63	Textiles	2.707.999.190
64-67	Footwear / Headgear	709.933.125
68-71	Metals	558.381.408
84-85	Machinery / Electrical	7.008.866.893
90-97	Miscellaneous	6.611.223.602

Source: UN Comtrade, 2015

Figure E.1 Norway Import Data 2015 by HS Category (value in USD) (table E.5)

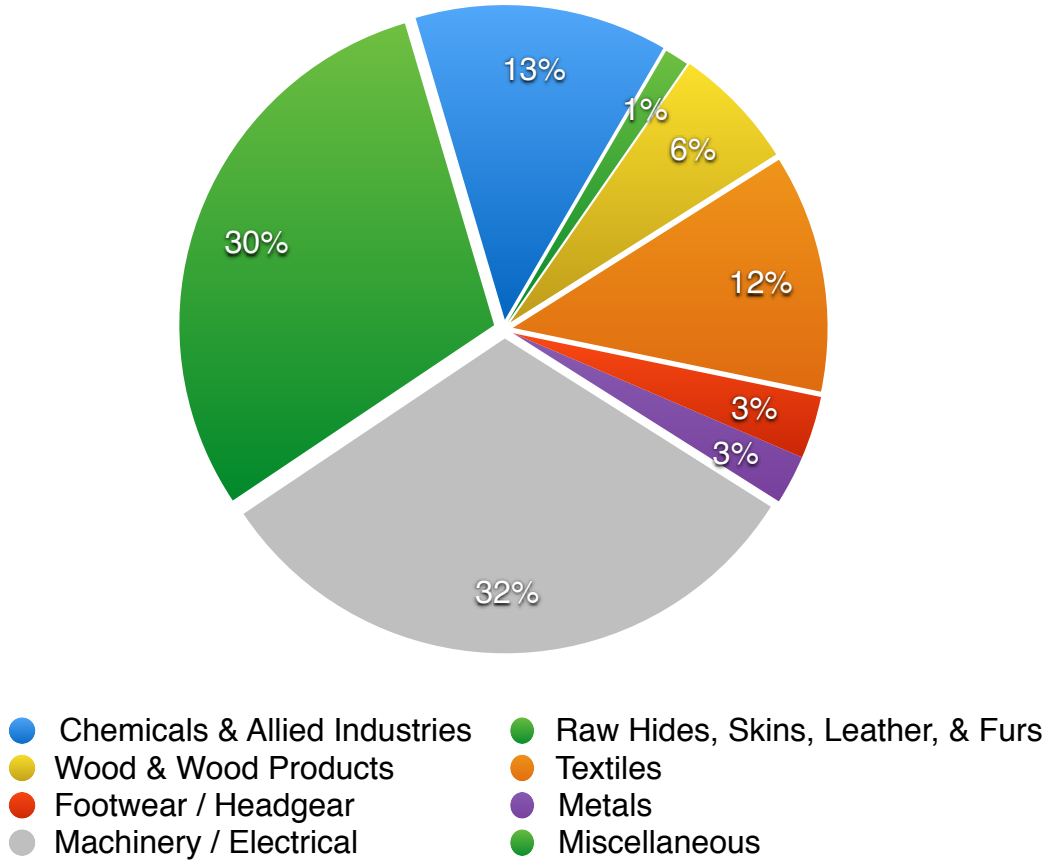

Table E.5.2 Norway Import Data 2015 by HS Category (detail)

HS code	HS description	Trade Value (US$) 2015
30	Pharmaceutical Products	1.824.053.858
33	Oils & Resinoids, Perfumery, Cosmetic Or Toilet Preparations	611.017.071
34	Soaps, Waxes, Scouring Products, Candles, Modeling Pastes, Dental Waxes	412.677.994
37	Photographic Or Cinematographic Goods	31.305.179
42	Articles Of Leather, Saddlery & Harness, Travel Goods, Handbags, Articles Of Gut	275.791.578
48	Paper & Paperboard, Articles Of Paper Pulp	926.186.062
49	Printed Books, Newspapers, Pictures, Manuscripts, Typescripts & Plans	487.265.896
57	Carpets & Other Textile Floor Coverings	92.353.167
60	Knitted Or Crocheted Fabrics	16.757.504
61	Articles Of Apparel & Clothing Accessories-Knitted Or Crocheted	1.074.764.947
62	Articles Of Apparel & Clothing Accessories-Not Knitted Or Crocheted	1.162.695.160
63	Made-Up Textile Articles Nesoi, Needlecraft Sets, Worn Clothing, Rags	361.428.412
64	Footwear, Gaiters, & The Like	632.461.103
65	Headgear & Other Parts	66.917.536
66	Umbrellas, Sun Umbrellas, Walking-Sticks, Whips, Riding-Crops & Parts	10.554.486
69	Ceramic Products	287.942.038
71	Pearls, Stones, Prec. Metals, Imitation Jewelry, Coins	270.439.370
8467	Tools for working in the hand, pneumatic etc, pts	183.857.067
8468	Machines, solder etc, gas surf temper machines, pt	7.482.334
8469	Typewriters & word processing machines	209.881
8470	Calculating & account machines, cash registers etc	19.115.124
85	Electrical Machinery & Equip. & Parts, Telecommunications Equip., Sound Recorders, Television Recorders	6.798.202.487
90	Optical, Photographic, Cinematographic, Measuring, Checking, Precision, Medical Or Surgical Instruments & Accessories	2.723.529.291
91	Clocks & Watches & Parts Thereof	94.742.685
92	Musical Instruments, Parts & Accessories	48.806.291
94	Furniture, Bedding, Cushions, Lamps & Lighting Fittings Nesoi, Illuminated Signs, Nameplates & The Like, Prefabricated Buildings	2.891.703.799
95	Toys, Games & Sports Equip, Parts & Acces.	596.281.966
96	Miscellaneous Manufactured Articles	256.159.570

Source: UN Comtrade, 2015

Table E.6.1 Norway Export Data 2015 by HS Category

Finland Top 10 HS - Export	HS description	Trade Value (US$) 2015
28-38	Chemicals & Allied Industries	834.793.149
41-43	Raw Hides, Skins, Leather, & Furs	13.642.689
44-49	Wood & Wood Products	507.833.302
50-63	Textiles	123.968.088
64-67	Footwear / Headgear	23.160.046
68-71	Metals	501.144.176
84-85	Machinery / Electrical	2.967.785.766
90-97	Miscellaneous	2.721.165.950

Source: UN Comtrade, 2015

Figure E.2 Norway Export Data 2015 by HS category (value in USD) (table E.6.1)

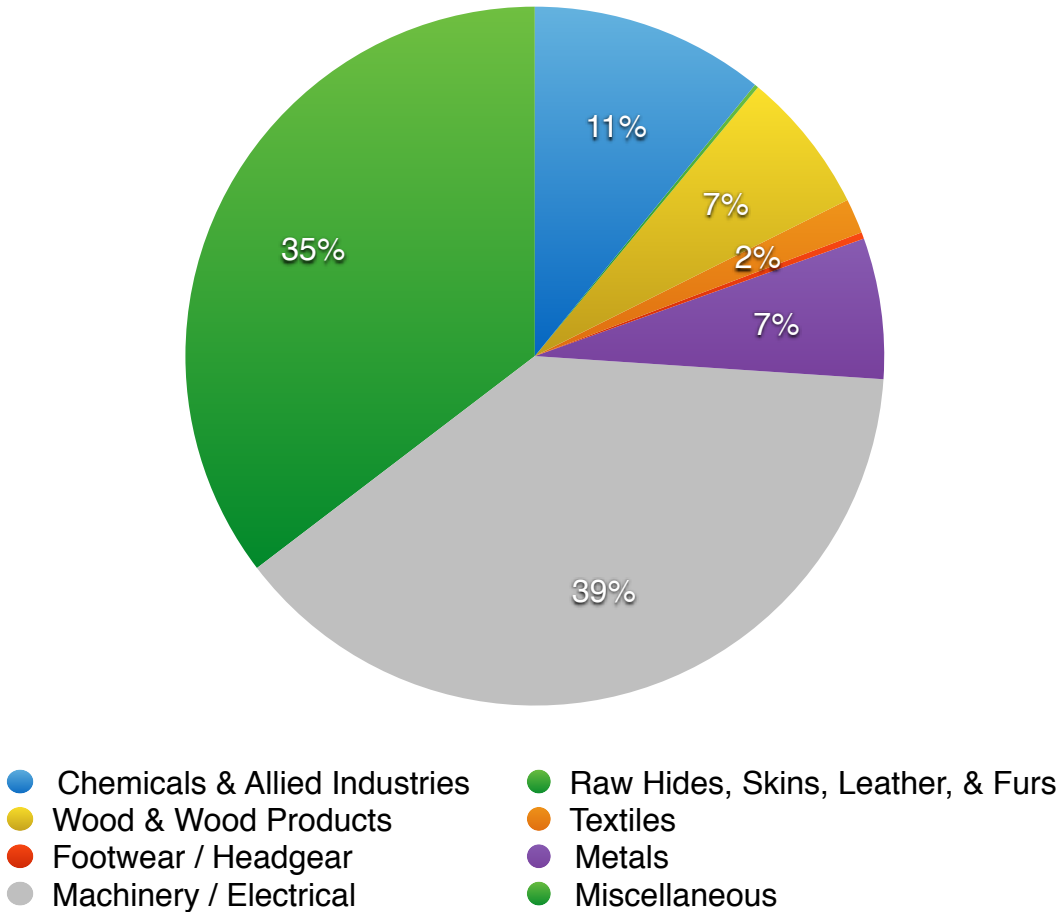

Table E.6.2 Norway Export Data 2015 by HS Category (detail)

HS code	HS description	Trade Value (US$) 2015
30	Pharmaceutical Products	716.142.182
33	Oils & Resinoids, Perfumery, Cosmetic Or Toilet Preparations	42.295.041
34	Soaps, Waxes, Scouring Products, Candles, Modeling Pastes, Dental Waxes	76.054.631
37	Photographic Or Cinematographic Goods	301.295
42	Articles Of Leather, Saddlery & Harness, Travel Goods, Handbags, Articles Of Gut	13.642.689
48	Paper & Paperboard, Articles Of Paper Pulp	427.131.776
49	Printed Books, Newspapers, Pictures, Manuscripts, Typescripts & Plans	67.058.837
57	Carpets & Other Textile Floor Coverings	957.691
60	Knitted Or Crocheted Fabrics	989.953
61	Articles Of Apparel & Clothing Accessories-Knitted Or Crocheted	54.328.755
62	Articles Of Apparel & Clothing Accessories-Not Knitted Or Crocheted	25.610.063
63	Made-Up Textile Articles Nesoi, Needlecraft Sets, Worn Clothing, Rags	42.081.626
64	Footwear, Gaiters, & The Like	17.276.160
65	Headgear & Other Parts	5.327.114
66	Umbrellas, Sun Umbrellas, Walking-Sticks, Whips, Riding-Crops & Parts	556.772
69	Ceramic Products	20.582.571
71	Pearls, Stones, Prec. Metals, Imitation Jewelry, Coins	480.561.605
8467	Tools for working in the hand, pneumatic etc, pts	48.151.005
8468	Machines, solder etc, gas surf temper machines, pt	3.406.896
8469	Typewriters & word processing machines	34.892
8470	Calculating & account machines, cash registers etc	1.329.001
85	Electrical Machinery & Equip. & Parts, Telecommunications Equip., Sound Recorders, Television Recorders	2.914.863.972
90	Optical, Photographic, Cinematographic, Measuring, Checking, Precision, Medical Or Surgical Instruments & Accessories	2.138.049.309
91	Clocks & Watches & Parts Thereof	12.686.663
92	Musical Instruments, Parts & Accessories	2.119.544
94	Furniture, Bedding, Cushions, Lamps & Lighting Fittings Nesoi, Illuminated Signs, Nameplates & The Like, Prefabricated Buildings	509.089.879
95	Toys, Games & Sports Equip, Parts & Acces.	55.628.641
96	Miscellaneous Manufactured Articles	3.591.914

Source: UN Comtrade, 2015

APPENDIX “F” - DETAIL TRADE SWEDEN

Table F.1 Sweden Import/Export 2015

Import (USD)	Export (USD)	Total (USD)
137.986.741.780	140.089.772.744	278.076.514.524

Source: UN Comtrade, 2015

Table F.2 Sweden - Top 5 Import Countries (Value in USD)

Country	Trade in USD 2015
Germany	24.773.079.351
Netherlands	11.421.002.899
Norway	11.323.719.790
Denmark	10.618.591.078
United Kingdom	7.614.114.734

Source: UN Comtrade, 2015

Table F.3 Sweden - Top 5 Export Countries (Value in USD)

Country	Trade in USD 2015
Norway	14.108.114.814
Germany	13.982.231.920
USA	10.160.876.437
United Kingdom	9.818.620.833
Denmark	9.509.120.496

Source: UN Comtrade, 2015

Table F.4 Sweden Import/Export 2015 Neighbours Countries

Country	Trade in USD 2015
Denmark	20.127.711.574
Import	10.618.591.078
Export	9.509.120.496
Norway	25.431.834.604
Import	11.323.719.790
Export	14.108.114.814
Finland	15.629.212.928
Import	6.362.885.839
Export	9.266.327.089

Source: UN Comtrade, 2015

Table F.5.1 Sweden Import Data 2015 by HS Category (value in USD)

HS code	HS description	Total value USD
28-38	Chemicals & Allied Industries	5.345.119.519
41-43	Raw Hides, Skins, Leather, & Furs	480.539.116
44-49	Wood & Wood Products	1.820.695.233
50-63	Textiles	4.612.020.740
64-67	Footwear / Headgear	1.019.245.504
68-71	Metals	609.609.362
84-85	Machinery / Electrical	17.613.259.480
90-97	Miscellaneous	8.054.959.383

Source: UN Comtrade, 2015

Figure F.1 Sweden Import Data 2015 by HS Category (value in USD) (table F.5.1)

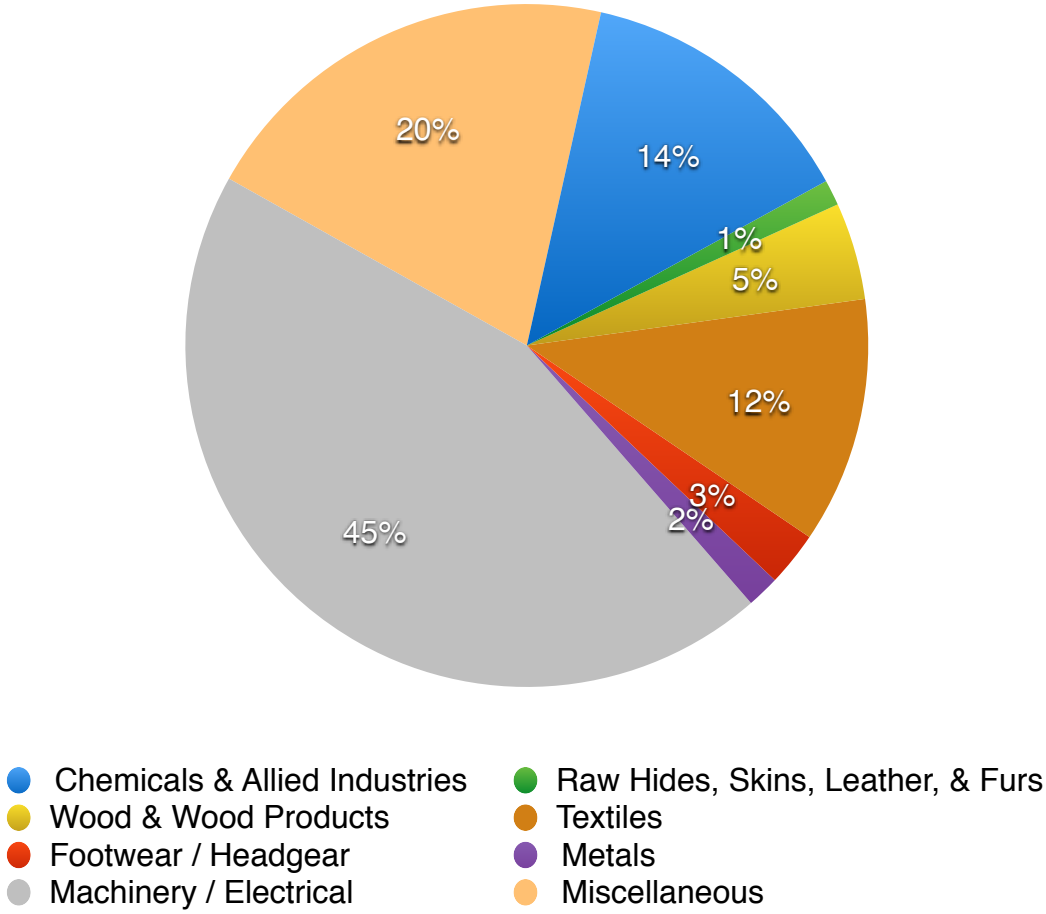

Table F.5.2 Sweden Import Data 2015 by HS category (value in USD) (detail)

HS code	HS description	Trade Value (US $) 2015
30	Pharmaceutical Products	3.843.033.416
33	Oils & Resinoids, Perfumery, Cosmetic Or Toilet Preparations	789.767.066
34	Soaps, Waxes, Scouring Products, Candles, Modeling Pastes, Dental Waxes	660.676.544
37	Photographic Or Cinematographic Goods	51.642.493
42	Articles Of Leather, Saddlery & Harness, Travel Goods, Handbags, Articles Of Gut	480.539.116
48	Paper & Paperboard, Articles Of Paper Pulp	1.443.950.489
49	Printed Books, Newspapers, Pictures, Manuscripts, Typescripts & Plans	376.744.744
57	Carpets & Other Textile Floor Coverings	195.598.980
60	Knitted Or Crocheted Fabrics	26.440.489
61	Articles Of Apparel & Clothing Accessories-Knitted Or Crocheted	1.822.876.958
62	Articles Of Apparel & Clothing Accessories-Not Knitted Or Crocheted	2.022.466.715
63	Made-Up Textile Articles Nesoi, Needlecraft Sets, Worn Clothing, Rags	544.637.598
64	Footwear, Gaiters, & The Like	886.426.130
65	Headgear & Other Parts	113.326.493
66	Umbrellas, Sun Umbrellas, Walking-Sticks, Whips, Riding-Crops & Parts	19.492.881
69	Ceramic Products	360.551.959
71	Pearls, Stones, Prec. Metals, Imitation Jewelry, Coins	249.057.403
8467	Tools for working in the hand, pneumatic etc, pts	350.672.777
8468	Machines, solder etc, gas surf temper machines, pt	6.888.203
8469	Typewriters & word processing machines	2.316.897
8470	Calculating & account machines, cash registers etc	35.708.314
85	Electrical Machinery & Equip. & Parts, Telecommunications Equip., Sound Recorders, Television Recorders	17.217.673.289
90	Optical, Photographic, Cinematographic, Measuring, Checking, Precision, Medical Or Surgical Instruments & Accessories	3.474.826.093
91	Clocks & Watches & Parts Thereof	230.476.815
92	Musical Instruments, Parts & Accessories	49.025.609
94	Furniture, Bedding, Cushions, Lamps & Lighting Fittings Nesoi, Illuminated Signs, Nameplates & The Like, Prefabricated Buildings	2.959.860.783
95	Toys, Games & Sports Equip, Parts & Acces.	936.579.715
96	Miscellaneous Manufactured Articles	404.190.368

Source: UN Comtrade, 2015

Table F.6.1 Sweden Export Data 2015 by HS category (value in USD)

Finland Top 10 HS - Export	HS description	Trade Value (US$) 2015
28-38	Chemicals & Allied Industries	8.443.048.244
41-43	Raw Hides, Skins, Leather, & Furs	211.428.561
44-49	Wood & Wood Products	8.988.436.856
50-63	Textiles	2.066.164.806
64-67	Footwear / Headgear	348.046.409
68-71	Metals	1.225.121.467
84-85	Machinery / Electrical	15.895.580.086
90-97	Miscellaneous	7.742.468.820

Source: UN Comtrade, 2015

Figure F.2 Sweden Export Data 2015 by HS category (value in USD) (table F.6.1)

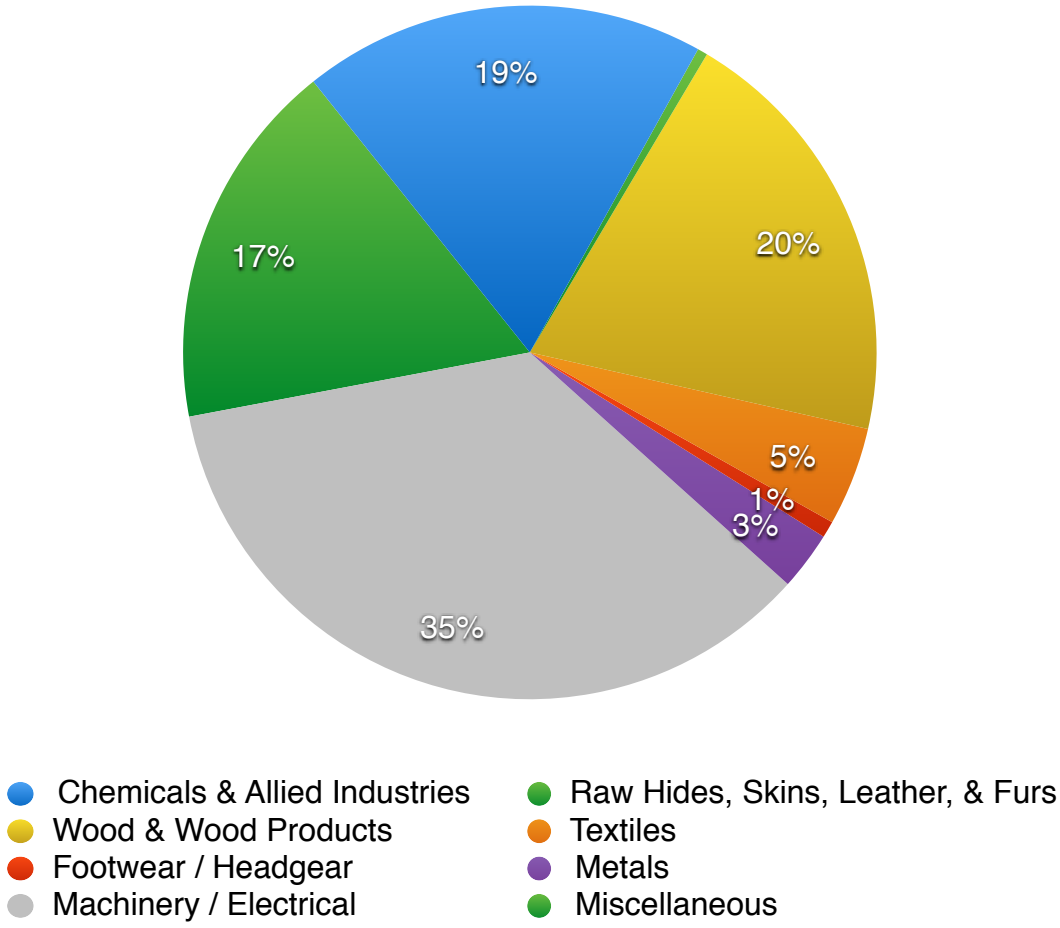

Table F.6.2 Sweden Export Data 2015 by HS category (value in USD) detail

HS code	HS description	Trade Value (US$) 2015
30	Pharmaceutical Products	7.341.552.552
33	Oils & Resinoids, Perfumery, Cosmetic Or Toilet Preparations	521.151.621
34	Soaps, Waxes, Scouring Products, Candles, Modeling Pastes, Dental Waxes	561.617.051
37	Photographic Or Cinematographic Goods	18.727.020
42	Articles Of Leather, Saddlery & Harness, Travel Goods, Handbags, Articles Of Gut	211.428.561
48	Paper & Paperboard, Articles Of Paper Pulp	8.410.748.031
49	Printed Books, Newspapers, Pictures, Manuscripts, Typescripts & Plans	366.260.264
57	Carpets & Other Textile Floor Coverings	96.041.887
60	Knitted Or Crocheted Fabrics	49.880.173
61	Articles Of Apparel & Clothing Accessories-Knitted Or Crocheted	684.559.120
62	Articles Of Apparel & Clothing Accessories-Not Knitted Or Crocheted	980.600.708
63	Made-Up Textile Articles Nesoi, Needlecraft Sets, Worn Clothing, Rags	255.082.918
64	Footwear, Gaiters, & The Like	282.169.414
65	Headgear & Other Parts	60.286.498
66	Umbrellas, Sun Umbrellas, Walking-Sticks, Whips, Riding-Crops & Parts	5.590.497
69	Ceramic Products	146.813.665
71	Pearls, Stones, Prec. Metals, Imitation Jewelry, Coins	1.078.307.802
8467	Tools for working in the hand, pneumatic etc, pts	680.384.540
8468	Machines, solder etc, gas surf temper machines, pt	4.995.619
8469	Typewriters & word processing machines	318.549
8470	Calculating & account machines, cash registers etc	10.921.624
85	Electrical Machinery & Equip. & Parts, Telecommunications Equip., Sound Recorders, Television Recorders	15.198.959.754
90	Optical, Photographic, Cinematographic, Measuring, Checking, Precision, Medical Or Surgical Instruments & Accessories	3.875.930.990
91	Clocks & Watches & Parts Thereof	180.334.587
92	Musical Instruments, Parts & Accessories	51.424.293
94	Furniture, Bedding, Cushions, Lamps & Lighting Fittings Nesoi, Illuminated Signs, Nameplates & The Like, Prefabricated Buildings	2.593.282.517
95	Toys, Games & Sports Equip, Parts & Acces.	429.658.246
96	Miscellaneous Manufactured Articles	611.838.187

Source: UN Comtrade, 2015

APPENDIX “G” - PORTS CHARACTERISTICS

Table G.1 shows the port’s characteristics by categories. The source is the National Geospatial Intelligence Agency. The macro categories are available at the following link (http://msi.nga.mil/NGAPortal/MSI.portal). The table wasn’t used in our analysis because is not descriptive and reliable; exact measures are not provided; in opposite, it provides a general overview about the four ports. Each single port has two column; the first one (with letters) is the macro category (classified by msi.nga.mil) and the second is the relative conversion (e.g. harbour size 7.9-9.1 meters).

Table G.1 Ports’ Characteristics a General Overview

Table G.1	Oslo		Malmo		Copenhagen		Stockholm		Gothenburg	
Harbor Size	L	7.9-9.1 meters	L	7.9-9.1 meters	L	7.9-9.1 meters	L	7.9-9.1 meters	L	7.9-9.1 meters
Harbor Type	CN	Coastal natural	CB	Coastal Breakwa	CB	Coastal Breakwater	CB	Coastal Breakwat	RT	River Tide Gate
Shelter Afforded	G	Good	G	Good	E	Excellent	G	Good	G	Good
Entrance Restriction										
Tide	N		N		N		N		N	
Swell	**N**		N		N		N		N	
Ice	N				Y		Y			
Other	Y		Y		L	7.9-9.1	Y		Y	
Overhead Limits			Y		Y		Y		Y	
Channel Depth	J	11-12.2 m	L	7.9-9.1 meters	L	7.9-9.1 meters	K	9.4-10.7 meters	L	7.9-9.1 meters
Anchorage Depth	E	17.1-18 .2 meters	K	9.4-10.7 meters			F	15.5 - 16.8 meters	A	23.2 - Over (meters)
Cargo Pier Depth	N	4.9 - 6.1 meters	N	4.9 - 6.1 meters	M	6.4 - 7.6 meters	M	6.4 - 7.6 meters	N	4.9 - 6.1 meters
Maximum Vessel Size	L	OVER 500' LENGT	M	UP TO 500' LENGTH	L	OVER 500' LENGTH	M	UP TO 500' LENGTH	L	OVER 500' LENGTH
Good Holding	Y		N		Y				Y	
Turning	Y				Y		Y			
First Port of Entry	Y		Y		Y		Y		Y	
Pilotage										
Compulsory	Y				Y		Y		Y	

Table G.1	Oslo		Malmo		Copenhagen		Stockholm		Gothenburg	
Available	Y		Y		Y		Y		Y	
Tugs			Y				Y			
Tugs Assist	Y		Y		Y		Y		Y	
Air	Y		Y		Y		Y		Y	
Rail	Y		Y		Y		Y		Y	
Load/										
Wharves	Y		Y		Y		Y		Y	
Anchor	Y		Y				Y		Y	
Ice Moor										
Garbage	Y		Y		Y		Y		Y	
Dirty Ballast	Y		Y		Y		Y		Y	
Cranes										
Fixed	Y		Y		Y		Y		Y	
Mobile	Y		Y		Y		Y		Y	
Floating	Y						Y		Y	
Lifts										
200 Tons +	Y				Y		Y		Y	
50-200 Tons	Y		Y		Y		Y		Y	
25-49 Tons	Y		Y				Y		Y	
0-24 Tons	Y						Y		Y	
Services										
Longshore	Y				Y		Y		Y	
Steam	Y		Y							
Repair	A	Major	A	Major			A	Major	A	Major
Dry dock			S	Small			L	Large	M	Medium
Railway	L	Large	L	Large	L	Large	M	Medium	L	Large

Table G.2 Ports' Characteristics Details

Table G.2	Malmo	Copenhagen	Oslo	Stockholm	Gothenburg
	Port details				
Port Number (1)	PO3225	PO1422	PO2303	PO2626	P2582
UNLOCODE	SEMMA	DKCPH	NOOSL	SESTO	SEGOT
Latitude	55° 37' N	55° 42' N	59° 54' N	59° 20' N	57° 41' N
Latitude decimals	55.616667	55.700000	59.900000	59.333333	57.683333
Longitude	12° 59' E	12° 38' E	10° 44' E	18° 3' E	11° 51' E
Longitude decimals	12.983333	12.633333	10.733333	18.050000	11.850000
Max Draught	12.5	11.5	11	11	19.05
Max LOA	260	NA	NA	295	350
Max Offshore BCM	NA	NA	NA	NA	NA
Max Beam	45	NA	NA	32.3	NA
MAX DWT	NA	NA	NA	NA	225.000
	Port Facilities				
Container Facilities	Y	Y	Y	Y	Y
RoRo Facilities	Y	Y	Y	Y	Y
	Port Description				
Location	**Malmo** is located on the southern tip of Sweden at the entrance to the Baltic Sea, approx 14nm ESE of Copenhagen. **Copenhagen** is located on the E coast of Sjaelland and the harbour is formed by a branch of the Sound that runs between the islands of Amager and Sjaelland.		Oslo is situated in the heart of S Norway and forms a natural junction for sea and land transport.	Stockholm is situated on the E coast of Sweden.	Gothenburg is situated on the W coast of Sweden
Load line zone	Summer Zone for ships over 100m in length and Winter Zone for ships of 100m or less in length. Winter Nov 1 to Mar 31, Summer Apr 1 to Oct 31.	Summer Zone for ships over 100m in length and Winter Zone for ships of 100m or less in length. Winter Nov 1 to Mar 31, Summer Apr 1 to Oct 30.	North Atlantic Winter Seasonal Zone II, Winter Nov 1 to Mar 31, Summer Apr 1 to Oct 31.	Summer Zone for ships over 100m in length and Winter Zone for ships of 100m or less. Winter Nov 1 to Mar 31, Summer Apr 1 to Oct 31.	North Atlantic Winter Seasonal Zone II, Winter Nov 1 to Mar 31, Summer Apr 1 to Oct 31.
Number of vessels	8000		Approx 9,020	-	-

Table G.2	Malmo	Copenhagen	Oslo	Stockholm	Gothenburg
Tons of cargo	14,400,000t cargo		5,820,000t of cargo	Approx 8,500,000 of cargo,	38,200,000t of cargo
TEUs	141,000TEU		202,500TEU	27,840TEU	820,000TEU
MAX size	LOA 260m, beam 45m, draught 12.5m	Provestenen Harbour: Draught 11.5m.	Max draught in Drobak Passage is 12.0m, alongside 11.0m.	Largest vessels handled: Passenger and dry cargo vessels: LOA 295m, beam 32.3m, draught 11.0m. Hammerby Lock: Length 115m, width 17.4m, depth 6.5m. Vessels transiting Lake Maleran max airdraught 25.2m.	LOA 350m, tanker draught 19.05m (18.6m if water level low), container draught 11.5m, 225,000DWT. Max airdraught in Inner harbour 45m. Gota River: LOA 89m, beam 13.4m, draught 4.7m, with special permission up to 5.4m. Airdraught 27.0m. Bohus: LOA 135m, beam 16.5m. Trollhattan Kanal: LOA 125m and beam 16.5m.
	Navigation				
Charts	BA 3194. Admiralty Pilot NP18, NP286(2).	BA 902, 903, 3194, 790, 2595. Danish 133 and 134. Admiralty Pilot NP18, NP286(2).	BA 3154, 3159, 3712. Admiralty Pilot NP56, NP286(2).	BA 3114. Admiralty Pilot NP19, NP286(2).	BA 858, 857. Admiralty Pilot NP18, NP286(2).
Dock density	1010	1005	1025.	1005.	Average 1013.
Weather	Prevailing winds: Malmo: NW'ly-SE'ly. Although the harbour is practically never closed by ice, drift ice can be encountered in the outer part of the dredged channels even during normal winters.	Prevailing winds: W'ly.	Prevailing winds: N'ly winter; S'ly summer.	Prevailing winds: W-SW'ly. Ice: Navigation is maintained throughout the year with the assistance of icebreakers. However, branch passages are often closed during severe periods of icing.	Prevailing winds: SW to NW'ly. Ice: The harbour is generally ice free, although it may have ice in the period January to March in hard winters.

Table G.2	Malmo	Copenhagen	Oslo	Stockholm	Gothenburg
Tugs	3	Compulsory for vessels over 100m in length, passing through bridges.	Tugs are available by arrangement with vessel's agent prior to arrival/departure. The largest tugs are equipped for fire fighting	2 ("Tug" 2,400hp, 30 board pull; "Ted" 1,400hp, 15 bollard pull)	Tankers of 30,000DWT or more are required to use at least 2 tugs when berthing or leaving Torshamnen crude oil jetty and 1 tug on arrival if over 5,000DWT (Berth Nos 800 and 801). This rule applies to both laden and empty vessels.

Note 1) Source: Sea-web 2016

G.1 Port description

G.1.1 General Overview

Port of Malmo : Malmo's new Northern Harbour opened in 2011. Three new terminals were opened increasing freight capacity by five times. (Sea-web, 2016)

Port of Copenhagen: The port extends to 1,108ha with a land area of 413ha and a total quayage length of 39,651m. 3 sections: The North Harbour, The Inner Harbour and The Provestenen Harbour; Free Port is located in the North Harbour. (Sea-web, 2016)

Port of Oslo: The port is a well sheltered major harbour built around the mainland coast of the bay in the NE corner of Oslofjorden. The harbour is divided into Eastern and Western harbours by a group of islands lying in the entrance to the bay and joined by channels.
The port serves a considerable industrial and commercial centre, handling a large part of the country's foreign trade, both imports and exports. There are extensive Ro-Ro, ferry and cruise facilities including two floating Ro-Ro ramps with three daily ferry arrivals from Denmark and Germany. It has excellent road and rail connections with the rest of Norway and is equipped to handle most types of cargoes including oil, salt, cement, stone, timber, newsprint, vehicles, grain and animal feeds. (Sea-web, 2016)

Port of Stockholm: The quays, which includes 10 cruise berths, have a total length of 16km extending approx 10km from W to E. The area of the harbour is approx 1,750ha.
The waterway Hammarbyleden, connecting Lake Malaren with the sea, has a length of 6,550m from Danviksbron to Reimersholme with a depth of 6.1m. There is a lock connection, Hammarby Lock, max vessel dimensions LOA 110m, beam 15m and draught 5.6m at MW. (Sea-web, 2016)

Port of Gothenburg: The port is the largest port in the Nordic countries

The port is also the central Nordic port for liner shipping with about 30% of its general cargo imports and exports being transit cargo to or from other Nordic countries.

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Direct calling deep sea container or Ro-Ro liners connect Gothenburg to all continents with their base at the Scandia Terminal. Ro-Ro ferry liner operations to Continental Europe and UK calls at the Alvsborg Terminal. The total complex of a unit load centre of 2,000,000m2 with 2,500m of quay length and 11 container cranes including 2 post Panamax and 3 super post Panamax with a lifting capacity of 103t each. In addition, the port also has cruise liner facilities with berths dedicated to cruise vessels.

Traffic can also navigate the Gota River and via locks to Lake Vanern where channel depth is 6.1m. (Sea-web, 2016)

Table G.3 Berth Length - Depth Analysis

	Malmo		Copenhagen		Oslo		Stockholm		Gothenburg	
	Berth length	Depth (m)	Berth length	Depth (m)	Berth length	Depth (m)	Berth length	Depth (m)	Berth length	Depth (m)
	175	7,2	27	9	463	8,9	200	7,5	203	9,8
	180	7,2	173	9	165	7,2	200	7,5	47	9,8
	120	9,1	200	9	304	12	180	8,5	225	9,8
	185	8,1	210	7	287	9,45	298	8,25	200	11,0
	500	9,2	72	9,5			367	8	149	11,0
	325	10,0	72	6			110	7,5	232	11,0
	190	9,0	98	6			222	8	265	11,0
	245	8,5	130	9,5			240	8,75	210	11,0
	245	8,5	33	9,5					190	9,5
	245	8,5	105	9,5					135	14,2
	150	9,2	100	9,5					95	14,2
	150	9,2	100	9,5					190	14,2
			112	9,5					190	14,2
			100	9,5					190	14,2
			100	9,5					190	14,2
			98	9,5					190	14,2
			100	6					570	14,2
			150	6					135	14,2
			100	6					170	14,2
			100	6					60	9
			115	6,7					138	9
			100	6,3					137	9
			147	6					140	9
Total length	**2710**		**2542**		**1219**		**1817**		**4251**	
Weighted Mean	**8,75**		**7,91**		**9,57**		**8,05**		**12,12**	
	Port of Copenhange-Malmo Weighted average		**8,34**							

The total weighted mean identified, taking into consideration all berth length and depth is **65,90.**

APPENDIX “H” - CONTAINERSHIPS BY PORT

Table H.0 Gross Tonnage by Country and by Port

	2014	% by country
Denmark	23.595	-
Københavns Havn	3.432	14,55
Norway	21.933	-
Oslo	3.283	14,97
Sweden	37.776	-
Malmö	488	1,29
Stockholm	1.725	4,57
Göteborg	21.373	56,58

Note: 1) Eurostat
The “dot” :.” is used for thousand and the “comma” “,” for decimals.

Table H.1 Number of Containerships in Specified Ports (inwards) (2014)

Flow 2014 / Vessel Type (GT) (1)	Port of Oslo	Port of Copenhagen-Malmo	Port of Stockholm	Port of Gothenburg
From 2 000 to 2 999 gross tonnage	**25**	5	0	0
From 3 000 to 3 999 gross tonnage	0	3	1	**12**
From 5 000 to 5 999 gross tonnage	1	2	24	**42**
From 6 000 to 6 999 gross tonnage	1	**63**	16	47
From 7 000 to 7 999 gross tonnage	111	40	21	**245**
From 8 000 to 8 999 gross tonnage	**101**	50	5	32
From 9 000 to 9 999 gross tonnage	81	146	7	**162**
From 10 000 to 19 999 gross tonnage	65	46	91	**119**
From 20 000 to 29 999 gross tonnage	1	**34**	0	20
From 40 000 to 49 999 gross tonnage	0	0	0	4
From 50 000 to 79 999 gross tonnage	0	0	0	4
From 80 000 to 99 999 gross tonnage	0	0	0	**41**
From 100 000 to 149 999 gross tonnage	0	0	0	6
From 150 000 to 199 999 gross tonnage	0	0	0	**53**
Total	386	389	165	787

Note: (1) Eurostat 2014

Table H.2 Containerships by GT Calculus

Total number of containerships calls	**1727**		**Percentge of containerships by port (on total no.) (column A)**
Average no. containerships	30,84	**Port of Oslo**	22,35%
		Port of Copenhagen-Malmo	22,52%
		Port of Stockholm	9,55%
		Port of Gothenburg	45,57%

The total number of containerships is 1.727 (in 2014) for the selected ports. The port of Oslo received 386 calls (equal 22,35 per cent of total), the Port of Copenhagen-Malmo received 389 calls (equal to 22,52 per cent of total), the Port of Stockholm received 165 calls (equal to 9,55 per cent), and finally the PoG received 787 calls (equal 45,57 per cent). The recent data (2016) show a an increase number of calls for the segment 100.000 to 199.999 GT (PoG source).
In the column “A” - the table H.2 - are reported the total percentages, but in the table H.5 are reported the specific data by port and category.

Table H.3, shows the different performance by port and by category. The percentage was calculated by the single category in the table H.1 (by port) divided by the total calls by port. For example the value for Oslo was calculated by (category 2.000 - 2.9999):
[(25)/(386)*100] = 6,48 % (result in table H.3.)

The data are highlight the ships calls main segment by GT.

Table H.3 Port's Calls Performance

Performance port by containership/ by total port	Port of Oslo	Port of Copenhagen-Malmo	Port of Stockholm	Port of Gothenburg
From 2 000 to 2 999 gross tonnage	6,48%	1,29%	0,0%	0,0%
From 3 000 to 3 999 gross tonnage	0,00%	0,77%	0,6%	1,5%
From 5 000 to 5 999 gross tonnage	0,26%	0,51%	14,5%	5,3%
From 6 000 to 6 999 gross tonnage	0,26%	16,20%	9,7%	6,0%
From 7 000 to 7 999 gross tonnage	28,76%	10,28%	12,7%	31,1%
From 8 000 to 8 999 gross tonnage	26,17%	12,85%	3,0%	4,1%
From 9 000 to 9 999 gross tonnage	20,98%	37,53%	4,2%	20,6%
From 10 000 to 19 999 gross tonnage	16,84%	11,83%	55,2%	15,1%
From 20 000 to 29 999 gross tonnage	0,26%	8,74%	0,0%	2,5%
From 40 000 to 49 999 gross tonnage	0,00%	0,00%	0,0%	0,5%
From 50 000 to 79 999 gross tonnage	0,00%	0,00%	0,0%	0,5%
From 80 000 to 99 999 gross tonnage	0,00%	0,00%	0,0%	5,2%
From 100 000 to 149 999 gross tonnage	0,00%	0,00%	0,0%	0,8%
From 150 000 to 199 999 gross tonnage	0,00%	0,00%	0,0%	6,7%
Total	**100,00%**	**100,00%**	**100,0%**	**100,0%**

Note: (1) Eurostat 2014

Table H.4, shows the different performance by port and by (single) category.

The percentage, by category and by port was calculated taking into consideration the the single value (e.g. 25, Port of Oslo, category 2000-2999) and divided by the total number of calls for the specified category.
For example the value of 83,33 per cent (Port of Oslo) was calculated as below:
= [(25/30 total by category)*100]

The PoG receive a larger number of calls in different categories (total 10 out of 14). Instead the Port of Oslo receive calls (25) for the segment 2.000-2.999 (83,33 per cent), and 101 (segment 8.000-8.999) equal to 53,72 per cent. In the other side the Port of Copenhagen-Malmo (CMP) receive 63 calls for the segment 6.000-6.999, equal to 49,61 per cent of the total segment; CMP perform better in the segment 20.000-29.999 with 34 calls, equal to 61,82 per cent of the total segment.

Table H.4 Port's performance by GT category

Flow 2014 / Vessel Type (GT) (1) by category	Port of Oslo		Port of Copenhagen-Malmo		Port of Stockholm		Port of Gothenburg		Total by category
From 2 000 to 2 999 gross tonnage	**25**	83,33%	5	16,67%	0	0,00%	0	0,00%	30
From 3 000 to 3 999 gross tonnage	0	0,00%	3	18,75%	1	6,25%	**12**	75,00%	16
From 5 000 to 5 999 gross tonnage	1	1,45%	2	2,90%	24	34,78%	**42**	60,87%	69
From 6 000 to 6 999 gross tonnage	1	0,79%	**63**	49,61%	16	12,60%	47	37,01%	127
From 7 000 to 7 999 gross tonnage	111	26,62%	40	9,59%	21	5,04%	**245**	58,75%	417
From 8 000 to 8 999 gross tonnage	**101**	53,72%	50	26,60%	5	2,66%	32	17,02%	188
From 9 000 to 9 999 gross tonnage	81	20,45%	146	36,87%	7	1,77%	**162**	40,91%	396
From 10 000 to 19 999 gross tonnage	65	20,25%	46	14,33%	91	28,35%	**119**	37,07%	321
From 20 000 to 29 999 gross tonnage	1	1,82%	**34**	61,82%	0	0,00%	20	36,36%	55
From 40 000 to 49 999 gross tonnage	0	0,00%	0	0,00%	0	0,00%	4	100,00%	4
From 50 000 to 79 999 gross tonnage	0	0,00%	0	0,00%	0	0,00%	4	100,00%	4
From 80 000 to 99 999 gross tonnage	0	0,00%	0	0,00%	0	0,00%	**41**	100,00%	41
From 100 000 to 149 999 gross tonnage	0	0,00%	0	0,00%	0	0,00%	6	100,00%	6
From 150 000 to 199 999 gross tonnage	0	0,00%	0	0,00%	0	0,00%	**53**	100,00%	53
Total	**386**		**389**		**165**		**787**	863,00%	**1727**

Note: (1) Eurostat 2014

Table H.5, shows the different performance by port and by category. The percentage was calculated by the single category in the table H.5 (by port) divided by the total calls in table H.2. For example the value for Oslo was calculated for the category 2.000 - 2.9999:
[(25 calls) / (1727 total calls)*100] = 1,45 % (results in table H.5).

Table H.5 Total port performance - calls by GT category

Flow 2014 / Vessel Type (GT) (1)	Port of Oslo		Port of Copenhagen-Malmo		Port of Stockholm		Port of Gothenburg	
From 2 000 to 2 999 gross tonnage	**25**	**1,45%**	5	0,29%	0	0,00%	0	0,00%
From 3 000 to 3 999 gross tonnage	0	0,00%	3	0,17%	1	0,06%	**12**	**0,69%**
From 5 000 to 5 999 gross tonnage	1	0,06%	2	0,12%	24	1,39%	**42**	**2,43%**
From 6 000 to 6 999 gross tonnage	1	0,06%	**63**	**3,65%**	16	0,93%	47	2,72%
From 7 000 to 7 999 gross tonnage	111	6,43%	40	2,32%	21	1,22%	**245**	**14,19%**
From 8 000 to 8 999 gross tonnage	**101**	**5,85%**	50	2,90%	5	0,29%	32	1,85%
From 9 000 to 9 999 gross tonnage	81	4,69%	146	8,45%	7	0,41%	**162**	**9,38%**
From 10 000 to 19 999 gross tonnage	65	3,76%	46	2,66%	91	5,27%	**119**	**6,89%**
From 20 000 to 29 999 gross tonnage	1	0,06%	**34**	**1,97%**	0	0,00%	20	1,16%
From 40 000 to 49 999 gross tonnage	0	0,00%	0	0,00%	0	0,00%	4	**0,23%**
From 50 000 to 79 999 gross tonnage	0	0,00%	0	0,00%	0	0,00%	4	**0,23%**
From 80 000 to 99 999 gross tonnage	0	0,00%	0	0,00%	0	0,00%	**41**	**2,37%**
From 100 000 to 149 999 gross tonnage	0	0,00%	0	0,00%	0	0,00%	6	**0,35%**
From 150 000 to 199 999 gross tonnage	0	0,00%	0	0,00%	0	0,00%	**53**	**3,07%**
Total	386	**22,35%**	389	**22,52%**	165	**9,55%**	787	**45,57%**

Note: (1) Eurostat 2014

Table H.6, data 2015, shows the performances by port with the total TEUs flow (1.245.210). The PoG

Table H.6: Port TEUs flows and performance on total

	Port of Copenhagen-Malmo(2-3)	Port of Stockholm (1)	Port of Oslo (1)	Gothenburg (1)	Total (3)
TEUs Flow	145.000	51.000	212.579	836.631	1.245.210
Percentage (4)	11,64%	4,10%	17,07%	67,19%	100%
	Source: 1) Maritime Insight 2015 2) Eurostat 2015 3) Author elaboration 4) Author elaboration				

The **Liner Shipping Connectivity** Index captures how well countries are connected to global shipping networks. It is computed by the United Nations Conference on Trade and Development (UNCTAD) based on five components of the maritime transport sector: number of ships, their container-carrying capacity, maximum vessel size, number of services, and number of companies that deploy container ships in a country's ports. For each component a country's value is divided by the maximum value of each component in 2004, the five components are averaged for each country, and the average is divided by the maximum average for 2004 and multiplied by 100. The index generates a value of 100 for the country with the highest average index in 2004. The underlying data come from Containerisation International Online.

Liner shipping bilateral connectivity index

The table presents the liner shipping bilateral connectivity index (LSBCI), which indicates a country pair's integration level into global liner shipping networks. The LSBCI is an extension of UNCTAD's country-level Liner Shipping Connectivity Index (LSCI) and based on a proper bilateralization transformation.

Transport connectivity is a crucial determinant of bilateral exports. UNCTAD's Liner Shipping Bilateral Connectivity Index is meant to reflect specifically the liner shipping connectivity between pairs of countries.

The current version of the LSBCI includes 5 components. For any pair of countries A and B represented in our sample, the LSBCI is based on:

1) the number of transshipments required to get from country A to country B;
2) the number of direct connections common to both country A and B;
3) the geometric mean of the number of direct connections of country A and of country B;
4) the level of competition on services that connect country A to country B;
5) the size of the largest ships on the weakest route connecting country A to country B.

The data are derived from Containerisation International Online and Lloyd's List Intelligence.

In order to establish a unit free index, all components are normalized using the standard formula:

Normalized_Value = (Raw - Min(Raw)) / (Max(Raw) - Min(Raw)).

This formula rather than the Raw/Max(Raw) formula has been chosen essentially because of the existence of minimum values which differ from zero. If all minimum values for all components were zero both formulas would be equivalent and would generate identical normalized values.

The LSBCI is computed by taking the simple average of the five normalized components. As a consequence, the LSBCI can only take values between 0 (minimum) and 1 (maximum). As to the first component, we simply take its complement to unity that is 1-Normalized_Value to respect the correspondence between higher values and stronger connectivity.

APPENDIX “I” - VOYAGE COSTS

Table I.1 Voyage Costs Shanghai - Copenhagen

	Shanghai to Copenhagen	via Suez-Gibraltar	via Cape of Good hope	via Cape Horn	Northern Sea Route (passing by: 70° 26' 47"N 171° 39' 57"W
	Costs				
1	Fixed costs (Time Chartered) (USD)	$60.000	$60.000	$60.000	$60.000
2	Average Fuel consumption per day (mt) at 20 knots	190	190	190	190
3	**IFO 0380 price USD/mt**	$233,00	$233,00	$233,00	$233,00
4	**MGO price USD/mt**	$465,00	$465,00	$465,00	$465,00
	Navigation data				
5	(1) Distance (nm)	11.371	14.761,00	18.051,00	7.705,00
6	(2) SECA (nm)	1.177	1.177	1.177	760,00
7	(3) Distance in open sea	10.194	13.584	16.874	6.945
8	(4) Days	23,7	30,80	37,61	16,10
	Assumptions				
9	**total consumption (2*8)**	4.503	5.852	7.146	3.059
10	**Average nautical (5/8)**	480	479	480	479
11	**cost per day IFO0380 (2*3)**	$44.270,00	$44.270,00	$44.270,00	$44.270,00
12	**Price per nautical mile IFO0380 (11/10)**	$92,27	$92,37	$92,24	$92,50
13	**Cost per day MGO (2*4)**	$88.350,00	$88.350,00	$88.350,00	$88.350,00
14	**Price per nautical mile MGO (**	$184,14	$184,35	$184,08	$184,61
15	**Total Fuel price IFO0380 (12*7)**	$940.597,54	$1.254.793,13	$1.556.430,15	$642.443,60
16	**Total Fuel Price MGO (14*6)**	$216.736,82	$216.979,12	$216.663,17	$140.305,07
17	**Total Fuel price route (15+16)**	$1.157.334,36	$1.471.772,25	$1.773.093,31	$782.748,67
18	**Total voyage cost (1*8)**	$1.422.000,00	$1.848.000,00	$2.256.600,00	$966.000,00
19	**Chartered voyage cost**	**$2.579.334,36**	**$3.319.772,25**	**$4.029.693,31**	**$1.748.748,67**
	Charges				
20	**Port Charges (9,000 containers, 2tonnes/each), price in DKK, VAT excluded**	DKK3.780.000,00	DKK3.780.000,00	DKK3.780.000,00	DKK3.780.000,00
21	**20 converted in USD (1 DKK = 0.150015 USD); source: xe.com (10 May 2016)**	$567.057,07	$567.057,07	$567.057,07	$567.057,07
	Total Cost	**$3.146.391,43**	**$3.886.829,32**	**$4.596.750,38**	**$2.315.805,74**

Table I.2 Voyage Costs Shanghai - Oslo

	Shanghai to Oslo	via Suez-Gibraltar	via Cape of Good hope	via Cape Horn	Northern Sea Route (passing by: 70° 26' 47"N 171° 39' 57"W
	Costs				
1	Fixed costs (Time Chartered) (USD)	$60.000	$60.000	$60.000	$60.000
2	Average Fuel consumption per day (mt) at 20 knots	190	190	190	190
3	**IFO 0380 price USD/mt**	$233,00	$233,00	$233,00	$233,00
4	**MGO price USD/mt**	$465,00	$465,00	$465,00	$465,00
	Navigation data				
5	(1) Distance (nm)	11.177	14.508,00	17.798,00	7.420,00
6	(2) SECA (nm)	923	924	924	475,00
7	(3) Distance in open sea	10.254	13.584	16.874	6.945
8	(4) Days	23,16	30,23	37,08	15,50
	Assumptions				
9	**total consumption (2*8)**	4.400	5.744	7.045	2.945
10	**Average nautical (5/8)**	483	480	480	479
11	**cost per day IFO0380 (2*3)**	$44.270,00	$44.270,00	$44.270,00	$44.270,00
12	**Price per nautical mile IFO0380 (11/10)**	$91,73	$92,24	$92,23	$92,48
13	**Cost per day MGO (2*4)**	$88.350,00	$88.350,00	$88.350,00	$88.350,00
14	**Price per nautical mile MGO (**	$183,07	$184,09	$184,07	$184,56
15	**Total Fuel price IFO0380 (12*7)**	$940.624,18	$1.253.048,25	$1.556.309,93	$642.258,06
16	**Total Fuel Price MGO (14*6)**	$168.974,65	$170.101,88	$170.077,57	$87.665,35
17	**Total Fuel price route (15+16)**	$1.109.598,83	$1.423.150,14	$1.726.387,51	$729.923,41
18	**Total voyage cost (1*8)**	$1.389.600,00	$1.813.800,00	$2.224.800,00	$930.000,00
19	**Chartered voyage cost**	**$2.499.198,83**	**$3.236.950,14**	**$3.951.187,51**	**$1.659.923,41**
	Charges				
20	**Port Charges (18,000 TEUs, NOK 124/TEU)**	NOK2.232.000	NOK2.232.000	NOK2.232.000	NOK2.232.000
21	**20 converted in USD (1 NOK = 0.119762 USD); source: xe.com (10 May 2016)**	$267.309,00	$267.309,00	$267.309,00	$267.309,00
	Total Cost	**$2.766.507,83**	**$3.504.259,14**	**$4.218.496,51**	**$1.927.232,41**

Table I.3 Voyage Costs Shanghai - Stockholm

	Shanghai to Stockholm	via Suez-Gibraltar	via Cape of Good hope	via Cape Horn	Northern Sea Route (passing by: 70° 26' 47"N 171° 39' 57"W
	Costs				
1	Fixed costs (Time Chartered) (USD)	$60.000	$60.000	$60.000	$60.000
2	Average Fuel consumption per day (mt) at 20 knots	190	190	190	190
3	**IFO 0380 price USD/mt**	$233,00	$233,00	$233,00	$233,00
4	**MGO price USD/mt**	$465,00	$465,00	$465,00	$465,00
	Navigation data				
5	(1) Distance (nm)	11.725	15.115,00	18.405,00	8.059,00
6	(2) SECA (nm)	1.531	1.531	1.531	1.114,00
7	(3) Distance in open sea	10.194	13.584	16.874	6.945
8	(4) Days	24,43	31,49	38,34	16,80
	Assumptions				
9	**total consumption (2*8)**	4.642	5.983	7.285	3.192
10	**Average nautical (5/8)**	480	480	480	480
11	**cost per day IFO0380 (2*3)**	$44.270,00	$44.270,00	$44.270,00	$44.270,00
12	**Price per nautical mile IFO0380 (11/10)**	$92,24	$92,23	$92,22	$92,29
13	**Cost per day MGO (2*4)**	$88.350,00	$88.350,00	$88.350,00	$88.350,00
14	**Price per nautical mile MGO (**	$184,08	$184,06	$184,04	$184,18
15	**Total Fuel price IFO0380 (12*7)**	$940.296,39	$1.252.857,58	$1.556.122,76	$640.928,96
16	**Total Fuel Price MGO (14*6)**	$281.833,34	$281.803,42	$281.772,13	$205.172,84
17	**Total Fuel price route (15+16)**	$1.222.129,72	$1.534.660,99	$1.837.894,88	$846.101,80
18	**Total voyage cost (1*8)**	$1.465.800,00	$1.889.400,00	$2.300.400,00	$1.008.000,00
19	**Chartered voyage cost**	**$2.687.929,72**	**$3.424.060,99**	**$4.138.294,88**	**$1.854.101,80**
	Charges				
20	**Port Charges (9,000 containers, SEK 425/unit) (VAT excluded)**	SEK3.825.000	SEK3.825.000	SEK3.825.000	SEK3.825.000
21	**20 converted in USD (1 SEK = 0.120195 USD); source: xe.com (10 May 2016)**	$459.744,60	$459.744,60	$459.744,60	$459.744,60
	Total Cost	**$3.147.674,32**	**$3.883.805,59**	**$4.598.039,48**	**$2.313.846,40**

Table I.4 Voyage Costs Shanghai - Gothenburg

	Shanghai to Gothenburg	via Suez-Gibraltar	via Cape of Good hope	via Cape Horn	Northern Sea Route (passing by: 70° 26' 47"N 171° 39' 57"W
	Costs				
1	Fixed costs (Time Chartered) (USD)	$60.000	$60.000	$60.000	$60.000
2	Average Fuel consumption per day (mt) at 20 knots	190	190	190	190
3	**IFO 0380 price USD/mt**	$233,00	$233,00	$233,00	$233,00
4	**MGO price USD/mt**	$465,00	$465,00	$465,00	$465,00
	Navigation data				
5	Distance (nm)	11.054	14.445,00	17.734,00	7.388,00
6	SECA (nm)	860	860	860	443,00
7	Distance in open sea	10.194	13.585	16.874	6.945
8	Days	23,03	30,09	36,95	15,40
	Assumptions				
9	total consumption (2*8)	4.376	5.717	7.021	2.926
10	Average nautical (5/8)	480	480	480	480
11	cost per day IFO0380 (2*3)	$44.270,00	$44.270,00	$44.270,00	$44.270,00
12	Price per nautical mile IFO0380 (11/10)	$92,23	$92,22	$92,24	$92,28
13	Cost per day MGO (2*4)	$88.350,00	$88.350,00	$88.350,00	$88.350,00
14	Price per nautical mile MGO (	$184,07	$184,04	$184,08	$184,16
15	Total Fuel price IFO0380 (12*7)	$940.218,15	$1.252.777,10	$1.556.450,47	$640.878,36
16	Total Fuel Price MGO (14*6)	$158.299,48	$158.274,02	$158.311,60	$81.583,83
17	Total Fuel price route (15+16)	$1.098.517,62	$1.411.051,13	$1.714.762,07	$722.462,19
18	Total voyage cost (1*8)	$1.381.800,00	$1.805.400,00	$2.217.000,00	$924.000,00
19	**Chartered voyage cost**	**$2.480.317,62**	**$3.216.451,13**	**$3.931.762,07**	**$1.646.462,19**
	Charges				
21	**Port Charges (194,849GT)**	SEK140.424,50	SEK140.424,50	SEK140.424,50	SEK140.424,50
22	**20 converted in USD (1 SEK = 0.120195 USD); source: xe.com (10 May 2016)**	$16.879,00	$16.879,00	$16.879,00	$16.879,00
	Total Cost	**$2.497.196,62**	**$3.233.330,13**	**$3.948.641,07**	**$1.663.341,19**

APPENDIX “L” - POPULATION DETAILS

Table L.1 Digital Users

	Denmark	%	Finland	%	Norway	%	Sweden	%
Internet subscribers	9.055,1	22,23%	9.613,2	23,60%	7.267,3	17,84%	14.800,1	36,33%
Internet users	5.184,1	22,24%	4.842,3	20,78%	4.698,5	20,16%	8.581,3	36,82%
Mobile internet subscriptions	6.664,4	21,51%	7.805,7	25,20%	5.108,4	16,49%	11.398	36,80%
Mobile telephone subscriptions	7.249,6	21,56%	7.799,6	23,19%	6.063,3	18,03%	12.518,2	37,22%
personal computers (%)	92	-	90,8	-	96	-	94,3	-
Tablets (%)	50	-	41,7	-	37	-	35,5	-
smartphones (%)	77	-	68,4	-	74	-	74,9	-

Source: Euromonitor (2015)
Note: this table identify thousands with the “.” “dot”, and decimals with “comma “,”

Table L.2 Social Classes, Population And Median Income

	Denmark	Finland	Norway	Sweden
Median Disposable Income per Household (USD)	47,324.5	47.426,1	64.001,9	51.236,8
Saving ratio (% of disposal income)	2,9	6,5	9,1	11,3
Social class A (‘000)	443,7	396,6	362,0	594,6
Social Class B (‘000)	479,8	472,5	417,3	792,8
Social class C (‘000)	914,3	984,1	947,9	3
Social Class D (‘000)	1.602,4	1.646,0	1.651,3	3.258,2
Social Class E (‘000)	1.403,5	1.179,0	1.099,0	1.763,6
Urban Consumer Expenditure	133,742.4	117,306.3	136,703.4	218,621.5
Population aged 0-14	938,6	910,2	977,0	1.814,9
Population Aged 15-64	3.682,3	3.434,1	3.546,1	6.249,8
Population aged 65+	1.161,4	1.244,1	931,4	2.068,1
Urban popualtion	5.122,7	4.742,5	4.455,3	8.765,8
Total popualtion	5782,3	5588,4	5454,5	10.132,8

Source: Euromonitor (2015)
Note: this table identify thousands with the “.” “dot”, and decimals with “comma “,”

Social Class A presents data referring to the number of individuals with a gross income over 200% of an average gross income of all individuals aged 15+.
Social Class B presents data referring to the number of individuals with a gross income between 150% and 200% of an average gross income of all individuals aged 15+.
Social Class C presents data referring to the number of individuals with a gross income between 100% and 150% of an average gross income of all individuals aged 15+.
Social Class D presents data referring to the number of individuals with a gross income between 50.0% and 100% of an average gross income of all individuals aged 15+.
Social Class E presents data referring to the number of individuals with a gross income less than 50.0% of an average gross income of all individuals aged 15+.

Table L.3 Retailing Analysis

retailing analysis $USmn, constant prices, fixed exchange rate	Denmark	Finland	Norway	Sweden
Retailing (2015)	42.766,7	38.965,6	52.924,9	71.847,6
Retailing forecast 2020	*44.410,9*	*40.948,8*	*56.195,2*	*77.756,5*
Internet Retailing (2015)	5.401,4	3.894,8	4.657,7	5.475,7
Internet Retailing (forecast 2020)	*7.297,4*	*4.649,8*	*6.275,0*	*7.645,3*
Direct selling 2015	72,8	179,8	164,9	236,6
Direct selling (forecast 2020)	*77,2*	*202,9*	*167,5*	*211,5*

this table identify thousands with the "." "dot", and decimals with "comma ","
Source: Euromonitor (2015)

Table L.4 Sales by Sector

$USmn, constant prices, fixed exchange rate	Denmark	Finland	Norway	Sweden
Apparel and Footwear (2015)	5,142.9	NA	7,123.6	11,539.4
Apparel and Footwear (2020)	*4,990.2*	NA	*7,377.0*	*12,052.6*
Beauty and Personal Care (2015)	1,388.8	1,151.5	1,519.5	2,393.5
Beauty and Personal Care (2015)	*1,452.8*	*1,225.1*	*1,590.7*	*2,498.6*
Consumer electronics (2015)	6,391.7	NA	6,190.1	8,821.4
Consumer electronics (2020)	*5,884.0*	NA	*5,709.7*	*10,556.1*

Note: this table identify thousands with "comma "," , and decimals with "." "dot".
Source: Euromonitor (2015)